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Table of Contents

Perceptions of Adult Learners Concerning Remote Education

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The IAFOR International Conference on Education in Hawaii 2025
Official Conference Proceedings

Abstract
This study delves into the human-centred perspective of online language learning, prompted by a global shift to digital platforms. Focusing on adult learners of Maltese as a second language, the research uncovers both the opportunities and obstacles encountered in this digital learning landscape. Through semi-structured interviews with 35 participants, the study paints a comprehensive picture of the online learning experience. The data, analyzed thematically using NVivo software, reveals a complex interplay of benefits and challenges. The participants appreciated the flexibility of online learning, which allowed them to juggle domestic responsibilities alongside their studies. They also valued the accessibility of learning materials, which remained available outside of live sessions. Furthermore, online learning was seen as a solution to logistical issues such as commuting and parking. However, the study also highlights the digital divide, with issues such as unreliable internet connections, lack of IT skills, and inadequate access to personal computers creating barriers to equitable online learning. Home distractions were another concern, impacting the learning environment. Despite these challenges, the participants viewed online learning as a resilient response to the suspension of traditional academic activities. The study concludes by proposing strategies to mitigate the identified issues, thereby enhancing the human experience in online language learning.

Keywords: Adult Learners, Remote Education, Online Language Learning, Digital Learning Landscape, Challenges and Opportunities, Digital Divide

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Introduction

The rapid shift to digital education platforms, accelerated by global events such as the COVID-19 pandemic, has transformed the landscape of learning across the world. As educational institutions and learners transitioned to online environments, questions arose regarding the effectiveness, accessibility, and experiences of learners in this new digital realm. In particular, adult learners, often balancing educational pursuits with other responsibilities, face unique challenges and opportunities within online education (Hodges et al., 2020). This study seeks to explore the perceptions of adult learners participating in remote language learning, specifically in the context of Maltese as a second language, through a human-centred lens. By examining the experiences of these learners, this research aims to shed light on both the advantages and difficulties encountered in this increasingly digital learning environment.

The purpose of this study is twofold: to assess the opportunities and challenges adult learners face in remote language learning, and to explore how these learners perceive their overall online learning experiences. Through in-depth interviews with 35 adult learners, the study aims to provide a comprehensive understanding of how online education impacts learners' ability to engage with the material, manage their time, and overcome technological and environmental barriers. While much of the existing research on online learning has focused on younger or traditional-age students, the adult learner population remains under-explored, especially in the context of language acquisition (Garg, 2020).

The background of this study lies in the growing importance of digital learning platforms, which have opened up new avenues for education, but also exposed significant challenges. Adult learners, who may face limited technological skills, unreliable internet access, and competing time commitments, often experience different dynamics compared to younger, more tech-savvy students (López-Pérez et al., 2011). This shift to remote learning has also exacerbated the digital divide, highlighting issues related to technology access, equity, and the preparedness of both learners and educators (Ferrante et al., 2023). As this research seeks to understand the nuanced experiences of adult learners in an online language learning context, it also aims to provide insights that can inform future educational strategies to create more inclusive and effective digital learning environments.

The following were the research questions for this study:

1. What are the perceived opportunities and benefits of remote language learning among adult learners of Maltese as a second language?
2. What challenges do adult learners face in engaging with online language learning platforms, and how do these challenges impact their overall learning experience?
3. How do adult learners perceive the role of technology (e.g., internet access, digital skills) and home environments in shaping their success in remote language learning?

Literature Review

The experiences of adult learners in online education, particularly in language learning, have been extensively discussed in recent research. Żammit's studies (2020, 2021, 2024) provide foundational insights into how adult learners perceive the benefits and challenges of remote learning, offering a lens through which to compare and contrast findings from broader literature. This review examines the recurring themes of flexibility, accessibility,

technological barriers, and environmental challenges while situating Żammit's findings within existing scholarly discourse.

Flexibility and Accessibility of Online Learning

Flexibility is frequently cited as a key advantage of online education. Żammit's (2021) research underscores this by showing how adult learners value balancing educational pursuits with personal and professional responsibilities. In particular, Żammit's (2024) study highlights that flexibility allows learners of Maltese as a second language to engage with materials asynchronously, reducing the pressure of rigid schedules. These findings align with Sun and Chen's (2016) research, which identifies flexibility as critical for adult learners managing competing priorities.

However, Żammit (2020) acknowledges logistical benefits, such as the elimination of commuting and parking concerns. Żammit (2020) contrasts with studies like Kauppi and colleagues (2020), which emphasize that accessibility can remain uneven due to economic disparities. Żammit (2020) also notes that while online platforms increase the availability of resources, these benefits may not reach all learners equally due to systemic inequities.

Challenges: Technological Barriers and the Digital Divide

Żammit's (2020) findings on the technological barriers experienced by learners resonate with broader discussions on the digital divide. Żammit (2020) demonstrates how limited IT skills, unreliable internet access, and inadequate access to personal devices hinder the learning experience, particularly for older or economically disadvantaged learners. This aligns with Ferrante and colleagues' (2023) exploration of how the digital divide exacerbates inequalities in online education. Both Żammit (2020) and Ferrante and colleagues (2023) highlight the importance of addressing these technological barriers to create equitable learning environments.

Table 1: Technological Barriers to Online Learning

Challenge	Description	Key References
Limited IT Skills	Adult learners, particularly older individuals, face difficulties in navigating online platforms effectively.	Żammit (2020); Ferrante et al. (2023)
Unreliable Internet Access	Poor connectivity disproportionately affects economically disadvantaged learners, limiting participation.	Żammit (2020); Ferrante et al. (2023)
Inadequate Devices	Limited access to personal computers or mobile devices hinders learning, especially for marginalized groups.	Żammit (2020); Ferrante et al. (2023)
Institutional Support	Tailored training and technical support can mitigate many of these challenges.	Żammit (2024); Hodges et al. (2020)
Systemic Inequities	Economic disparities exacerbate the digital divide, creating unequal learning opportunities.	Ferrante et al. (2023); Kauppi et al. (2020)

In contrast, Żammit's (2024) study goes further by emphasizing that tailored technical support and training can mitigate some challenges. This reflects the findings of Hodges and colleagues (2020), who argue that institutional support can significantly reduce the negative impact of technological limitations. Żammit's work, however, is unique in its focus on adult

learners in the specific context of Maltese language learning, providing a more targeted understanding of the challenges in this niche field.

Żammit (2021) identifies home-based challenges such as distractions, caregiving responsibilities, and limited access to quiet study spaces as significant obstacles to effective online learning. These findings align with Adnan and Anwar's (2020) work, which highlights the tension between home responsibilities and educational demands in remote learning settings. However, Żammit's (2024) study adds nuance by exploring how adult learners actively adapt their home environments to optimize their learning experiences, demonstrating resilience in navigating these challenges.

Żammit (2024) explores how adult learners exhibit resilience and adaptability in the face of challenges posed by online learning, viewing it as a viable alternative to traditional classroom settings during times of disruption. This complements Garrison and colleagues' (2010) findings on the self-directed nature of adult learners, which facilitates their success in online environments. However, Żammit's (2021) study cautions that prolonged reliance on online education without adequate support can lead to isolation and disengagement, a concern also raised by Kahu (2011).

Opportunities for Improvement

Żammit (2020, 2024) proposes targeted strategies to enhance the online learning experience for adult learners, such as integrating synchronous and asynchronous elements, providing robust technical support, and designing culturally relevant language materials. These recommendations align with broader calls in the literature for inclusive and accessible online education (Allen & Seaman, 2017; Moore et al., 2018). Żammit's emphasis on cultural relevance, however, is a unique contribution, highlighting the importance of contextualizing learning materials to the learners' linguistic and cultural realities.

Żammit's studies (2020, 2021, 2024) offer a comprehensive understanding of the experiences of adult learners in online education, particularly in the context of learning Maltese as a second language. Żammit's (2020, 2021, 2024) findings on flexibility, technological barriers, and environmental challenges align with broader scholarly discussions while providing a unique perspective on the role of cultural and contextual factors in shaping learning experiences. Future research should continue to explore the interplay of these factors and investigate systemic solutions to improve the inclusivity and effectiveness of online education for adult learners.

Table 2: Comparative Analysis of Key Findings Highlighting Connections Between Żammit's Studies and Other Literature

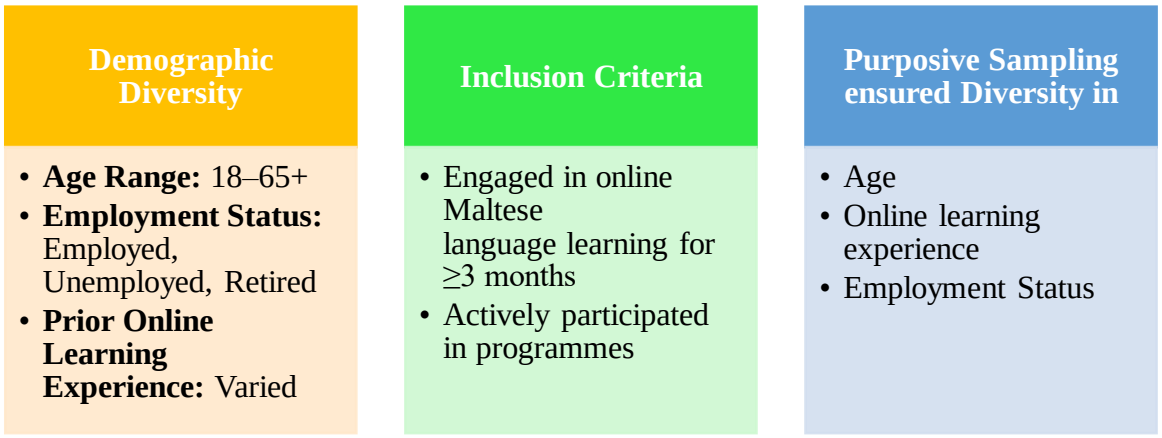
Aspect	Żammit's Findings	Broader Literature
Flexibility	Enables asynchronous engagement and balances life/work (2021, 2024).	Sun & Chen (2016): Critical for adult learners.
Technological Barriers	IT skills, internet/device limitations (2020); support reduces impact (2024).	Ferrante et al. (2023): Digital divide worsens inequalities.
Home Environment	Distractions, caregiving hurdles (2021); adaptive solutions (2024).	Adnan & Anwar (2020): Home roles interfere with learning.
Cultural Relevance	Highlights tailored materials for Maltese learners (2024).	Moore et al. (2018): Need for inclusive, contextual resources.

Methodology

Participants

This study involved 35 adult learners of Maltese as a second language who participated in online language learning programs. The participants were selected through purposive sampling to ensure a diverse representation of adult learners in terms of age, employment status, and prior experience with online education. The inclusion criteria required participants to have actively engaged in online Maltese language learning for at least three months.

Figure 1: Participant Profile and Selection Criteria



Research Design and Method

The study employed a qualitative research design to explore the human-centred experiences of adult learners in an online educational environment. A phenomenological approach was chosen to delve deeply into the participants' perceptions, challenges, and opportunities associated with online language learning. Data was collected through semi-structured interviews, which allowed for a detailed exploration of individual experiences while maintaining the flexibility to probe into specific areas of interest.

Data Collection

Semi-structured interviews were conducted via video conferencing platforms to accommodate the participants' schedules and preferences, particularly considering the focus on online learning. Each interview lasted approximately 45 to 60 minutes and was audio-recorded with the participants' consent. An interview guide was developed to ensure consistency across interviews, with questions focusing on learners' perceptions of online learning, their strategies for navigating challenges, and their views on the accessibility and effectiveness of the digital learning environment.

Data Analysis

The data collected from the semi-structured interviews were transcribed verbatim and analyzed using thematic analysis to uncover patterns and insights into the experiences of adult learners in online language learning. The researcher employed NVivo software (version 14) to systematically organize and code the data. The analysis process began with the

researcher immersing themselves in the data by reading and re-reading the transcripts to gain a comprehensive understanding of the participants' perspectives.

Initial coding was conducted by identifying segments of the data that captured key ideas, challenges, and benefits described by the participants. These codes were then examined for connections and grouped into broader themes that reflected the central aspects of the learners' experiences. For instance, themes such as flexibility, digital divide, accessibility of learning materials, and home environment challenges emerged during this stage.

The researcher refined the themes through an iterative process to ensure they accurately represented the data and captured the complexity of the participants' experiences. Subthemes were developed to highlight nuances within each theme, such as how flexibility was both a benefit and, at times, a challenge when competing priorities overwhelmed learners. Finally, the themes were clearly defined and named, allowing the researcher to structure the analysis and produce a comprehensive interpretation of the findings.

This approach facilitated a rich understanding of the interplay between the advantages and obstacles of online language learning for adult learners, offering insights into their lived experiences within this digital educational landscape.

Ethical Considerations

The study adhered to ethical research practices, ensuring informed consent, confidentiality, and the right to withdraw at any stage. Ethical approval was obtained from the University of Malta's research ethics board.

This methodology enabled a comprehensive exploration of adult learners' experiences, providing a nuanced understanding of the opportunities and challenges in the online language learning environment.

Results

The findings of this study highlight the complex interplay of opportunities and challenges experienced by adult learners in online Maltese language learning. The results are presented under key themes that emerged from the thematic analysis, supported by direct quotations from the participants to provide depth and context to the data.

Flexibility and Accessibility

The participants overwhelmingly appreciated the flexibility that online learning offered, allowing them to balance their studies with other responsibilities. Participant 8 noted, "The flexibility of online classes means I can attend even after a long day at work. It is something I would not manage with traditional in-person lessons." Participant 15 agreed, adding, "Having recorded materials available outside live sessions has been a game-changer for me. I can revisit lessons whenever I need to."

However, not all participants shared this sentiment. Participant 12 expressed concerns, stating, "While flexibility is great, it sometimes makes it harder to prioritize the class because there is always something else demanding my attention." Participant 3 supported this view,

explaining, “It is easy to fall behind when you know you can catch up later. Sometimes, you lose the sense of urgency to stay on track.”

Benefits of Accessibility to Learning Materials

Many participants valued the accessibility of online learning resources. Participant 21 observed, “It is convenient to have all the resources in one place. I can access notes, videos, and exercises without waiting for the next class.” Similarly, Participant 35 remarked, “Online platforms make it easier to find everything you need for learning in one click. You do not have to rely on paper handouts that can get lost.”

In contrast, some participants felt that having resources online created an over-reliance on digital access. Participant 7 said, “If the platform is down, I cannot access anything, and it is very frustrating. It feels like you are stranded.” Participant 11 agreed, noting, “Technology is great, but it is not perfect. A simple issue like internet downtime can halt your progress completely.”

Challenges of the Digital Divide

The study also revealed significant barriers stemming from the digital divide. Participant 19 explained, “I struggled initially because I did not have a proper computer and had to use my phone, which made everything harder.” Participant 30 added, “Unreliable internet is a constant problem. Sometimes, I miss half the lesson because the connection drops.”

Other participants highlighted the lack of digital skills as a barrier to effective learning. Participant 25 said, “I did not grow up using computers, so learning how to navigate the platform was an extra challenge for me.” Participant 6 echoed this, commenting, “For someone like me who is not tech-savvy, online learning adds a layer of stress that would not exist in a face-to-face class.”

Distractions in the Home Environment

A recurring concern was the difficulty of creating a conducive learning environment at home. Participant 14 remarked, “It is hard to focus during online classes because there is always something happening at home—kids, chores, pets or visitors.” Participant 22 agreed, saying, “I do not have a quiet space at home, and it makes it difficult to concentrate during lessons.”

Despite these challenges, some participants found ways to adapt. Participant 5 shared, “It was a struggle at first, but I set up a small corner in my living room as my study space, and it has helped me focus better.” Participant 29 agreed, stating, “You learn to manage the distractions over time. It is not perfect, but you make it work.”

Perceptions of Online Learning as a Resilient Response

Despite the challenges, most participants viewed online learning as a resilient response to the suspension of traditional academic activities. Participant 10 said, “The online format kept us learning during a time when everything else had stopped. It was a lifeline.” Participant 17 supported this, adding, “It is not without its flaws, but it proved that education can continue even during disruptions.”

However, some participants were less optimistic. Participant 28 commented, “While online learning worked in a pinch, it is not sustainable long-term for everyone. The challenges can be overwhelming for some.” Participant 13 agreed, noting, “It is better than nothing, but it does not replace the interaction and engagement of in-person classes.”

These findings highlight the diverse perspectives of adult learners, emphasizing the need for targeted strategies to address their unique challenges while maximizing the benefits of online learning environments.

Discussion

The results of this study align with and build upon existing literature, while also providing unique insights into the experiences of adult learners in online language education. This discussion explores how the findings compare with previous research, highlighting consistencies, divergences, and contributions to the ongoing discourse on remote education.

The participants’ appreciation of flexibility in online learning supports findings from Żammit (2024), who emphasized that adult learners value the ability to balance educational pursuits with domestic and professional responsibilities. Similar observations were made by Sun and colleagues (2008), who noted that flexibility allows learners to integrate education into their daily routines, reducing logistical barriers such as commuting. However, this study also reveals a downside to this flexibility, as some participants reported a lack of urgency and difficulty prioritizing online classes, a finding consistent with Barrot and colleagues (2021), who argued that the self-directed nature of online learning can lead to procrastination among learners.

The participants highlighted the ease of accessing learning materials online as a key benefit, echoing studies like those of Żammit (2020) and Martin and colleagues (2023), who found that digital platforms improve access to resources, enabling learners to revisit content and reinforce understanding. However, the participants in the current study also raised concerns about technological dependency, such as platform outages or internet issues, which echoes findings by Aboagye and colleagues (2020) that technical reliability is crucial for effective online learning. This dual perspective highlights the importance of robust technological infrastructure to support remote education.

The barriers posed by the digital divide were a significant concern in this study, with the participants citing unreliable internet connections, lack of digital skills, and inadequate access to devices as major challenges. These findings align closely with Żammit (2021), who identified similar issues among adult learners in online education. Additionally, Huisman (2021) described the digital divide as a persistent obstacle to equitable learning, emphasizing that it disproportionately affects learners from lower socio-economic backgrounds. Unlike studies focusing primarily on younger learners (e.g., Anderson & Perrin, 2018), this research highlights how these barriers uniquely affect adult learners, who may also face generational gaps in technological literacy.

The participants’ struggles with home distractions during online learning align with findings from Almahasees and colleagues (2021), who reported that competing domestic responsibilities often interfere with the ability to focus in virtual classes. While some participants in this study adapted by creating dedicated study spaces, others continued to struggle, indicating that personal circumstances heavily influence the effectiveness of online

learning environments. This insight builds on Żammit's (2020) findings, which suggest that tailored support for managing home environments can improve outcomes for adult learners.

Most participants viewed online learning as a resilient response to disruptions in traditional education, particularly during the COVID-19 pandemic. This finding aligns with Hodges and colleagues (2020), who described emergency remote teaching as a lifeline for education continuity. The participants' mixed views on the sustainability of online learning reflect similar concerns raised by Murphy (2020), who argued that while online education proved viable during emergencies, its long-term effectiveness depends on addressing inherent challenges such as engagement and equity.

The findings of this study extend the existing body of research by offering a human-centred perspective on the experiences of adult learners in online language education, particularly in the context of Maltese as a second language. While prior studies, such as Żammit (2024), provide a broad overview of online learning benefits and challenges, this study delves deeper into learners' perceptions, revealing nuanced insights into their struggles with flexibility, accessibility, and technological barriers.

Building on these findings, future research could explore interventions to address the digital divide and home distractions, particularly for adult learners balancing multiple responsibilities. Additionally, this study underscores the need for training programs to improve learners' digital skills and the resilience of technological platforms. Such measures could enhance the accessibility and effectiveness of online learning, ensuring that it remains a viable and equitable educational option.

Limitations of the Study

While this study provides valuable insights into the perceptions of adult learners concerning remote education, several limitations must be acknowledged. The sample size was relatively small, with 35 participants, which may limit the generalizability of the findings. Although the qualitative design allowed for an in-depth exploration of the participants' experiences, the perspectives captured in this study may not fully represent the diversity of adult learners, particularly those from different cultural or socio-economic backgrounds.

The study focused exclusively on learners of Maltese as a second language, which may make the findings less applicable to other disciplines or language learning contexts. Language acquisition involves unique challenges and dynamics that may not align with the experiences of learners in other subject areas.

The reliance on self-reported data collected through semi-structured interviews introduces the potential for response bias. The participants might have felt compelled to provide socially desirable answers or may have struggled to recall their experiences accurately, which could affect the reliability of the data.

Furthermore, the study was conducted during a period of increased reliance on remote learning due to global events, such as the COVID-19 pandemic. This context may have heightened certain challenges or benefits that could differ in more stable educational environments, thereby limiting the applicability of the findings to post-pandemic settings.

The use of NVivo software for thematic analysis, while effective for organizing and interpreting qualitative data, relies heavily on the researcher's subjective judgment in coding and theme development. This interpretive process may inadvertently introduce bias, despite efforts to maintain rigour and consistency.

Recommendations

This study highlights several practical recommendations to enhance the online learning experience for adult learners, as well as areas for further research. To address the challenges posed by the digital divide, educational institutions should prioritize investing in infrastructure and resources. Providing reliable internet connections, personal computers, and user-friendly learning platforms is essential to ensure equitable access. Furthermore, offering free or low-cost digital skills training can empower learners with limited technological proficiency, enabling them to fully engage with online education.

Flexibility emerged as a significant advantage of online learning; however, this flexibility should be accompanied by structured support to help learners maintain consistency and avoid procrastination. Institutions can achieve this by implementing progress-tracking tools, offering scheduled check-ins, and providing resources that help learners improve their time-management skills. Enhancing engagement and interaction is another critical area. Educators should incorporate collaborative activities, promote peer interactions, and use interactive tools to create a more dynamic learning environment. Training programs for educators can further equip them with the skills needed to foster inclusivity and engagement in virtual classrooms.

Home distractions were a recurring issue for the participants, and addressing this challenge requires guiding and creating effective home learning environments. This could include advice on minimizing distractions and establishing dedicated study spaces, as well as offering flexible scheduling options to accommodate learners with domestic responsibilities. Institutions should also consider the long-term integration of online learning. While it has proven to be a resilient response to educational disruptions, refining online education for sustained use is crucial. Hybrid models that combine the flexibility of online platforms with the interactivity of in-person sessions could offer a balanced approach, particularly for adult learners juggling multiple responsibilities.

Future research should expand upon the findings of this study by examining broader and more diverse populations. Including learners from various socio-economic, cultural, and geographical contexts would provide a more comprehensive understanding of the challenges and opportunities in online education. Comparative studies that explore different disciplines and education levels could reveal variations in how learners experience remote education. Longitudinal research is also needed to examine how perceptions of online learning evolve as learners adapt to technological advancements and changing practices.

Additionally, research focused on specific interventions, such as digital skills training or strategies to increase engagement, could provide valuable insights into their effectiveness. Investigating the potential of hybrid learning models, particularly for adult language learners, is another promising area for future studies. These models could combine the best aspects of online and in-person education, balancing flexibility with active participation and engagement.

By implementing these recommendations and pursuing further research, educational institutions can create more inclusive and effective learning environments that meet the needs of adult learners in an increasingly digital world.

Conclusion

This study explored the perceptions of adult learners concerning remote education, particularly in the context of learning Maltese as a second language. The findings underscore both the opportunities and challenges that adult learners encounter in online learning environments. The participants appreciated the flexibility that remote education provided, enabling them to balance their studies with personal and professional responsibilities. However, they also highlighted significant barriers, including issues related to the digital divide, unreliable internet access, lack of IT skills, and home distractions. Despite these challenges, the participants viewed online learning as a resilient and effective response to disruptions in traditional education, particularly during the global shift to digital platforms prompted by the COVID-19 pandemic.

The insights gained from this study contribute to the growing body of research on online education, particularly in the context of adult learners, a population often underexplored in existing studies. The findings suggest that while online learning offers flexibility and accessibility, it also requires targeted support to address technological barriers and ensure an engaging and effective learning environment. As educational institutions continue to embrace digital platforms, this study emphasizes the importance of providing equitable access to technology, fostering engagement, and creating learning environments that accommodate the unique challenges faced by adult learners.

Moving forward, further research is needed to explore the long-term impact of online education on adult learners, particularly concerning strategies that can address the identified challenges. By refining online learning models and focusing on inclusivity, institutions can create more supportive and effective educational experiences for adult learners in an increasingly digital world.

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Taking It Personally or Getting Personal: Adopting AI Toolsets to Enable a Constructivist Approach to Education

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Abstract
AI-driven tools are transforming business education by enhancing content delivery, student engagement, and course management. These tools can revolutionize instructional and learning design, facilitating quality assessment, and personalized tutoring, while also improving accessibility to educational resources. Constructivism, an educational theory that emphasizes the active role of learners in constructing their understanding and knowledge through experiences and reflection, is enabled by advancements in AI. AI-driven tools can significantly enhance the constructivist learning approach by creating interactive and engaging learning environments. Natural Language Processing tools and chatbots provide immediate, personalized feedback, fostering continuous assessment and reflection. Simulations and AI-based content creation tools enable students to engage in experiential learning, critical for constructivism. These tools allow learners to immerse themselves in realistic business scenarios, promoting deep understanding through practical application. AI-driven ethics and bias detection tools ensure that educational content remains fair and inclusive, aligning with constructivist principles of reflective and equitable learning. This research investigates ten AI-driven tools available to business educators. These innovations allow educators to concentrate on teaching while AI handles routine and supportive tasks. A scoping review, aimed at addressing emerging topics, answering novel questions, generating new hypotheses, and identifying gaps in existing knowledge for further research, was employed in this study. The research summarizes published findings from over seventy publications on the usefulness of these tools and articulates their main benefits for teaching practice. The adoption of AI in business education thus aligns well with constructivist principles, promoting an educational paradigm that is dynamic, inclusive, and student-centred.

Keywords: Constructivism, Adaptive Personalised Learning Platforms, Intelligent Tutoring Systems, Simulation and Virtual Reality (VR) Tools, AI-Based Content Creation Tools, Ethics and Bias Detection Tools

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Introduction

As AI technology continues to advance, its role in education is expanding, offering even more innovative solutions for professors and students alike. AI-driven business education tools are transforming how professors deliver content, engage with students, and manage courses. They enhance teaching efficiency, personalizing student learning experiences, and providing deeper insights into educational outcomes.

Benefits of Using AI Tools

AI in education aims to transform instructional and learning design, process, and assessment (Xu & Ouyang, 2022). The application of AI in education includes quality assessment, personalization, and tutoring assessment (Lainjo & Tsmouche, 2023). Integrating AI into education enhances accessibility to educational resources, breaking down barriers (Robinson, 2024). By monitoring and evaluating the impact of AI applications, institutions can make evidence-based decisions to better serve educational needs (Busch et al., 2023).

The integration of AI in educational settings is essential for various reasons. To begin with, enhancing students' learning experiences and better preparing them for the evolving demands of the job market is crucial (Vanoy, 2023). In this context, AI plays a vital role in preparing students to deal with the transformative impact of AI on industries and competitive landscapes (Abdelwahab et al., 2022). AI can significantly improve students' writing skills by offering automated assistance, thereby contributing to their academic development (Alharbi, 2023). Equipping both teachers and students for a future that is heavily reliant on technology should be a fundamental objective (Luan et al., 2020). AI also enhances the learning-teaching process, improves student skills, promotes inclusion, and increases administrative efficiency (Pisica et al., 2023). AI introduces innovative learning methods and provides valuable support to students (Ishaaq & Sohail, 2023). Finally, aligning with the broader trend of exploring the benefits and challenges of AI across various sectors is necessary to stay current and competitive (Menzies et al., 2024).

Forewarnings

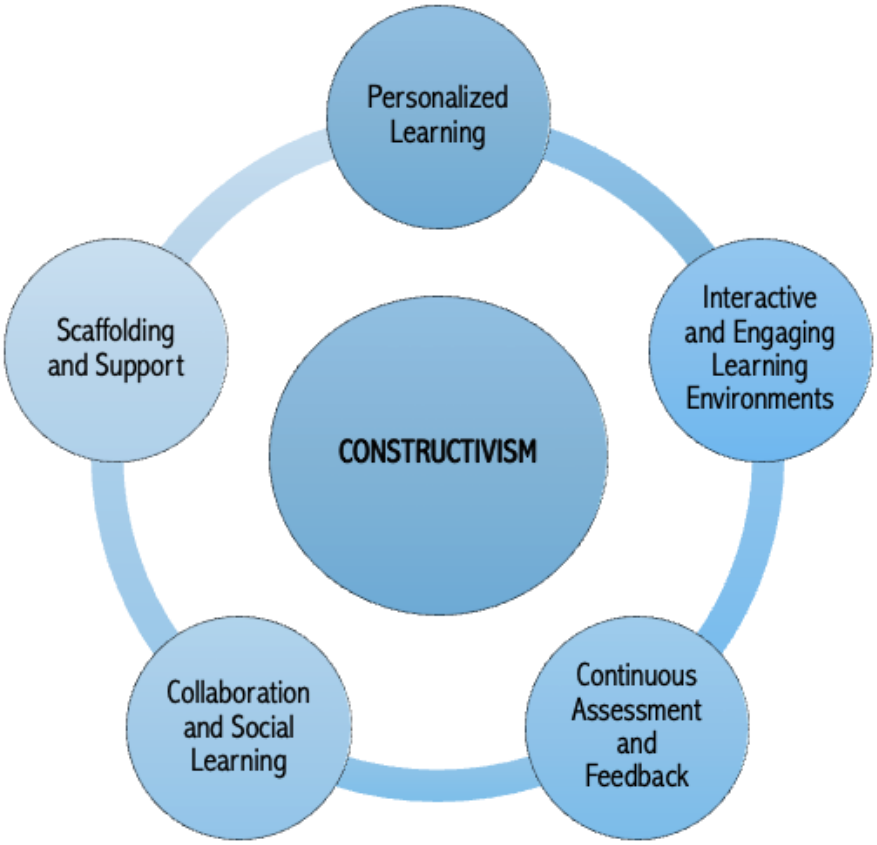
The growing concerns about the misuse of AI tools, the credibility of AI-generated information, and the potential impact on students' willingness to use AI learning tools are important considerations (Simms, 2024; Wen et al., 2024). It is essential to develop strategies to ensure the credibility of AI-generated information and to address students' concerns about the safety and privacy issues related to AI learning tools (Wen et al., 2024). Thus, the integration of AI tools into post-secondary education presents new and difficult challenges. Issues related to academic integrity, information accuracy, validation, unpredictable errors leading to negative user experiences, and difficulty designing interactions for collaborative decision-making have been documented (Lawrence et al., 2023; Simms, 2024; Yang et al., 2020). Studies have highlighted the limitations of using AI tools in education, underscoring the need for careful consideration before incorporating such technologies into teaching practices (Williams et al., 2021). Using AI tools in classrooms may not always align effectively with educational objectives and the learning environment, potentially impacting the efficacy of traditional teaching methods.

A major area of concern and one that has been gaining substantial attention is the ethical challenges associated with using AI in education. These include dilemmas related to privacy,

plagiarism, and the responsible use of AI tools (Akgün & Greenhow, 2021). For instance, there is a risk, if the reality, of students using generative AI tools to cheat and plagiarize assignments, raising concerns about academic integrity (Lye & Lim, 2024). There is still a lack of clarity from universities and privacy issues tend to cause significant worries among students regarding the use of AI tools in academia (Arowosegbe et al., 2024). Although student misbehaviour is not a new activity, AI has the ability to reinforce and improve the chances of academic misconduct to be successful. This creates the necessity for educators to understand and effectively integrate AI tools into teaching practices. For this to be effective teachers require support and development to maximize the benefits of AI integration (Arvin et al., 2023).

Constructivism and AI in Education

Figure 1: Constructivism Elements



The integration of AI in education is supported by various theories. Constructivist learning theories emphasize learners constructing knowledge through experiences (Piaget, 1964; Simms, 2024). This paper focuses on how AI tools support constructivism. Figure 1 shows the elements of constructivism that were explored in this research.

The synergy between **constructivism and AI in education** lies in their shared goal of creating learner-centred, adaptive, and engaging learning experiences (see Table 1). AI technologies, when designed and implemented with constructivist principles in mind, have the potential to transform education by providing personalized, interactive, and collaborative learning opportunities that foster deeper understanding and continuous growth.

Table 1: Synergy Between Constructivism and AI in Education

	Constructivist Approach	**AI Integration**
Personalized Learning	Constructivism posits that learners build knowledge based on their individual experiences and interactions with the world. This approach recognizes that each student has a unique learning path.	AI can analyze vast amounts of data on student performance, learning styles, and preferences to tailor educational content to individual needs. Adaptive learning systems powered by AI can adjust the difficulty of tasks, provide personalized feedback, and recommend resources and activities that align with each student's pace and understanding, reflecting the constructivist emphasis on individualized learning experiences.
Interactive and Engaging Learning Environments	Constructivism encourages interactive learning environments where students engage in hands-on activities, discussions, and problem-solving tasks that promote deeper understanding.	AI technologies, such as intelligent tutoring systems and virtual reality (VR), create immersive and interactive learning experiences. These technologies can simulate real-world scenarios where students can experiment, make decisions, and see the consequences of their actions in a safe environment, thereby enhancing engagement and active learning.
Continuous Assessment and Feedback	Constructivism values continuous assessment and feedback as integral parts of the learning process. Formative assessments help learners reflect on their understanding and make necessary adjustments.	AI-driven educational tools can provide real-time feedback and assessments, allowing students to immediately understand their mistakes and learn from them. These tools can track progress over time, offering insights into areas where students struggle and need additional support, thus supporting the constructivist principle of ongoing reflection and adaptation.
Collaboration and Social Learning	Constructivism emphasizes social learning, where knowledge is constructed through collaboration and interaction with others.	AI can facilitate collaborative learning by connecting students with peers, mentors, and experts across the globe. Tools such as collaborative platforms, discussion forums, and AI-driven social learning environments enable students to share ideas, work on group projects, and learn from diverse perspectives, thereby fostering a community of learners.
Scaffolding and Support	Constructivist teaching often involves scaffolding, where educators provide temporary support structures to help	AI systems can act as virtual tutors, providing scaffolding tailored to each student's needs. These systems can offer hints, resources, and step-by-

	Constructivist Approach	AI Integration
	students achieve higher levels of understanding and skill.	step guidance to help students progress through complex tasks, gradually reducing support as the learner becomes more proficient, mirroring the scaffolding technique used in constructivist education.

Research Approach – Scoping Review

A scoping review is a method of providing an initial assessment using an evidence synthesis that systematically identifies and maps the breadth of available evidence on a specific topic, field, concept, or issue, providing conceptual boundaries and a usable nomenclature. It aims to address emerging topics, answer novel questions, generate new hypotheses, and identify gaps in existing knowledge for further research (Peters et al., 2021).

Given the current state of AI development and potential undertaking a scoping review of the role of AI in education allows for a comprehensive exploration of the existing literature on how AI impacts various aspects of course design and delivery, providing insights from diverse studies that can be synthesized to identify critical areas where AI contributes to education.

The objective of this scoping review is to explore the integration of AI-powered educational tools in promoting constructivist learning approaches. It aims to identify and synthesize existing research on how AI tools enhance personalized learning, interactive and engaging environments, continuous assessment and feedback, social collaboration, and scaffolding support. The review seeks to map the current landscape of AI applications in education, highlight their benefits and challenges, and identify gaps in knowledge for future research, ultimately providing insights for educators to effectively leverage AI in fostering constructivist learning environments.

While conducting the scoping review, the keywords used for constructivism included personal learning, interactive and engaging learning, environments, continuous assessment and feedback, collaborating at social learning, scaffolding and support. These keywords encapsulate the essence of constructivism, covering its theoretical foundations, practical applications, and the social dynamics involved in the learning process.

To identify the tools powered by AI that support constructivism, the following set of keywords were used – Adaptive Learning Platforms, AI-enhanced learning Management Systems (LMS), Intelligent Tutoring Systems, Automated Grading and Feedback Tools, AI-powered analytics Tools, Natural Language Processing (NLP) Tools, Chatbots and Virtual Assistants, Simulation and Virtual Reality (VR) Tools, AI-Based Content Creation Tools, Ethics and Bias Detection Tools.

When conducting a scoping review on the intersection of constructivism and AI tools, it was essential to establish clear exclusion criteria to ensure the relevance, quality, and specificity of the reviewed studies. To achieve this:

- Publications that predate 2020 were excluded to focus on the most current research and technological advancements.

- Studies that did not explicitly address constructivist theories or AI tools were omitted. This included research that deals with constructivism in unrelated contexts or AI tools that are not used within educational or learning frameworks.
- Studies focusing solely on theoretical discussions without practical applications or case studies demonstrating the implementation of AI tools in constructivist learning environments were omitted to prioritize research that offers concrete insights and evidence.

By applying these criteria, the scoping review was expected to be focused, relevant, and representative of the current state of research on constructivism and AI tools, providing valuable insights into how these technologies can support and enhance constructivist learning approaches in contemporary educational settings. This exclusion ensured that the review not only highlighted innovative practices and theoretical advancements but also provided a robust foundation for further research and application in the field. In a demonstration of tool efficacy, AI research tools such as scite.ai and Elicit were used to scan 500 journal publications from 2020. The search resulted in the synthesis of literature from seventy articles.

The Toolsets

The toolsets discussed in this paper are listed below:

1. Adaptive Learning Platforms
2. AI-Enhanced Learning Management Systems (LMS)
3. Intelligent Tutoring Systems
4. Automated Grading and Feedback Tools
5. AI-Powered Analytics Tools
6. Natural Language Processing (NLP) Tools
7. Chatbots and Virtual Assistants
8. Simulation and Virtual Reality (VR) Tools
9. AI-Based Content Co-Creation Tools
10. Ethics and Bias Detection Tools

Adaptive Learning Platforms

Adaptive learning platforms are utilized to enhance student engagement, performance, and motivation through tailored interactive approaches and instant feedback (Yakin & Linden, 2021). These platforms leverage adaptive personalized content presentation, exercise navigation, and difficulty scaffolding to create effective and engaging e-learning experiences (Sayed et al., 2022). The initial expectations of a more broad and accelerated adoption driven by LMS and hyper-connectivity have not been met (Balkaya & Akkucuk, 2021).

The incorporation of AI can greatly advance the capabilities of adaptive learning systems to personalize the learning experience for each student. By analyzing individual performance and learning preferences, they adjust the content and pace to optimize understanding and retention. In addition, as electronic devices become more prevalent, adaptive learning platforms have increasing data sets allowing them to evolve and offer increasingly sophisticated learning experiences (Eau et al., 2021). By incorporating techniques like Adapted Spaced Learning, these platforms aim to improve academic performance and long-term memory retention (Gupta et al., 2020). Adaptive learning platforms play a role in

modern education by providing personalized learning experiences that cater to individual learner needs and preferences (Muhammad & Ariatmanto, 2021).

These platforms use AI to personalize the learning experience for each student. By analyzing individual performance and learning styles, they adjust the content and pace to optimize understanding and retention.

Adaptive learning platforms align closely with constructivism by tailoring educational experiences to individual learners. They promote personal learning through customized content, ensuring relevance and engagement. These platforms create interactive environments, utilizing multimedia and gamification to maintain learner interest. Continuous assessment and real-time feedback help learners track progress and adjust their approaches. Collaborative features enable social learning, allowing learners to interact, share insights, and build knowledge collectively. Scaffolding is provided through incremental challenges and support, gradually increasing complexity as learners build competence. Adaptive learning platforms embody constructivist principles, fostering a dynamic, learner-centered educational experience.

AI-Enhanced Learning Management Systems (LMS)

Learning management systems (LMS) have become essential supports since the COVID-19 pandemic, enabling institutions to continue to introduce hybrid and hyflex learning into their modes of delivery. AI-enhanced LMS platforms improve instructor efficiency through the automation of administrative tasks and by providing real-time analytics on student performance, allowing professors to focus more on teaching and less on administrative work. For learners, AI-enabled LMS transforms knowledge sharing, learning processes, and roles in modern knowledge worker environments (Sundaresan & Zhang, 2021). AI enhancements offer benefits that include personalized learning experiences, adaptive assessments, and improved predictions based on data (Seo et al., 2021). These systems can enhance students' dedication to educational content, and foster engagement through adaptive learning, gamified learning, and virtual reality (Chen et al., 2023). AI in LMS provides centralized management of educational activities, supports instant feedback for students at various levels, and cultivates decision-making and problem-solving skills (Ali et al., 2023). AI technologies in higher education institutions contribute to enhancing students' skills, collaborative learning, and creating accessible research environments (Kuleto et al., 2021). AI-enabled LMS transforms knowledge sharing, learning processes, and roles in modern knowledge worker environments (Sundaresan & Zhang, 2021).

Modern LMS platforms integrate AI to automate administrative tasks, provide real-time analytics on student performance, and offer personalized recommendations to students. This allows professors to focus more on teaching and less on administrative work.

AI-Enhanced Learning Management Systems (LMS) personify constructivism by personalizing learning paths, fostering interactive and engaging environments, and offering continuous assessment and feedback. These systems adapt content to individual needs, promoting personal learning. Interactive tools and multimedia resources create dynamic learning experiences. AI enables real-time feedback, helping students continuously improve. Collaboration is facilitated through social learning features like forums and group projects. Scaffolding is provided via AI-driven support, guiding learners progressively. This integration enhances understanding engagement and retention, helping to address the problem

of isolation and disconnectedness that impacts technology-enabled learning, while also aligning with constructivist principles that emphasize active, collaborative, and personalized learning experiences.

Intelligent Tutoring Systems

Intelligent tutoring systems (ITSs) expand the capacity of professors and teaching assistants using AI to provide one-on-one tutoring at scale. They aim to enhance a student's learning by providing a personalized learning experience that responds to the individual student's learning needs (Jakobsche et al., 2023). By incorporating conversational abilities and animated agents, ITSs have proven effective in teaching (Chen et al., 2020). These systems provide prompt, high-quality feedback, improving students' understanding and solution accuracy (Sharma & Harkishan, 2022). ITSs aim to scale up individualized education by imitating human expert tutors, offering consistent and accurate feedback (Huang et al., 2023). ITSs, chatbots, and automated grading systems increase efficiency, save time, and provide precise feedback (Harry & Sayudin, 2023). The adaptability and pedagogical enhancements of ITSs contribute to successful implementation and meeting student needs (Haryanto et al., 2023). ITSs mimic human tutors by providing personalized instruction and assistance across various subjects, fostering effective teaching and learning processes (Schez-Sobrino et al., 2020; Zhao, 2023).

These systems use AI to provide one-on-one tutoring at scale. They can assess students' knowledge gaps and offer tailored practice problems and explanations, which helps in reinforcing concepts and improving comprehension.

Intelligent Tutoring Systems (ITS) exemplify constructivist principles by offering personalized learning experiences and adapting to individual student needs. They foster interactive and engaging learning environments through dynamic content and immediate responses. ITS provide continuous assessment and feedback, enabling real-time tracking of progress and tailored support. They facilitate collaborative social learning by incorporating peer interaction and cooperative tasks. ITS offers scaffolding, gradually removing support as learners gain proficiency, thus enhancing autonomy and understanding. These systems integrate various constructivist elements, creating a holistic and effective learning experience that aligns with modern educational theories.

Automated Grading and Feedback Tools

These tools enhance assessment capabilities enabling a shift from using multiple choice options to more inclusive forms of formative and summative assessments, such as long and short essay grading. Professors gain from the assistance they receive in grading assignments allowing them to evaluate performance and gain insights from an evaluation of overall performance. Automated grading and feedback tools offer several benefits for business students. They can significantly reduce turnaround time, allowing students to receive prompt feedback on their work, and fostering a more dynamic learning process (Zhao, 2023). Research has shown that timely and comprehensive feedback from automated tools can improve student writing skills more effectively than human evaluations (Abraha & Nazir, 2024). Automated tools have been found to shorten correction times, reduce errors, and support students in solving exercises, ultimately enhancing the learning experience (Vittorini et al., 2020). By shifting the focus from assigning grades to providing useful feedback,

automated assessments help students assess their learning and improve their understanding (Zamprogno et al., 2020).

These tools use AI to grade assignments, quizzes, and even essays, providing detailed feedback quickly. This not only saves time for professors but also ensures consistency and objectivity in grading.

Automated grading and feedback tools align with constructivist principles by fostering personal learning through individualized feedback and allowing learners to progress at their own pace. They enhance interactive and engaging environments by providing instant, adaptive responses that keep students motivated. Continuous assessment is facilitated by real-time evaluation, promoting ongoing improvement. These tools support social learning by enabling collaborative platforms where students can share and critique work. Scaffolding is achieved through tailored guidance, helping learners build on their current knowledge. They create a dynamic, supportive educational experience, emphasizing active learning and continuous development.

AI-Powered Analytics Tools

Existing analytics tools provide aggregated data on student and course performance, providing a rich data set for learning designers, assessment strategies and professors evaluating both teaching and student learning performance. Aggregate data from various sources to provide insights into student performance, engagement, and progress. Professors can use these insights to identify at-risk students, tailor their teaching strategies, and improve overall course effectiveness.

AI-powered analytical tools can be further utilized in business education to track students' progress by customizing content to individual needs, enhancing motivation, and improving learning outcomes (Chen et al., 2020). These tools enable the evaluation of learning and impact analysis, allowing for real-time tracking of progress through modules (Bhatt & Muduli, 2022). Integrating AI into educational programs positions institutions at the forefront of business education, equipping students with essential skills for the modern business landscape (Vanoy, 2023). By automating and tracking student progress, AI enhances the learning experience and performance (Tapalova & Zhiyenbayeva, 2022).

AI can use aggregate data from various sources to provide real-time insights into student performance, engagement, and progress. Professors can use these insights to identify at-risk students, tailor their teaching strategies, and improve overall course effectiveness.

AI-powered analytics tools enhance constructivist learning by personalizing education and tailoring content to individual needs and preferences. They foster interactive and engaging environments through adaptive learning paths and immersive experiences. Continuous assessment and feedback are facilitated by real-time data analysis, allowing for timely interventions and personalized feedback. These tools support social learning by enabling collaborative platforms where learners can share insights and knowledge. AI provides scaffolding and support through intelligent tutoring systems, offering guidance and resources based on learner progress.

Natural Language Processing (NLP) Tools

Natural Language Processing (NLP) tools can support peer-feedback systems, automate tasks for instructors, assess student understanding from textual responses, and evaluate student short answer responses efficiently (Shaik et al., 2022; Somers et al., 2021). Additionally, NLP can aid in identifying areas for improvement in educational infrastructure, teaching practices, and study environments (Sousa, 2022). By integrating modern NLP models into learning management systems, institutions can translate automation goals into actionable insights and predictions, ultimately enhancing the educational experience (Bauer et al., 2023). NLP can be applied to gather and analyze text data from various sources like online browsing, conversations, and social media to perform tasks relevant to business education.

NLP tools assist both students and professors in improving writing quality. They can provide real-time feedback on grammar, style, and clarity, and can even generate summaries or translations.

Natural Language Processing (NLP) tools support constructivist principles by facilitating personalized learning through adaptive content and interactive interfaces, enhancing engagement. They create dynamic learning environments with real-time, context-aware responses, fostering continuous assessment and instant feedback. NLP tools support social learning by enabling collaborative platforms where learners communicate and share knowledge effectively. They provide scaffolding and support through intelligent tutoring systems that adapt to individual needs, guiding learners progressively towards mastery. By leveraging NLP, educational experiences become more tailored, interactive, and supportive, embodying the core tenets of constructivist pedagogy.

Chatbots and Virtual Assistants

Chatbots and virtual assistants are increasingly utilized in business education to enhance user interaction scenarios, optimize resources, and improve business metrics (Dobratulin & Nezhurina, 2022). They find applications in various areas such as student service, education administration, and providing the latest information about course activities (Jain & Bhati, 2022; Sari et al., 2020). Chatbots can increase efficiency, and connectivity, and reduce uncertainty during interactions with the system, serving as educational agents or service assistants (Pérez et al., 2020). They greatly assist students in navigating the complexity of institutional administration, reducing stress and allowing a greater focus on disciplinary learning. Research indicates the benefits of chatbots in education, highlighting their potential in aiding the transition to online learning environments and improving student engagement (Neo, 2022). These technologies offer continuous support to students when and where they choose to access it, facilitate learning processes, and provide personalized educational paths (Clarizia et al., 2020).

These AI-driven chatbots can answer common student queries, provide reminders about deadlines, and offer support services 24/7. This helps reduce the workload on professors and administrative staff while ensuring students receive timely assistance.

Chatbots and virtual assistants embody constructivist principles by offering personalized learning experiences through tailored interactions. They create interactive and engaging environments that adapt to individual needs, promoting active participation. Continuous assessment and feedback are integrated through real-time responses and data analytics,

guiding learners' progress. These tools facilitate social learning by enabling collaboration and communication among peers. They provide scaffolding and support by breaking down complex tasks into manageable steps and offering timely assistance. They enhance learning by making it more dynamic, responsive, and collaborative, aligning well with constructivist educational theories.

Simulation and Virtual Reality (VR) Tools

Simulation and virtual reality (VR) tools can play a crucial role in business education by offering immersive and interactive learning experiences. The simulations offer students a visceral learning experience that improves conceptualisation and retention by providing students with the opportunity to practice skills, receive feedback, and engage with complex scenarios in a safe environment (Mäkinen et al., 2023). VR technology, in particular, has demonstrated the potential to improve learning outcomes and offer cost-effective, self-directed learning opportunities (Zourrig, 2021). By replicating real-world business situations, VR tools help students develop practical skills, explore diverse scenarios, and enhance their comprehension of complex concepts (Solmaz & Gerven, 2021). VR simulations can be customized to accommodate different learning styles, providing flexible learning opportunities for a diverse student population (Mäkinen et al., 2023; Zourrig, 2021).

These tools use AI to create realistic business simulations and virtual environments where students can practice and apply their knowledge in a risk-free setting. This enhances experiential learning and helps students develop practical skills.

Simulation and Virtual Reality (VR) tools align with constructivism by providing immersive, interactive environments where learners actively construct knowledge. These tools support personal learning through individualized experiences and foster engaging, hands-on learning that enhances retention. VR environments enable continuous assessment and feedback, offering real-time performance insights. Collaboration in VR supports social learning by enabling teamwork and peer interaction in shared virtual spaces. Scaffolding is facilitated through guided experiences and adaptive support, enhancing learners' ability to grasp complex concepts. VR tools create dynamic, learner-centred environments that embody constructivist principles, promoting deeper understanding and skill development.

AI-Based Content Co-creation Tools

AI-based content creation tools enable automatic content generation, resource curation, and collaborative learning, allowing institutions to offer up-to-date and relevant educational materials (Bozkurt, 2023). They can enhance business education by providing personalized learning experiences, improving learning outcomes, and preparing students for the demands of the modern business landscape (Kashive et al., 2020). These tools Integrating AI to co-create content in business education programs can help equip students with essential skills in technology, data analytics, and logistics (Vanoy, 2023). AI can contribute to a deeper understanding of customer interactions and business strategies, thereby fostering effective decision-making and enhancing organizational performance (Alet, 2023).

These tools assist professors in creating engaging and interactive content. AI can help in designing multimedia presentations, generating quizzes, and course notes, and even creating custom learning paths based on student performance data.

AI-based content co-creation tools align with constructivist elements by facilitating personalized learning through adaptive content tailored to individual needs. They create interactive and engaging environments with multimedia and immersive experiences. Continuous assessment and feedback are enabled through real-time analytics and automated evaluations. These tools support collaborative and social learning by enabling seamless sharing and cooperative projects. Scaffolding is provided through adaptive assistance and resources that cater to learners' evolving proficiency levels.

Ethics and Bias Detection Tools

AI-driven ethics and bias detection tools are increasingly being integrated into business education to instil ethical awareness and responsibility in future business leaders. The concerns of bias and the ethical use of AI are real and have received significant attention, particularly in the period when ChatGPT was launched in 2022 (OpenAI, 2022). While much improved with each version release the issues remain. Professors will need tools to provide them assurance that allows them to address bias, promote fairness, and uphold ethical standards in education. They promote transparency, accountability, and benevolence in AI applications (Solomonides et al., 2021) ensuring that assumptions and conflicts of interest are declared, and risks are actively managed. Ethical principles, including “algorithmovigilance,” are crucial in monitoring and preventing adverse effects of AI in education (Klímová et al., 2023). Ethical and bias detection tools aid in the identification and mitigation of various forms of bias, such as racial bias and academic dishonesty (Zhang & Zhang, 2023). By implementing regulations, disseminating academic integrity policies, and raising awareness about the consequences of dishonesty, professors can create a more ethical learning environment (Ladera-Castañeda et al., 2023).

These tools help ensure that AI applications in education are unbiased and ethically used. Professors can use them to evaluate the balance of AI-driven assessments and recommendations, promoting ethical use of technology in the classroom.

Ethics in bias detection tools aligns with constructivism by emphasizing personal learning through critical engagement with diverse perspectives and ethical considerations in data interpretation. Interactive tools foster engaging learning environments by encouraging active participation and dialogue. Continuous assessment and feedback mechanisms promote iterative learning and improvement, reflecting constructivist principles of knowledge construction over time. Social collaboration enhances learning through shared insights and peer support, fostering scaffolding where learners build on each other's knowledge. Ethical frameworks guide these interactions, ensuring fair and respectful engagement. Ultimately, bias detection tools within a constructivist framework uphold ethical standards while enhancing interactive, engaging, and supportive learning environments.

Conclusion

The rapid development of AI capabilities is encroaching more broadly and more quickly into the educational domain. They help to address many time-sinks for both students and professors and offer a practical way to deliver adaptive and personalised learning. The growth of LMS usage in course delivery since the pandemic provides an accessible and sustainable platform for adoption by resource-constrained institutions. This paper has reviewed a toolset of ten related tools to suggest their value and provide a scope for future research, trial and evaluation.

The integration of AI-enhanced toolsets supported by constructivist principles into educational practices represents a significant advancement in fostering effective online and hybrid learning environments. The constructivist approach emphasizes the active role of learners in constructing their understanding through personal engagement, interactive learning, continuous assessment, social collaboration, and scaffolding support. These elements synergistically contribute to a holistic educational experience that is both enriching and adaptive.

Personalized learning, a cornerstone of constructivism and much heralded as a benefit of digital learning systems, can now be actualized by AI-driven tools that cater to individual learning styles and paces. These tools can analyze vast amounts of data to tailor content and feedback, promoting deeper comprehension and retention. By accommodating diverse learner needs, AI tools such as virtual reality enable educators to create truly personalized learning environments that resonate with constructivist ideals. These Interactive and engaging learning experiences are facilitated through AI tools that simulate real-world scenarios, encourage exploration, and provide immediate feedback. This interactivity not only keeps learners actively involved but also promotes critical thinking and problem-solving skills essential to future business graduates.

Continuous assessment and feedback mechanisms supported by Real-time analytics help educators identify areas where learners may struggle, allowing for timely interventions and adjustments to instructional strategies. This iterative process mirrors constructivist principles by promoting learning as an evolving process rather than a static event. Social learning and collaboration, integral to constructivism, are amplified by simulations using AI tools and greater leverage to knowledge share among peers in virtual classrooms, discussion forums, and game-playing. In addition, overcoming challenging concepts can be assisted through adaptive learning through its scaffolding and support of additional personally needed resources and activities to achieve mastery.

The fusion of constructivist principles with AI-driven tools represents a promising frontier in technology-enabled education. By harnessing the power of technology to support personalized, interactive, and collaborative learning experiences, educators can better meet the diverse needs of learners and prepare them for success in both their ability to learn from using the tools to advance their learning, and in turn their ability to adapt these tools into their future business environments. As we continue to innovate and refine these tools, it is essential to remain vigilant in upholding ethical standards and nurturing environments that empower learners to actively engage, collaborate, and construct knowledge in meaningful ways.

AI Declaration

While preparing this work, the author(s) *used Elicit and Google Scholar to find research articles on the topic using the keywords. Grammarly was also used to refine sentence structure. Google Scholar was used for APA-style citations.* After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the publication's content. We are responsible for the originality, validity and integrity of our submission.

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Investigating the Impact of Systematic Desensitization on Alleviating Mathematics Anxiety Among Secondary School Students

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Abstract
Reducing mathematics anxiety is crucial for improving students' academic performance, and Systematic Desensitization (SD) offers a promising solution. This study investigates the effectiveness of SD in alleviating mathematics anxiety among secondary school students. Utilizing a quasi-experimental approach, the study involved 120 senior secondary students from 59 public schools in the Nsukka Education Zone, Enugu, Nigeria. Participants were selected through a multi-stage sampling process, ensuring representation across two Local Government Areas (LGAs) with available professional guidance counselors. The Mathematics Anxiety Scale (MAS) was employed for data collection, requiring students to score ≥ 51 on the MAS to indicate significant mathematics anxiety. The study included pre-treatment, treatment, and post-treatment stages. Ethical approval was obtained, and informed consent was secured from parents and participants. The treatment group underwent six weekly sessions focusing on SD techniques, while the control group received no treatment. Data were analyzed using SPSS version 28, utilizing descriptive statistics and Analysis of Covariance (ANCOVA) to examine the study's questions and hypotheses. Results indicated a significant reduction in mathematics anxiety among students exposed to SD compared to the control group, with no notable gender differences observed among students in the SD group. The findings support SD's efficacy in reducing mathematics anxiety and suggest its potential for integration into school counseling programs. These results highlight the importance of evidence-based interventions like SD for fostering a positive learning environment and improving students' emotional well-being. Schools are recommended to integrate SD techniques into their counseling programs to mitigate mathematics anxiety.

Keywords: Cognitive-Behavioral Interventions, Gender Differences, Mathematics Anxiety, Mathematics Education, Secondary School Students

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Introduction

Mathematics is a fundamental subject in secondary education, serving as a cornerstone for academic advancement and future career opportunities. In Nigeria, proficiency in mathematics is a prerequisite for progression and vital for national technological growth and scientific development (Federal Republic of Nigeria, 2013). However, despite its significance, a concerning trend persists: many Nigerian students struggle with mathematics, as evidenced by consistently poor performance in standardized exams (Mosia et al., 2024; Mosimege & Egara, 2022, 2023a, 2023b; Onyeka & Arokoyu, 2018). Reports from institutions like the West Africa Examination Council (WAEC) and the National Examination Council (NECO) further highlight ongoing challenges in mathematics education, emphasizing the need for targeted interventions to improve outcomes (Mosia & Egara, 2024a, 2024b; National Bureau of Statistics, 2017; WAEC, 2017).

Various factors contribute to students' poor performance in mathematics (Egara & Mosimege, 2023, 2024a, 2024b; Okeke et al., 2025; Osakwe et al., 2023) among which mathematics anxiety emerges as a significant psychological barrier (Mosimege et al., 2024; Nzeadibe et al., 2023; Sarfo et al., 2020, 2022; Sule, 2017; Terry et al., 2023). Mathematics anxiety, characterized by feelings of panic, helplessness, and tension during mathematical activities, hampers students' learning experiences and academic achievement (Alam & Halder, 2018). Left unaddressed, mathematics anxiety often leads to avoidance behaviors, reinforcing a cycle of underperformance and limiting students' potential to succeed in STEM-related fields.

Counseling psychologists have proposed several evidence-based interventions to combat mathematics anxiety, with Cognitive Behavioral Therapy and Systematic Desensitization (SD) emerging as promising approaches (Eifediyi et al., 2018; Nzeadibe et al., 2023). SD, introduced by Joseph Wolpe in 1958, focuses on gradually exposing individuals to fear-inducing stimuli while teaching them relaxation techniques to replace anxiety responses with calmness and confidence (Raypole, 2019). While the efficacy of SD has been demonstrated across various domains (Ifeanyi et al., 2015; Oliha, 2013), its potential to alleviate mathematics anxiety among secondary school students in Nigeria remains underexplored.

This study investigates the effectiveness of SD in reducing mathematics anxiety among secondary school students in Enugu, Nigeria. By employing a quasi-experimental design, the research seeks to address the following research questions:

1. What are the mean mathematics anxiety scores of secondary school students exposed to SD treatment compared to those in the control group?
2. What are the mean mathematics anxiety reduction scores of male and female students exposed to SD treatment?

Based on these research questions, the study hypothesizes that:

1. Students exposed to SD treatment will have significantly lower mean scores on mathematics anxiety compared to those in the control group.
2. Male students exposed to SD treatment will exhibit a greater reduction in mean mathematics anxiety scores compared to female students.

This investigation aligns with broader educational objectives to improve students' academic resilience and confidence in mathematics, particularly in developing contexts like Nigeria. By exploring the role of SD in mitigating mathematics anxiety, the study aims to contribute to

the growing body of evidence-based strategies that enhance students' academic achievement and open doors to STEM-related opportunities.

Theoretical Basis

The theoretical underpinning of this study is rooted in classical conditioning theory, developed by Ivan Pavlov in 1903. This theory posits that emotional responses, such as anxiety, can be conditioned or unconditioned based on repeated associations between stimuli. In the context of systematic desensitization (SD), classical conditioning is the foundation for unlearning fear responses. By pairing anxiety-inducing stimuli, such as mathematical tasks, with relaxation techniques, SD gradually replaces the conditioned fear response with calmness and confidence. This process aligns with Pavlov's principle of counterconditioning, where a new, positive response is associated with a previously negative stimulus. Thus, classical conditioning provides a robust framework for understanding how SD can effectively reduce mathematics anxiety and improve students' learning experiences.

Methods

This study utilized a quasi-experimental design to assess the effectiveness of Systematic Desensitization (SD) in reducing mathematics anxiety among secondary school students in Enugu, Nigeria. Quasi-experimental designs are particularly suitable for research contexts where random assignment is not feasible, as in this study. The research was conducted in the Nsukka Education Zone of Enugu State, which includes three Local Government Areas (LGAs): Nsukka, Uzo-Uwani, and Igbo Etiti. The target population consisted of 3,390 senior secondary one (SS1) students enrolled in mathematics across 59 public schools within the Nsukka Education Zone. From this population, a sample of 120 students was selected based on specific inclusion criteria. Students who scored ≥51 on the Mathematics Anxiety Scale (MAS) during the pre-test were considered to have significant mathematics anxiety and were eligible for participation.

A multi-stage sampling procedure was employed. First, two LGAs, Nsukka and Igbo-Etiti, were purposively selected due to the availability of professional guidance counselors, which were crucial for implementing the SD intervention. Four public secondary schools with professional counselors were then purposively selected from these two LGAs, with two schools chosen from each LGA to ensure balance. These schools collectively enrolled 565 SS1 students, from which 120 students who met the inclusion criteria were selected for the study. The Mathematics Anxiety Scale (MAS), adapted from Zakariya (2018), was used to measure students' anxiety levels. The MAS is a 20-item instrument rated on a 4-point Likert scale. The scale underwent content and face validation, and it demonstrated a reliability coefficient of 0.79.

The study involved a structured process, with pre-treatment**,** treatment, and post-treatment phases. Ethical approval was obtained from the Research Committee on Ethics at the Faculty of Education, University of Nigeria, Nsukka, and informed consent was secured from the parents of the participants. Verbal consent was also obtained from the students. Pre-treatment activities included obtaining permissions from school authorities, screening students for eligibility, and administering the MAS as a pre-test. Eligible students were then randomly assigned to either the experimental group (receiving SD intervention) or the control group (receiving placebo sessions unrelated to mathematics anxiety). The treatment phase involved six weekly sessions for the experimental group, during which students were guided through

SD techniques to reduce their anxiety. The control group participated in placebo sessions that were unrelated to mathematics anxiety.

In the post-treatment phase, one week after the final session, the MAS was re-administered to both groups as a post-test to evaluate the intervention's effectiveness. Data analysis was performed using SPSS version 28. Descriptive statistics (means and standard deviations) were used to summarize the data, and Analysis of Covariance (ANCOVA) was employed to test the study's hypotheses. ANCOVA was selected to examine the treatment effect while controlling for pre-test scores. A significance level of $p \leq 0.05$ was maintained for all statistical analyses.

Results

The results are presented according to the research questions and hypotheses.

Research Question One

What are the mean mathematics anxiety scores of secondary school students exposed to SD treatment and those in the control group?

The analysis revealed that students exposed to Systematic Desensitization (SD) treatment experienced a notable reduction in their mathematics anxiety. Specifically, the pre-test mean score of students in the SD group was 56.76, with a standard deviation of 12.57. This dropped to a post-test mean score of 37.10, with a standard deviation of 15.00, resulting in a mean difference of 19.66. In contrast, students in the control group showed a minimal change, with a pre-test mean score of 56.89 (SD=17.88) and a post-test mean score of 57.97 (SD=14.14), leading to a mean difference of only 1.08. These results suggest that the SD treatment was effective in reducing mathematics anxiety, whereas the control group intervention had little to no impact.

Hypothesis One

Students exposed to SD treatment will have significantly lower mean scores on mathematics anxiety compared to those in the control group.

The findings from the Analysis of Covariance (ANCOVA) indicated a statistically significant effect of the treatment on mathematics anxiety, with $F(1,115)=86.66$ and $p<.05$. The partial eta squared value of .430 suggests that the SD intervention accounted for 43.0% of the variance observed in the reduction of mathematics anxiety among students. Thus, the null hypothesis was rejected, confirming that students in the SD group experienced significantly greater reductions in mathematics anxiety compared to the control group.

Research Question Two

What are the mean mathematics anxiety reduction scores of male and female students exposed to SD treatment?

The results showed a reduction in mathematics anxiety for both male and female students in the SD group. Male students had a pre-test mean score of 56.40 (SD=13.40) and a post-test mean score of 37.33 (SD=16.15), with a mean difference of 19.07. Similarly, female students

had a pre-test mean score of 57.03 (SD=12.11) and a post-test mean score of 36.80 (SD=13.66), yielding a mean difference of 20.23. While both genders exhibited reductions in anxiety, the female students demonstrated a slightly larger mean difference in their scores.

Hypothesis Two

Male students exposed to SD treatment will exhibit a greater reduction in mean mathematics anxiety scores compared to female students.

The ANCOVA results revealed no statistically significant difference in mathematics anxiety reduction between male and female students exposed to SD treatment, $F(1,115)=.365$, $p=.547$. Since the p-value exceeded the significance threshold of .05, the null hypothesis of no significant difference was retained. This indicates that while both male and female students benefited from the intervention, their reductions in mathematics anxiety were comparable and not significantly different.

Discussion

The findings of this study underscore the effectiveness of the Structured Desensitization (SD) treatment in reducing mathematics anxiety among secondary school students. Participants in the SD group experienced a significant decrease in mathematics anxiety scores compared to those in the control group. This outcome aligns with previous research demonstrating the efficacy of SD in alleviating anxiety in various educational settings (Akeb-urai et al., 2020; Ernest-Ehibudu & Wayii, 2017; Karfe & Ntasin, 2018). One possible explanation for the significant reduction in anxiety is the gradual and controlled exposure to anxiety-inducing stimuli that SD provides. By confronting their fears step-by-step, students will likely experience reduced stress and avoidance behaviors, leading to greater self-efficacy and confidence in mathematics.

Interestingly, the study did not find any significant gender differences in the mean mathematics anxiety reduction scores among students who received SD treatment (Ifeanyi et al., 2015; Oliha, 2013). This suggests that the benefits of SD treatment are not influenced by gender, highlighting its universal applicability for both male and female students. A possible reason for this finding is that SD's techniques are fundamentally cognitive-behavioral, focusing on individual experiences and coping mechanisms, which may be equally effective for both genders. Additionally, gender-specific differences in mathematics anxiety, while documented in some studies, may not always manifest in all educational contexts or interventions, especially when anxiety reduction strategies are applied broadly.

The effectiveness of SD treatment observed in this study adds to the growing body of literature supporting the use of cognitive-behavioral interventions for addressing mathematics anxiety. By focusing on behavior modification techniques, SD treatment provides students with practical strategies for managing their anxiety, thus empowering them to engage more confidently in mathematics-related tasks. It is worth noting that while SD treatment proved effective in reducing mathematics anxiety, its impact on academic achievement was not directly assessed in this study. Future research could explore the long-term effects of SD treatment on academic performance and examine potential moderators or mediators of its effectiveness. Overall, the findings of this study contribute to our understanding of effective interventions for addressing mathematics anxiety in educational settings and highlight the

importance of incorporating cognitive-behavioral techniques into school-based counseling programs.

Conclusion

This study highlights the efficacy of Structured Desensitization (SD) treatment in reducing mathematics anxiety among secondary school students. The results demonstrate a significant decrease in mathematics anxiety levels among students who underwent the SD intervention compared to those in the control group. This underscores the potential of SD treatment as a valuable intervention for addressing mathematics anxiety in educational settings. Moreover, the absence of significant gender differences in the effectiveness of SD treatment suggests its applicability for both male and female students. This emphasizes the importance of implementing evidence-based interventions that cater to the diverse needs of students.

Educational Implications

The findings of this study have significant educational implications. First, the success of the SD treatment in reducing mathematics anxiety highlights the need for schools to integrate cognitive-behavioral interventions into their guidance and counseling programs. Teachers and school counselors can be trained in implementing SD techniques to help students manage mathematics-related stress, thereby fostering a more positive learning environment. Additionally, mathematics teachers can collaborate with counselors to identify students struggling with anxiety early and provide targeted support. Furthermore, the lack of gender differences in the study suggests that SD is universally effective and can be applied to diverse student populations without bias. This universality makes it a cost-effective and inclusive strategy for addressing mathematics anxiety, particularly in resource-constrained settings.

Recommendations

Based on the findings of this study, it is recommended that school-based counseling programs integrate SD as a key intervention for addressing mathematics anxiety among students. Schools should provide professional development for guidance counselors to equip them with the necessary skills to administer SD techniques effectively. This would enable counselors to support students in overcoming anxiety and improving their confidence in mathematics. Future research is also recommended to explore the long-term effects of SD on academic performance and general well-being, as the study did not assess these aspects directly. Research should also investigate the potential moderators and mediators that could influence the effectiveness of SD in different contexts. Lastly, educators and policymakers should consider incorporating cognitive-behavioral strategies, like SD, into broader curriculum frameworks to create a more supportive learning environment for students who experience anxiety, particularly in subjects such as mathematics where anxiety is often most pronounced.

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Visualization Experience, Conceptual Understanding, and Problem-Solving Skills of Modular Distance Learning (MDL) Learners in Electromagnetism

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Abstract
This study was conducted to investigate the experiences in using visualization tools in printed modules and their relationship to the conceptual understanding and problem-solving skills of thirty Grade 12 learners under the Science, Technology, Engineering, and Mathematics (STEM) strand at a private school in Iloilo City. An Electromagnetism Conceptual Understanding Test (ECUT), Electromagnetism Problem-Solving Test (EPST), and Visualization Experience Questionnaire (VEQ) were made, validated, and tested for reliability. The instruments were rated highly valid, with the ECUT and VEQ having reliability indexes of 0.853 and 0.889, respectively. The results of the study revealed that learners had high visualization experience. The learners were at the Developing level as regards their conceptual understanding and in the Approaching Proficiency level as regards their problem-solving skills. In problem-solving, learners can easily identify the given quantities and write the correct formula but struggle in drawing illustrations. There is no significant relationship between the learners' visualization experience and conceptual understanding and their visualization experience and problem-solving skills. Learners' higher exposure to different visualization tools does not mean improved conceptual understanding and problem-solving skills. There is, however, a significant positive relationship between conceptual understanding and problem-solving skills, which means better conceptual understanding equates to better problem-solving performance. Exposing learners to several problem-solving activities may help improve their conceptual understanding of the topics. These results were the basis for developing sample lesson plans in electromagnetism that incorporated a good pedagogical framework for using visualization tools to effectively develop learners' conceptual understanding and problem-solving skills.

Keywords: Electromagnetism Conceptual Understanding, Physics Problem-Solving, Problem-Solving Skills, Visualization Tools

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Introduction

The K to 12 Basic Education Program, which was first introduced to the Philippines in the school year 2012–2013, covers kindergarten and 12 years of basic education to provide sufficient time for learners to master concepts and skills, develop lifelong learning, and prepare for tertiary education, middle-level skills development, employment, and entrepreneurship (Department of Education, 2012). The K to 12 Science Curriculum Guide (Department of Education, 2016) presents concepts and skills in life sciences, physics, chemistry, and Earth sciences in a spiral progression from one grade level to another, thereby promoting a deeper understanding of core concepts. By the end of Junior High School (JHS), the expectation is for learners to showcase their comprehension of science concepts and utilize their science inquiry skills to tackle real-world problems through scientific investigations.

Under the Senior High School (SHS) curriculum, schools offer General Physics 1 and 2 as specialized subjects in the Science, Technology, Engineering, and Mathematics (STEM) strand for Grade 11 and Grade 12 learners, respectively. Physics is a problem-solving discipline, and problem-solving is recognized as an essential life skill involving various processes that include analysis, interpretation, evaluation, and reflection (Bales & Estomo, 2022). Learners, however, should fully acquire understanding and mastery of the key concepts before they can effectively and efficiently solve a problem, as problem-solving requires not only computation but also understanding, comprehension, and analysis of the problem (Salma & Rodrigues, 2012).

Furthermore, evidence indicates that learners continue to face conceptual difficulties in physics, even after solving numerous textbook problems (Kim & Park, 2002), a phenomenon also evident in the Philippine context. A study by Cardona and colleagues (2013) revealed learners' average performance in recalling concepts in physics but low performance in understanding and applying such concepts. Another study by Pardo (2017) involving learners from Batangas National High School reported that none of the respondents exhibited an outstanding performance inside the physics laboratory. Arellano (2004) discovered that most learners showed an average performance in the physics achievement test.

There are several branches of physics, one of which is electromagnetism. The curriculum for General Physics 2 in SHS covers this primary field of physics, which involves studying the interaction among all electrically charged objects, objects with magnetic moments, and the electromagnetic field (Baird, 2019). Electricity and magnetism, considered central areas of physics and science curricula at primary, secondary, and tertiary levels of education (Gunstone et al., 2008), are some of the most critical areas in physics, considered difficult mainly due to their abstract and complex nature (Mbonyiryivuze et al., 2019). According to McColgan and colleagues (2017), students often face difficulties in understanding the concepts of electricity and magnetism, leading to numerous misconceptions.

On top of these already existing issues in learning physics content, particularly electromagnetism, a new educational system is the last thing the science curriculum needs. However, with the onset of the coronavirus disease pandemic in 2019, educational systems worldwide transitioned to a new system that offered distance learning modalities for learners. A survey by the DepEd revealed that parents who enrolled their children in the school year during the pandemic preferred learning through printed and digital modules (Panti, 2021).

Amid its rather hasty implementation in the country, distance learning poses a challenge to all stakeholders, especially learners. While the modular distance learning (MDL) modality provides opportunities for learners with problems in technology or Internet connectivity to have access to education, the absence of instruction affects learning. A study by Agaton and Cueto (2021) revealed that some students find it difficult to understand the core ideas of a lesson when a teacher is not there. The Movement for Safe, Equitable, Quality, and Relevant Education (SEQuRE Educ Movement) conducted a poll in 2021, revealing that 66 percent to 86 percent of public-school learners learned less under the remote learning setup, potentially impacting their content mastery and skill acquisition (Panti, 2021).

The main goal of science education is to teach conceptual understanding (Konicek-Moran & Keeley, 2015) and problem-solving (Fink & Mankey, 2010). To address the extant problem of the lack of conceptual understanding and problem-solving skills despite issues regarding the new learning setup, learners' modules should incorporate visualization, as the use of different visualization tools and techniques has been known to improve learners' conceptual understanding and problem-solving skills (Phillips et al., 2010). Science classrooms have utilized visualization tools such as simulations, animations, graphs, maps, pictures, videos, diagrams, charts, and models. Chang and colleagues (2008) proved that learning using simulation in optical lenses has significantly improved learning outcomes as compared to learning through traditional laboratory practices; thus, using simulations in the classroom has a positive effect on conceptual understanding (Sarabando et al., 2014).

Visualization, furthermore, is a powerful tool for enhancing learners' problem-solving skills. According to Varva and colleagues (2011), visualization serves two primary functions: to promote learning and understanding and to aid in analysis and problem-solving. The school where the researcher currently works has long encouraged the use of visualization tools like simulations, animations, and laboratory tools. At the onset of modular distance learning, science teachers were likewise urged to include visuals and online simulations in the modules to promote individual explorations at home.

The delivery of the lesson may have changed, but science education still aims to improve learners' problem-solving skills and conceptual understanding of the lesson, which can be achieved using visualization tools and techniques. As experienced by the researcher, learners struggle to apply concepts learned from printed modules in problem-solving or tend to directly solve the problem without understanding it or determining the best plan to obtain the correct solution. This problem was observed in the submitted outputs of Grade 12 learners under MDL taking the subject General Physics 2 in which some learners simply copied and followed the formula without understanding the problem. The learners' poor performance in their summative tests also revealed the need to improve their conceptual understanding of the lesson.

Conclusion

The study's findings showed that learners correctly identified the given quantities and the correct formula to use when solving a problem. However, some of them struggled to provide the correct illustrations to accompany their solutions, resulting in the lowest scores. They also struggled to solve for the specified quantity and to report their final answers. This means that they tend to solve a problem without an actual understanding of the necessary visual diagram to do so. One may attribute this failure to provide a correct illustration of the problem to a lack of understanding of the problem and the concepts involved.

Different forms of visualization, such as simulations, animations, videos, pictures, diagrams, and illustrations found in the modules on electromagnetism, were highly experienced by the learners, and these helped them understand the lessons presented. The learners' overall performance in the conceptual understanding and problem-solving tests remains in the Developing and Approaching Proficiency levels, respectively. This indicates that they have not yet attained a level where they can independently apply the fundamental knowledge and skills they have acquired to other situations. Learners' higher exposure to different visualization tools, therefore, does not mean an improved level of conceptual understanding and problem-solving skills. Better conceptual understanding, however, equates to better problem-solving skills. Although the use of visualization tools does not relate to better conceptual understanding, exposing learners to several problems helps reinforce their conceptual understanding of the lessons. Solving more problems thus supports knowledge acquisition. A learner's success in solving problems in physics depends on the learner first knowing the concepts of physics. Given the conclusion reached as regards the learners' problem-solving skills, their inability to provide the correct visual representation for the problem relates to their conceptual understanding of the topic as well. Simply put, drawing correct illustrations for the problem requires a thorough grasp of the concepts.

In creating lesson plans in physics, drills on problem-solving should be incorporated to foster deeper conceptual understanding of the topic. Visualization tools must be carefully selected to reinforce conceptual understanding of the topic. Visualization tools should also integrate problem-solving activities to help aid in knowledge acquisition.

Implications to Theory and Practice

In Theory. As shown by the learners' responses in the Visualization Experience Questionnaire (VEQ), using the different forms of visualization helped them better understand underlying concepts. The statements in the VEQ that received the highest ratings were "Visual representations aid my understanding of the lessons in electromagnetism" and "The different activities provided in the module encourage me to visualize concepts and solutions." These statements align with a report by Varva and colleagues (2011), which asserts that visualization serves two primary purposes: (1) enhancing learning and understanding, and (2) facilitating analysis and problem-solving. This also connects with the advantages of using visualization in class: to help learners see and track relationships and seek alternative solutions (Pylyshyn, 2003).

Statements about the use of simulations in the modules also received high ratings: "I utilized the simulations provided in the module to enhance my understanding of the topic." The statements "Using simulations given by the teacher helped me in the mastery of topics in electromagnetism" and "Using exercises helped improve my problem-solving skills in electromagnetism" also received high ratings. This aligns with the findings of Zacharia and Anderson (2003), who suggest that the success of simulations stems from the development and application of concepts and cognitive skills like problem-solving. Computer simulations indeed provide interactive, authentic, and meaningful learning opportunities for students because they facilitate the learning of abstract concepts (Smetana & Bell, 2012).

The results of this study, moreover, reinforce the premise of the dual-coding theory (DCT), which states that visual information supports the acquisition of learning. As mirrored by the learners' high visualization experience, visualization tools provided them with the necessary information and concepts to facilitate the application of knowledge and problem-solving

skills, as purported by the visual imagery hypothesis (VIH). However, because the study was not experimental, it was impossible to quantify the learners' acquisition of knowledge. The researcher could only gauge learners' perceived experiences when using visualization tools.

Another relevant theory on cognition could guide the implications of this study's results for classroom practice. The cognitive load theory is an instructional theory based on the knowledge of human cognition (Sweller, 2011), which builds on the premise that working memory has a limited capacity and that overloading it reduces the effectiveness of teaching (Loveless, 2022). Since learning aims to transfer new information from working memory to long-term memory, this theory recommends designing instructional materials and environments to lessen this load. This, in turn, allows for a more efficient transfer of desired learning from working memory to long-term memory by eliminating distractions.

Teachers have the most control over extraneous load, a form of cognitive load that involves the materials and environment the learners encounter. Images, illustrations, and animations that are irrelevant—or even fonts that are difficult to read—all add to the extraneous load. Poorly constructed materials, therefore, as well as busy classroom environments, add to extraneous cognitive load and can lead to the split-attention effect (Sweller, 2011). Reducing the materials down to containing only the required elements is thus crucial. These salient points in the theory, along with the premises of the DCT and VIH, are essential for enhancing practices within the physics classroom.

In Practice. The integration of visualization tools in lesson plans in physics is highly encouraged, and this integration can be successfully done in class by observing the following steps: (1) selecting the visualization tools to be used, (2) planning the way the tool will be used by learners, (3) elaborating on the concepts embedded in the tool, and (4) evaluating or checking concepts learned from the tool.

First, the teachers must carefully consider which visualization tool is most appropriate to use. The objectives for integrating the different visualization tools in the lesson plan must center around improving the learners' conceptual understanding and problem-solving skills while being pedagogically sound. These tools should not be complex to manipulate, as they facilitate conceptual understanding. If learners struggle to explore and manipulate a tool, they may lose motivation to continue using it.

Second, the lesson plan must incorporate a clear plan for how the learners will use the tool. Although the learners' experiences reveal a positive attitude toward learning with the use of visualization tools, this does not translate to the actual acquisition of knowledge and improvement of problem-solving skills. One possible explanation could be the ineffective use of the visualization tools. Therefore, before giving learners the opportunity to use these tools independently, teachers should guide them on how to use them effectively, either during the discussion or through a video for modular distance learners. Science teachers can integrate this into the Engage or Explore part of the 5E Instructional Model to stimulate learners' interest in using the tools.

Next, using the visualization tool should not be the end. Elaborating on the concepts embedded in the tool is necessary to foster conceptual understanding. Meaningful discussions should also follow to solidify the important concepts highlighted in the visualization tool. This should be part of the Elaborate part of the lesson plan. You can provide a detailed explanation when using images, pictures, or diagrams to help learners retain knowledge and

avoid overwhelming their cognitive load. Teachers should use animations to highlight the specific concept they want the learners to concentrate on. The purpose of visualization tools, after all, is to draw the learners' attention to specific visual experience features that will help with their retention of the concepts. If the tool incorporates lessons in physics with problem-solving, scaffolding the learners on the correct and complete steps is necessary. Thus, the researcher encourages problem-solving drills. In such cases, physics teachers may create videos showing the solutions to assist modular distance learners in following the correct processes.

Lastly, appropriate evaluation of the concepts learned from the tools may be conducted by the teacher through formative assessments. This is done in the Evaluation part of the lesson. This reinforces the concepts learned from the tool and will likewise serve as the teachers' basis on whether to continue using the tool or not. The assessment in connection with the objectives must exhibit the reason that the tool was selected in the first place.

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Effectiveness of Career Counseling in Primary Schools

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Abstract
In Slovenia, challenges in career counseling are particularly evident when primary school students decide on further education. The lack of systematic counseling can lead to subjective decisions that do not reflect the individual's interests and potential. Talent Center Slovenia, with its inclusive approach and scientific testing of individual characteristics, could significantly improve this situation. Slovenia can draw on foreign examples, such as the Talent Center Graz in Austria. Empirical findings highlight the need for comprehensive career counseling sought by young people. The survey showed that 77% of respondents had difficulties choosing a secondary school, and the same percentage would welcome the existence of a counseling institution for high school selection. Additionally, 1331 (84%) respondents expressed interest in testing that would provide them with information about the most suitable career based on their personality traits, talents, and abilities. The research sample consisted of 1749 elementary school students. This indicates a great need for an individualized approach to professional development, which Talent Center Slovenia could provide. Recommendations for students, teaching staff, and management include active involvement in counseling, training on modern approaches, and support for the establishment of a Talent Center. Future research should focus on the impact of career counseling on career performance and satisfaction, and on improving the quality of counseling and its impact on society.

Keywords: Career Counseling, Talent Center Slovenia, Empirical Findings, Primary School Students, Individualized Approach

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Introduction

In Slovenia, approximately 20 000 primary school students per generation face the choice of further education and career paths, often making decisions without scientific testing and relying on recommendations from parents or peers, which typically reflect their own interests and desires. Consequently, these decisions are mostly influenced by subjective factors rather than objective feedback on individual abilities. Furthermore, Slovenia lacks a systematically organized career counseling system for primary school students, similar to what neighboring Austria offers.

Slovenia operates 142 public secondary schools and 6 private institutions. Enrollment statistics show that 35% of primary school graduates enter general secondary education, 47% opt for technical and vocational education, 16% choose vocational education, and 1% enroll in lower vocational education. Boys most commonly choose technical and computing fields, while girls prefer health and personal services. Slovenia offers 4003 different professions, leading primary school students to have numerous questions regarding their interests, talents, weaknesses, and desires for further studies. The proportion of young people (aged 18-24) engaged in education in Slovenia exceeds the EU average; in the 2017/18 academic year, it was approximately 46%. However, 35% of enrolled students do not complete their studies, highlighting the need for better support in making decisions about further education.

Our external partner (City Municipality of Murska Sobota - MO MS), involved in our research, aims to establish Talent Center Slovenia in their region, which would serve as an inclusive support system for comprehensive career guidance, focusing on individual traits, abilities, and interests. The center would provide neutral and objective feedback useful for making decisions about further education, incorporating scientific and revolutionary testing systems.

We conducted a survey among eighth and ninth graders to gauge their opinions on the establishment of such a talent center. The project addressed theoretical and practical issues related to models, tools, and methods for implementing such a center in Slovenia. The introduction of Talent Center Slovenia would contribute to improved career orientation not only for school youth but also for adults, as economic challenges (digitalization, green growth, sustainability, rapid changes, and lifelong learning) require planned efforts even with employed individuals.

Comparison of Career Counseling Models in Slovenia and Abroad

Comparing career counseling models between Slovenia and abroad reveals numerous differences in approaches, structures, and accessibility of services available to individuals in planning their careers.

Comparison of Career Counseling Systems in Slovenia

In Slovenia, career counseling is conducted through various institutions such as the Employment Service of Slovenia (ZZZS), the Career Center for Youth, and VKO point. ZZZS offers a range of free services at its career centers, including programs for self-managing careers, basic career counseling, employer meetings, and workshops for developing job search skills (ZZZS, 2024). The Career Center for Youth focuses on proactive planning of further education paths for young people, providing individual information,

career testing, career counseling, and educational workshops in schools (Talentcenter.at, 2024). VKO point operates as an online platform supporting career counseling professionals with programs, modules, and research works (VKO point, 2024).

Additionally, the handbook "New Approaches to Working with Youth in Career Guidance" (Gergorić & Založnik, 2020) offers practical guidelines for professional staff in primary schools involved in career counseling for young people.

Comparison of Career Counseling Systems Abroad

Different countries have diverse approaches to career counseling, depending on their legislative frameworks, educational systems, and societal needs:

- Australia integrates career counseling into the school curriculum, though practices may vary between states.
- Canada has varied practices across provinces, where career counseling can be part of the curriculum or offered as a specialized course.
- Ireland and Luxembourg do not include career counseling in compulsory curricula, but some activities may be conducted as part of projects in certain classes.
- Spain mandates career counseling in all schools, with a specified number of hours for high school students (OECD, 2004).
- In Austria and Germany, career counseling is largely integrated into educational institutions. In Austria, for instance, career advisors collaborate with universities and schools, offering services such as career path counseling, educational fairs, and workshops (Cedefop, 2020). In Germany, school counselors play a key role in career counseling, working in collaboration with teachers and parents and focusing on vocational orientation (Schröder, 2013).

Training, qualifications, and roles of career counseling staff also vary. For example, in Australia, schools employ professional counselors, whereas in Canada, career counseling is often within the purview of teachers with additional licensing (OECD, 2004).

Additional research, such as OECD's study (2004) on career counseling and public policy, can further expand understanding of career counseling practices worldwide and highlight important aspects affecting the effectiveness and accessibility of these services.

Additional Career Counseling Model in the USA

In the USA, career counseling is similarly diverse but more decentralized, often linked with educational institutions and private counseling agencies (Gergorić & Založnik, 2020). Additionally, career counseling in the USA is frequently conducted through online platforms and mobile applications, allowing individuals access to information, tests, mentoring, and other career resources on demand (OECD, 2004).

Career counseling in US schools is implemented both in elementary and secondary schools, with some schools having dedicated career counselors, while others integrate this role into the duties of existing school counseling staff (Gergorić & Založnik, 2020). There is also a focus on counseling programs at universities and colleges in the USA, which assist students in career planning, finding internship opportunities, and preparing for entry into the job market (OECD, 2004).

Unlike Slovenia and some other countries, the USA lacks a national standard or legal framework for career counseling in schools (Gergorić & Založnik, 2020). Instead, guidelines and practices depend on individual school districts, states, and university systems (OECD, 2004). This variability means that approaches and the quality of career counseling can vary widely depending on the region and financial resources available to each institution.

Furthermore, the USA offers a rich array of commercial career counseling services provided by private counseling agencies, employment firms, and non-profit organizations (Gergorić & Založnik, 2020). These services often include individual counseling, workshops, online courses, and mentoring, which may be accessible to individuals for a fee or subsidized by employers or public entities (OECD, 2004).

This illustrates that career counseling practices and services in the USA are more dispersed and reliant on the private sector, regional, and local policies compared to some other countries.

Benefits of Career Counseling Awareness for Individuals

Knowledge of career counseling brings numerous advantages to individuals at all stages of education, from early childhood education to adult learning.

Preschool Education

Career counseling in the early stages of a child's life allows children to understand various career options and pathways early on. Research indicates that around 50% of an individual's cognitive abilities are developed by the age of 4, with the next 30% by age 8. This underscores the importance of starting career counseling in preschool. Children exposed to various career options can more easily choose a profession they wish to pursue in the future (Rahmat Hidayat & Ningrum, 2017).

Commencing career counseling in preschool enables children to develop skills and competencies in fields of interest, facilitating their decision-making regarding future career paths (Rahmat Hidayat & Ningrum, 2017).

Primary Education

Career counseling in primary school allows students to discover their interests, abilities, and values, aiding them in making decisions about further education. Students who receive career counseling show better school engagement, improve their academic achievements, and develop more personal and interpersonal skills (Yavuz, 2022).

Secondary Education

Career counseling in high school helps students better recognize their talents, interests, and values, easing their decision-making regarding further studies. Students who receive career counseling are less confused and concerned about their future, which enhances their focus and motivation to achieve their career goals (Michael, 2024).

Tertiary Education

Career counseling assists students in deciding on their future career path and successfully transitioning into the job market. It fosters greater self-awareness among students regarding their interests, values, abilities, and personalities, helping them to achieve their career goals (Akhter et al., 2021).

Adult Education

Career counseling for adults fosters adaptability in the job market, aids in upgrading qualifications, finding suitable employment, and advancing within companies (Andragogical Center of the Republic of Slovenia, 2021). Adults engaging in career counseling gain increased self-confidence, self-assurance, and new skills, making it easier for them to overcome obstacles on their path to career success (OECD, 2021).

Knowledge of career counseling thus enables individuals to gain better direction, self-awareness, and motivation in choosing and developing their careers throughout life.

Talent Center Graz (Austria) – A Case Study of Good Practice

The Talent Center Graz in Austria is a renowned career counseling center for youth aged 13 to 15, recognized nationally and internationally for its excellence, including winning the Best Education and Training Project award at the 2019 International Chamber of Commerce Congress (Talentcenter.at, 2024).

With a mission to identify, develop, and support young talent, the center fosters confidence, motivation, and innovation through 48 testing stations that explore individual interests, talents, and potential. Their holistic approach is grounded in cutting-edge insights from psychology, pedagogy, and career development (Talentcenter.at, 2024).

Funded by the City of Graz, the Austrian Ministry of Education, EU projects, and private sponsors, the center collaborates with the University of Graz, schools, businesses, and NGOs to deliver tailored programs. It plays a vital role in local social and economic development, empowering youth to make informed career decisions and enhancing the quality of career counseling in Austria (Talentcenter.at, 2024).

Talent Center Slovenia: A Vision for Youth Career Development

Talent Center Slovenia will create an innovative environment to advance scientifically supported career guidance for youth. Operating as a research organization, it will collaborate with domestic and international partners to develop methods for career planning based on individuals' characteristics, competencies, and interests. The center aims to provide an inclusive platform for the professional and personal growth of youth, offering impartial assessments and guidance to foster their unique talents.

Founded by the Municipality of Murska Sobota (MO MS), the center will pioneer scientifically grounded testing systems to evaluate talents objectively, enabling youth to better understand their abilities and make informed decisions about education and careers. Located in Murska Sobota, it will be architecturally integrated with the natural setting of

Lake Sobosko and the Expano Pavilion, emphasizing sustainable, eco-friendly materials and aligning with the region's green vision.

To achieve its mission, Talent Center Slovenia will analyze labor market needs, monitor talent development trends, and engage experts from psychology, education, and entrepreneurship (Stoeger et al., 2018). A holistic approach will address technical knowledge, soft skills, and personality development, ensuring programs meet individual needs and interests (Caplan, 2013; Storey & Wright, 2023).

Youth visiting the center will explore key questions about their future, such as:

- **What interests me?** Discovering passions through scientifically supported testing.
- **Where do I see myself?** Gaining clarity on future career and education options.
- **What am I good at?** Identifying and nurturing talents with innovative assessment methods.
- **What are my weaknesses?** Receiving objective feedback for personal growth.
- **Which direction should I pursue?** Making informed decisions on education and career paths.

The center will be funded through a mix of public funds, private donations, sponsorships, and revenue from services, with support from European and national education and entrepreneurship projects.

Talent Center Slovenia will serve as a creative space where youth can explore their potential, contributing to personal growth and regional economic development.

Presentation of Services

Talent Center Slovenia will offer a range of services, including educational programs, workshops, mentoring, career counseling, and support for entrepreneurial development. Ensuring accessibility and flexibility will be key to maximizing participation and the benefits of talent development opportunities (Groenewald et al., 2024).

Written Testing

A variety of tests and questionnaires will assess individuals' knowledge, skills, abilities, and interests, helping youth better understand themselves and their career options.

Systematic and Organized Guidance

The center's team of experienced professionals in psychology, career counseling, and vocational guidance will provide structured support throughout the career development process.

Practical Testing

In addition to written assessments, youth will engage in practical tasks that simulate real-world work situations to further evaluate their skills.

Expert Analysis of Results

Experts will analyze test results to create a comprehensive profile of each individual's competencies and traits.

Report Compilation

Each testing phase will conclude with a detailed report offering insights and guidance to support informed decisions about education and career paths.

Macro-Level Monitoring and Analysis

Data will be analyzed at a macro level to inform strategic decisions, helping to understand trends and youth needs in education and career development.

Comprehensive Concluding Report for Individuals

Each visitor will receive a comprehensive report summarizing their results, offering valuable insights into their skills, abilities, and potential for future growth.

Empirical Verification: What Is the Opinion of 8th and 9th Grade Elementary School Students Regarding the Establishment of the Talent Center?

Based on identified challenges and needs among young people facing decisions about further education and career paths in Slovenia, we decided to conduct an empirical study among eighth and ninth grade students (sample of 1749 units).

The primary goal of the research is to thoroughly examine and understand aspects related to the establishment of Talent Center Slovenia and its potential impact on young people's decisions regarding career paths and education, using a survey questionnaire. The research process outlined below is based on theoretical foundations detailed in the theoretical part of the report, providing the substantive basis for designing the survey questionnaire.

The empirical research was conducted over a specific time interval (from March 27, 2024, to May 6, 2024) and represents a cross-sectional study based on this period. Using the 1KA platform, we collected data from the defined sample, which were processed using Excel. Subsequently, students participating in the project were asked to provide their opinions based on the results obtained by the survey questionnaire.

We also confirmed the content validity of the measurement instrument by utilizing a theoretical framework and comparing it with established measurement instruments. Content validity refers to the properties that measurement units and instruments must possess to ensure that the measurement outcome is a true reflection of what the researcher intends to measure (Aaker et al., 2008).

Quantitative Analysis of Survey Questionnaires

Demographic Questions. In response to this question, 1740 respondents answered in the survey, comprising 53% girls and 43% boys, with 3% of respondents choosing not to disclose their gender, as also depicted in the graph below.

The next question in the survey pertained to the grade level of the respondents. 922 (53%) respondents are in the 8th grade of elementary school, while 817 (47%) are in the 9th grade.

The final question in the demographic section focused on the distribution of respondents according to regions, highlighting the geographical diversity of the sample. From the results, it can be observed that the largest proportion of elementary schools is located in the Pomurska region of Slovenia (22%). Following closely is the Savinjska region of Slovenia (17%), which also contributes significantly to the sample. Conversely, regions such as Koroška, Posavska, Zasavska and Southeast Slovenia have a smaller share of elementary schools in the sample, each accounting for less than 5%.

Information About Secondary Schools. The majority of respondents, 1664 (63%), obtained information about secondary schools during the school's open house day. Similarly, a large proportion of respondents (64%) received information from friends, acquaintances, or parents. About a third of the respondents got informed through official websites of secondary schools (28%) and via official social media channels (23%). A smaller portion of respondents obtained information from informative meetings organized by their elementary school (14%), through the school social worker (20%), and from their elementary school teachers (14%). Only a small percentage of respondents (3%) did not seek any information before enrolling in secondary school, while a slightly larger percentage (8%) obtained information at a career fair.

This indicates that respondents gathered information about secondary schools from a variety of sources, including open house days, social media, websites, friends, acquaintances, parents, school staff and career fairs. This highlights the importance of diverse information sources in making decisions about further education and career paths.

Decision-Making About Secondary School. The analysis of the following two questions provides insight into the decision-making process of students regarding the choice of secondary school and the potential impact of counseling on this decision.

Question Q7 focused on the difficulty of choosing a secondary school. 40% of respondents reported that the choice was difficult, indicating that selecting a secondary school was quite challenging for 697 respondents.

Furthermore, question Q8 explored whether the existence of an institution offering guidance on selecting a secondary school would ease the decision-making process. The majority of respondents, 533 (77%), believed that they would find it easier to choose a secondary school if such a counseling institution existed. The average rating for this question was 1.2, indicating a positive attitude of the respondents towards the idea of a counseling institution for secondary school selection, with a standard deviation of 0.4, showing relatively low variability in responses.

Based on the survey data on secondary school selection, it is clear that for 40% of 8th and 9th-grade students, this decision remains a challenge. Therefore, the opinion of the majority of respondents is that the establishment of a Talent Center for counseling on secondary school selection would be very welcome. Such a center could provide additional support, information, and professional counseling, helping students make more informed and confident decisions. This could also increase the success rate in the secondary school selection process, leading to greater satisfaction and success for students in their further education. Thus, the establishment of a Talent Center could bring significant benefits to the entire education system and to individual students.

Importance of Advice in Deciding on Further Education. In analyzing question Q9 ("Whose advice do you consider most important when deciding on further education? Rank by importance (1 - most important, 2 - important, 3 - less important, 4 - least important)"), we used descriptive statistics to understand and describe patterns in the data. The results are as follows:

- Parental advice was rated the most important, with 1041 respondents (63%) marking it as the most important, 379 (23%) as important, 145 (9%) as less important and 75 (5%) as the least important.
- Peer advice was rated as the second most important, with 178 respondents (11%) marking it as the most important, 362 (22%) as important, 568 (35%) as less important, and 521 (32%) as the least important.
- Advice from relatives and acquaintances and advice from the school counseling service were rated equally. Advice from relatives and acquaintances was rated most important by 130 respondents (8%), important by 515 (32%), less important by 584 (36%), and least important by 398 (24%). Advice from the school counseling service was rated most important by 282 respondents (17%), important by 375 (23%), less important by 334 (21%), and least important by 633 (39%).

The results indicate that parental advice has the greatest weight in deciding on further education, while peer advice is also important but less than parental advice. Advice from relatives, acquaintances, and the school counseling service is also important but has a somewhat smaller impact compared to parental and peer advice.

In the next question, we aimed to determine who had the most significant influence on the respondents' decision regarding the secondary school they wish to enroll in. Based on their answers, we found the following:

- 69% of respondents (1205 out of 1650) replied that they themselves had the most significant influence on their secondary school decision.
- 14% of respondents (242 out of 1650) stated that parents or guardians had the most significant influence.
- 5% of respondents (81 out of 1650) mentioned that siblings had the most significant influence.
- 4% of respondents (74 out of 1650) stated that friends had the most significant influence.
- 1% of respondents (16 out of 1650) mentioned that classmates had the most significant influence.
- 1% of respondents (13 out of 1650) stated that teachers had the most significant influence.

- 1% of respondents (19 out of 1650) mentioned that media or social networks had the most significant influence.

Table 1: Impact on High School Decision

Q10	**Who had the biggest influence on your decision for the high school you want to go to? Choose one answer.**				
	Responses	Frequency	Percentage	Valid	Cumulative
	1 (I'm)	1205	69%	73%	73%
	2 (Parents/foster parents)	242	14%	15%	88%
	3 (brother(s)/sister(s))	81	5%	5%	93%
	4 (Friends)	74	4%	4%	97%
	5 (Classmates)	16	1%	1%	98%
	6 (Teachers)	13	1%	1%	99%
	7 (Media or social networks)	19	1%	1%	100%
Valid	Together	1650	94%	100%	
		Average	1,5	Std. deviation	1,1

Source: own

The results show that most respondents attribute the most significant influence on their decisions to themselves, indicating independence and confidence in making important life decisions. However, it would be interesting to explore how this dynamic changes based on various factors such as socioeconomic background, parents' educational level, geographical location and similar aspects.

Further research could reveal potential differences in the influence of various factors on young people's decisions in different circumstances. Additionally, it would be worthwhile to consider additional factors that could influence decisions, such as interests, hobbies, ambitions and individual goals, and how these affect the perception of the role of various information sources. These additional studies could expand our understanding of the decision-making process among youth and contribute to more targeted support measures in the educational system.

The establishment of the Talent Center Slovenia could be beneficial in the choice of secondary school, as such an institution could provide additional professional support and information to young people when deciding on their future educational path. The results indicate that most respondents would appreciate such support, suggesting a need for additional information sources and counseling. This could enable young people to make more thoughtful and informed decisions that better align with their interests, abilities, and goals. Moreover, the Talent Center Slovenia could offer individual counseling that considers the specific needs of each person and organize events and activities to explore further education options. This could enhance students' emotional well-being and reduce feelings of uncertainty and stress in the process of choosing a secondary school.

Influence of Various Factors on the Decision for Secondary School. In the analysis of questions Q12, Q13, Q14 and Q15, we arrived at the following results:

Q12: Do you think that information days and secondary school websites alone are sufficient for you to imagine whether the chosen profession would suit you (considering your personality traits and desires)?

- 54% of respondents (940 out of 1637) believe that information days and secondary school websites alone are sufficient to give them an idea of whether the chosen profession would suit them.
- 40% of respondents (697 out of 1637) believe that these are not enough and that they need additional sources of information.

Table 2: Need for Additional Information

Q12	**Do you think that information days and high school websites are enough in themselves to imagine whether the acquired profession would suit you (given your personality traits and preferences)?**				
	Responses	Frequency	Percentage	Valid	Cumulative
	1 (yes)	940	54%	57%	57%
	2 (no)	697	40%	43%	100%
Valid	Together	1637	94%	100%	
		Average	1,4	Std. deviation	0,5

Source: own

Q13: To what extent do you agree with the following statement: "I have more than enough information about the secondary school I will enroll in, and I have no doubt about my decision" (where 1 - strongly disagree, 5 - strongly agree)?

- The average rating among respondents is 3.4, indicating moderate confidence in the information they have about the secondary school they will enroll in.
- The standard deviation is 1.3, indicating a wide range of responses, with some respondents feeling very confident and others less so.

Q14: Would you like more information about further education options (regarding different secondary schools and their programs)?

- 69% of respondents (1200 out of 1635) would like more information about further education options.
- 25% of respondents (435 out of 1635) feel they have enough information.

Table 3: Desire for More Information on Further Education

Q14	**Would you like more information about the possibilities of further education (regarding the different secondary schools and their majors)?**				
	Responses	Frequency	Percentage	Valid	Cumulative
	1 (yes)	1200	69 %	73 %	73 %
	2 (no)	435	25 %	27 %	100 %
Valid	Together	1635	93 %	100 %	
		Average	1,3	Std. deviation	0,4

Source: own

Q15: Do you know the difference between a secondary school, vocational school, and gymnasium?

- 70% of respondents (1220 out of 1635) know the difference between a secondary school, vocational school and gymnasium.
- 24% of respondents (415 out of 1635) do not know the difference between these types of secondary schools, indicating a need for additional explanation or a refresher on this topic.

The analysis of these questions provides insight into respondents' perceptions of their level of information, the need for additional information and their understanding of the differences between various types of secondary schools. Overall, we can conclude that there is a diversity in the level of information among respondents regarding the choice of secondary school and further education options. Additional sources of information, educational and informational campaigns and the Talent Center Slovenia could help bridge the knowledge gaps and improve the information available to future students.

Acceptance and Willingness for Potential Talent Testing. The results show that 76% of respondents are willing to participate in testing that, through an interactive game, would identify five professions matching their personality, talents, knowledge and abilities.

This high level of interest suggests that young people are eager for interactive approaches to career exploration, which could help them make more informed decisions about education and career paths. The positive response is particularly strong among those uncertain about their high school choice, indicating a desire for additional guidance in understanding career possibilities.

These findings highlight the importance of offering young people tools to explore career options. Interactive testing could play a key role in supporting career planning, especially for those who feel uncertain about their educational direction, ultimately leading to more informed and satisfying career choices.

Conclusion

In Slovenia, career counseling faces significant challenges, particularly for primary school students making decisions about further education and career paths. The lack of systematic guidance often leads to decisions based on subjective factors, not necessarily aligning with individual interests and potential. Establishing Talent Center Slovenia could address this issue by offering an inclusive, scientifically based approach to career counseling, providing objective information for better decision-making. It could also support adults navigating the rapidly changing job market by offering career development and skill acquisition. Slovenia could learn from international examples like the Austrian Talent Center Graz to improve its own system. A more comprehensive and effective career counseling framework is crucial to support individuals at different life stages, helping them achieve personal and professional fulfillment.

Data analysis highlights a strong emotional involvement among students regarding their education and career choices. Most students expressed interest in additional information on educational options, with high school open days and parental advice being common sources. However, over a third of students struggled with high school selection and most would appreciate a dedicated counseling institution. Parental advice was also seen as encouraging

for decision-making. Additionally, students showed high interest in tests that could guide them towards suitable careers based on their personality and abilities. The Talent Center Slovenia concept is positively received by 8th and 9th-grade students, indicating its potential to aid in education and career decisions.

Future research should explore key areas to improve career counseling. This includes studying how student involvement in counseling impacts career success, examining the role of teaching staff competence and comparing different career counseling models across institutions. Research should also focus on best practices in various countries and analyze the impact of career counseling on employability, productivity and innovation.

Scientific research in these areas will enhance understanding of career counseling's complexities, leading to effective guidelines and practices that promote individual success and broader societal development.

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Workshop and Discussion on PICTOGRAMMING: An Integrated Learning Environment for Communication, Information Design and Programming

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Abstract
Pictogramming (Pictoch) is an environment for integrated learning of communication, information design, and programming by designing a human-shaped pictogram and moving it with block-type programs. This tool works on a web browser with any network-connected PC, tablet, or smartphone, so it frees you from the problem of having to install an app or only working on certain models. This tool was developed at the Pictogram Research Institute of Aoyama Gakuin University. The authors experimentally taught elementary school students (10-12 years old) and junior high school students (13-15 years old) how to use Pictogramming in a simple way and how much content they could learn in about one hour. Through trial and error, the students autonomously mastered "sequential processing" and "iterative processing", which are basic elements of programming, and understood what kind of design can convey what meaning to others. In this workshop, the authors will first give an overview of the experiment. Next, the participants will experience Pictogramming. Then, the authors will discuss with the participants the application of this tool and learning situations.

Keywords: Communication, Information Design, Programming, Human-Shaped Pictogram, Pictogramming

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Introduction

Pictogram is a graphical symbol used to understand a semantic concept based on the meaning of its shape. The authors focus on human pictograms, and they had been developed lots of educational tools using pictograms. Pictogram resembles a person or object at a high level of abstraction. For the well-known "emergency exit" pictogram, the design focused on a person identifying with the human pictogram running toward the exit.

One of the authors Kaz Ito has been developing an animated pictogram content creation environment, called Pictogramming and its derivative applications. These are applications to learn programming concepts through pictogram content creation.

Practical Experiment

One of the authors Yoshi Nakano conducted a demonstration class on Pictogramming on 19 January 2024 in all grades from 1st to 3rd at the Taketomi Municipal Funaura Junior High School at Iriomote Island, Okinawa, Japan. Also, on 14-15 February 2024, a Pictogramming demonstration class was held in three grades from 4th to 6th at Ishigaki Municipal Shiraho Elementary School at Ishigaki Island, Okinawa, Japan. In each case, only the minimum necessary and simple operating procedures were taught at the beginning, and then the students were working freely for about 30 minutes. Most of the students were able to pose or move the human-shaped pictogram on Pictogramming.

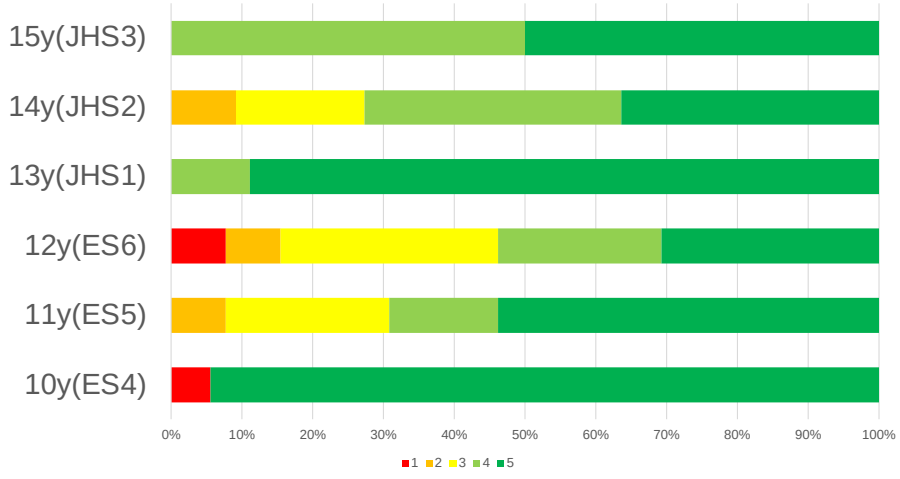
Analysis of the Students' Survey Results

Although in different schools, the lessons were conducted in different grades, from 10 years old at grade 4 in Elementary School (ES4) to 15 years old at grade 3 in Junior High School (JHS3), and the students were asked to submit their work. They were also asked to complete some short questionnaires.

The authors" views on the content of the questionnaires are described below.

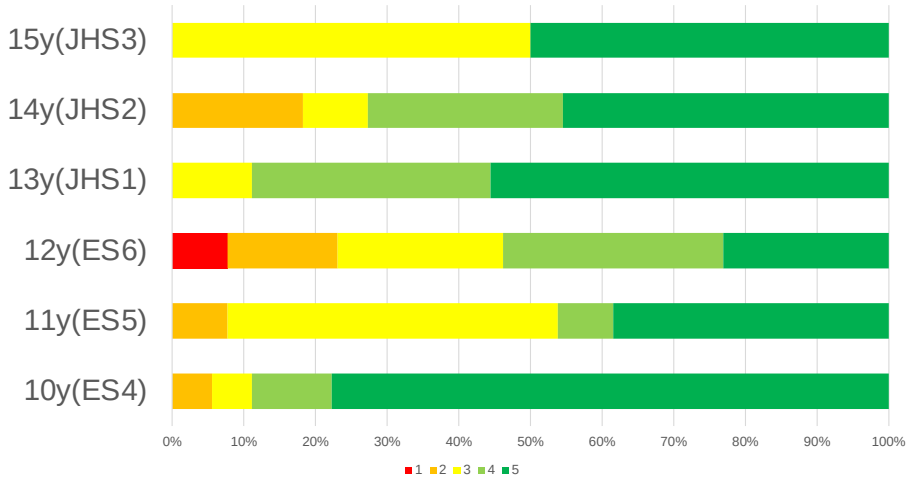
Interests of the Students. The results of the 5-point scale, with 1 being "boring" and 5 being "interesting", showed that, although opinions varied a little at ES6, most students from ES4 to JHS3 generally agreed that the lessons were "interesting" (Figure 1).

Figure 1: Interests of the Students



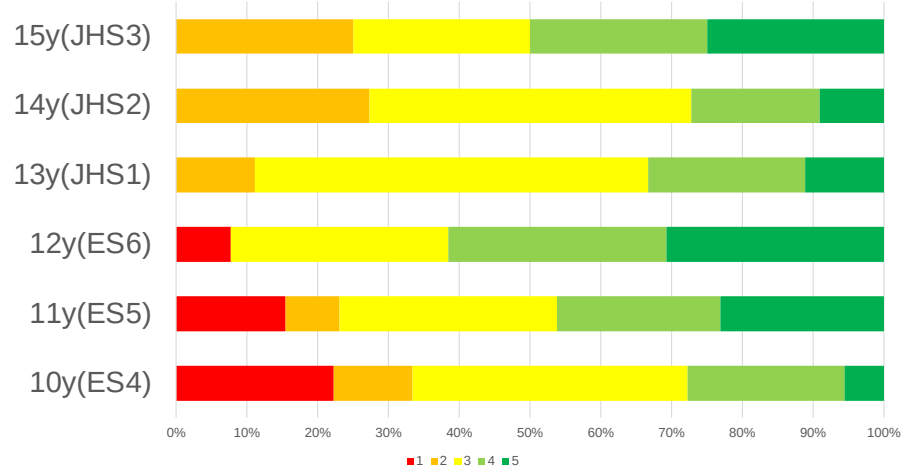
Whether the Students Would Like to Do More. The students were asked whether they would like to make more works, with 1 indicating that "he/she did not want to" and 5 indicating that "he/she would like to". Most of the students answered that they would like to make more works, but there were also a certain number of those who answered that they were not particularly interested in making more works. It can be inferred that they are satisfied with the activities in the class alone (Figure 2).

Figure 2: Whether the Students Would Like to Do More



Whether the Students Found It Difficult. The students were asked to rate their experience as 1 for "easy" and 5 for "difficult". The youngest students, ES4, felt that it was easy, but as they progressed to ES5 and ES6, the tendency to consider it difficult increased. On the other hand, Junior High School students seemed to have images of what they wanted to achieve using the slightly more advanced features of Pictogramming, and none of them considered it to be 1, which means it was easy (Figure 3).

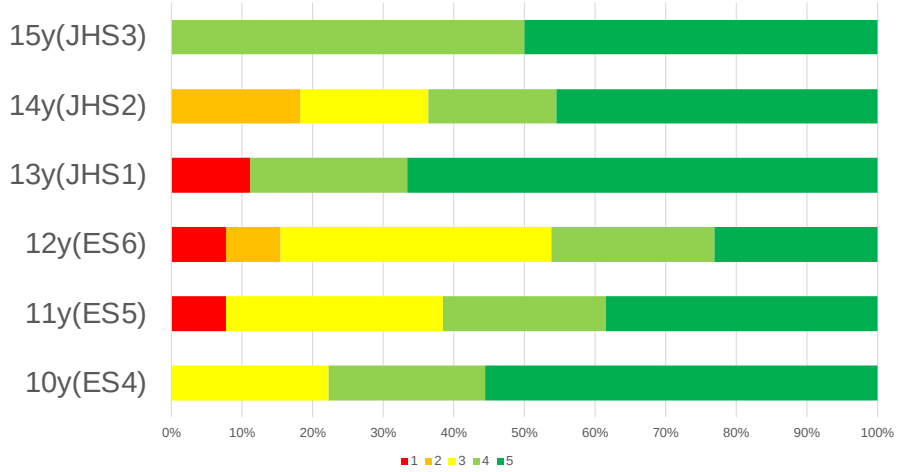
Figure 3: Whether the Students Found It Difficult



Whether the Students Understood the Importance of Pictograms. The students were asked to rate their understanding of the importance of pictograms, with "did not understand" as 1 and "understood" as 5. This is a slightly different aspect from the previous questions, as it asks about pictograms in general, not just about Pictogramming works. While the proportion of Elementary School students who "did not understand" increased as their school age increased, a V-shaped change was observed in Junior High School students, with the

proportion of those who "understood" increasing as their school age increased. The authors believe that this may be because the students are able to think about not only the superficial meaning but also the deeper meaning that exists behind it (Figure 4).

Figure 4: Whether the Students Understood the Importance of Pictograms



From Free Comments. The students were asked to write free comments. Two of the most typical ones were as follows:

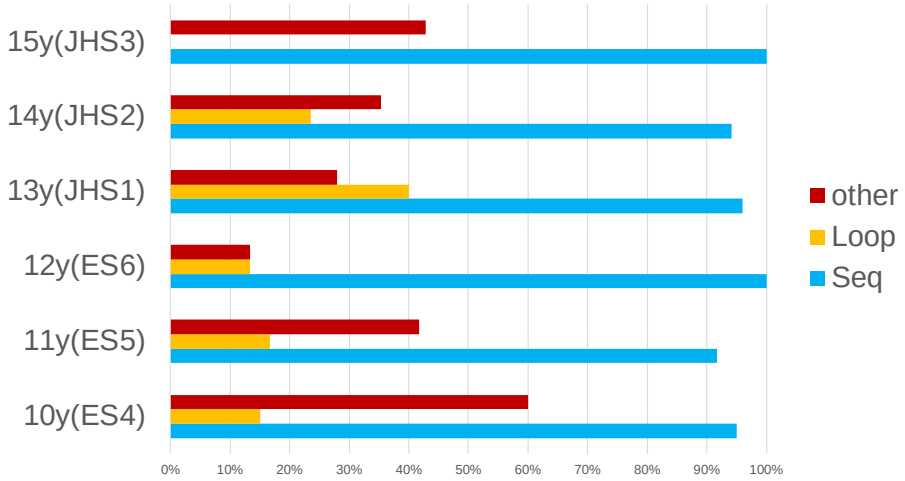
"I **enjoyed** being able to **move it freely**."
"It was **difficult** to move it **as I wanted**."

The freedom of movement was attractive to the students, but they found it difficult to move it as they wished. This is also the aim of the authors: Pictogramming is like an "Othello" game or horseback riding, where anyone can start easily, but it is not easy and deep to master.

Analysis of the Codes Created by the Students

The authors analyzed all codes produced by the students. "Sequential structure" with multiple blocks were used by all grades. "Loop structure" were used by more than a dozen per cent of Elementary School students, and by around a third of Junior High School pupils (No students used Loop structure in JHS3, where the sample size was small.) (Figure 5).

Figure 5: Whether the Students Understood the Importance of Pictograms



"Other" functions of note are highlighted in Table 1. Pictogramming has a feature where the pictogram speaks. For Elementary School students it seemed to be a very attractive feature and the lower the school age the more students used it. However, there was no significant use of other functions.

Junior High School students also used the Talking function, but in addition some students used Double Loops. In addition, a relatively large number of students were moving pictograms. Other than these, there were also students who created quite advanced programs without any specific instruction, such as Event Control in response to events such as keystroke, or Object Definition and handling them in programs. These students were not originally good at programming, but seemed to have acquired the ability to use these functions in this experimental lesson. This confirms that Pictogramming is an effective tool for developing programming skills.

Table 1: Other Functions

Grade (Year)	Students who used	Talking	Double Loops	Moving	Event Control	Object Definition
ES4 (10)	60% (12/20)	100%				
ES5 (11)	42% (5/12)	100%				
ES6 (12)	13% (2/15)	100%				
JH1 (13)	28% (7/25)	43%	14%	43%		
JH2 (14)	35% (6/17)			83%	17%	17%
JH3 (15)	43% (3/7)	67%		67%	33%	

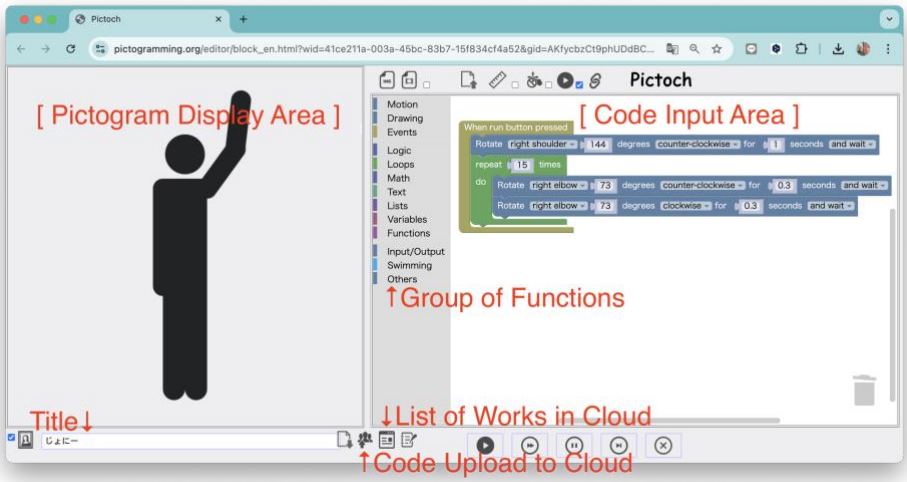
Workshop for Pictogramming

Provides an overview of Pictogramming (Pictoch), which was used in the workshop.

The Window of Pictogramming

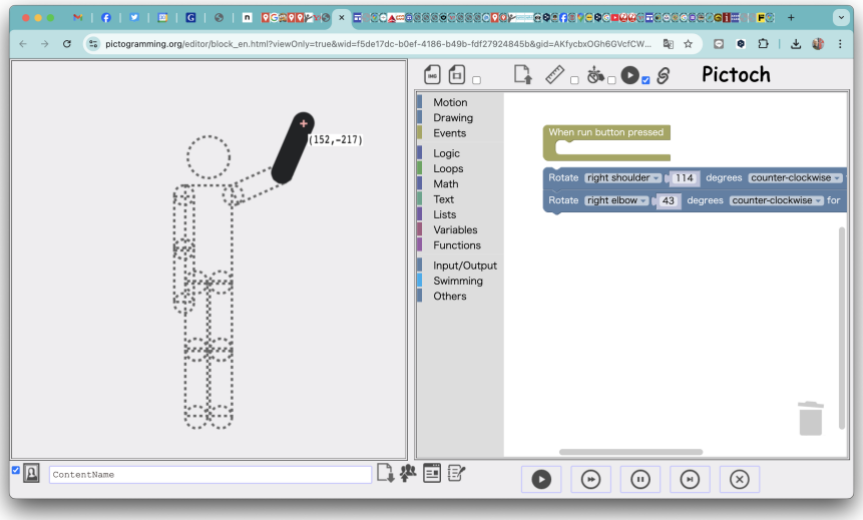
An overview of Pictogramming used in the workshop is given below. The Pictogramming (Pictoch) window is divided into two large areas. The left is the pictogram display area, and the right is the code input area. Code entry can be achieved by dragging the pictogram on the left or by selecting from a group of functions on the right, as in Scratch. When using Pictogrameeting, you can upload your works to the cloud and view the works of other students in the same class, including your own works. You can also download or upload the code to your local environment, whether you are using Pictogrameeting or not. The pictogram created can also be saved as an image file. Furthermore, for its involving movement, it can be saved as animated GIF file (Figure 6).

Figure 6: Pictogramming (Pictoch) Window



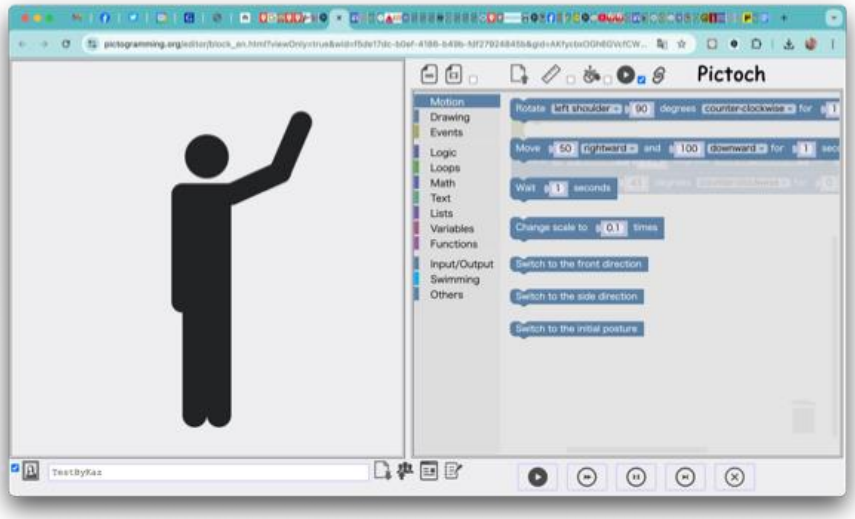
The most rudimentary use is to first drag the arm or leg of the pictogram in the left area to create some kind of pose. Then a code is automatically generated in the right area. You can then easily create a code by modifying it (Figure 7).

Figure 7: Pictogramming (Pictoch) Operation



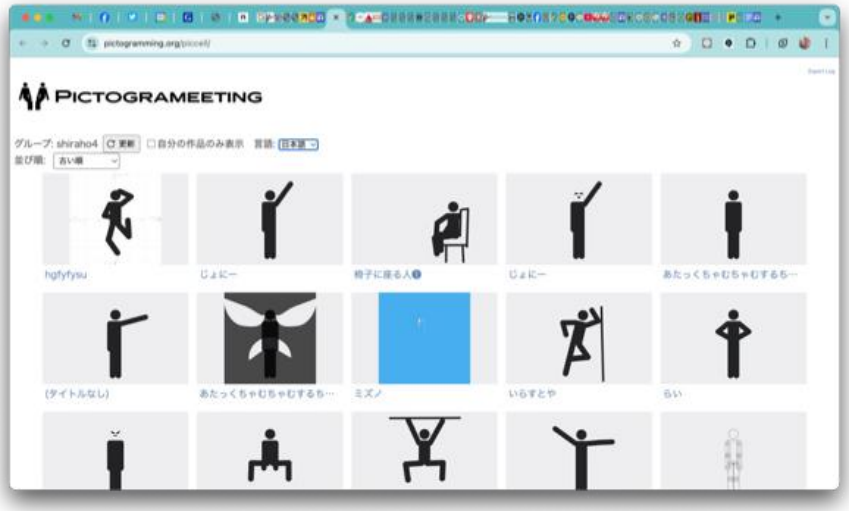
Of course, it is also possible to create a code from scratch by selecting a block from the function group in the right area (Figure 8).

Figure 8: Pictogramming (Pictoch) Functions



Pictogrameeting is a system whereby a specific group of people can create pictograms and share them, as in this lesson. It is also possible to evaluate them mutually. This time, the mutual evaluation function was not used, but only the sharing of contents (Figure 9).

Figure 9: Pictogrameeting



Conclusion

The experimental classes conducted in January and February 2024 only had about one hour each for Pictogramming, so it was not possible to fully educate the students in the areas of communication and information design. In the workshop at IICE 2025, after presenting these results, the authors asked the participants to experience Pictogramming first-hand. Various questions and discussions were raised during the workshop, which will be taken into consideration for future enhancements and educational use.

Acknowledgement

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Integrating Digital Tools to Enhance Algorithmic and Critical Thinking in Civil Engineering Education

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Abstract
This study explores the integration of digital tools in civil engineering education, focusing on their impact on algorithmic and critical thinking. Building on previous research, the study investigates how digital and traditional approaches influence students' ability to solve complex problems related to foundation engineering. Thirty-three students were tasked with solving two problems: one using classical methods (taught during lectures) and the other, more complex, requiring the use of a specialized digital platform. The findings revealed a stark contrast in performance, with traditional methods yielding near-universal success (average score: 97%), while digital tasks posed significant challenges (average score: 26%). Statistical analysis, including Wilcoxon signed-rank tests and correlation studies, indicated a significant performance disparity between the two approaches and highlighted the need for guided integration of digital tools in the curriculum. The study concludes that digital tools, though initially challenging, hold promise for cultivating independent problem-solving skills essential for professional practice, provided students receive structured guidance and exposure during their studies.

Keywords: Digital Tools, Algorithmic Thinking, Critical Thinking, Civil Engineering Education, Problem-Solving Skills

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Introduction

Mathematical skills are the foundation of civil engineering education, with critical concepts such as integrals, differential equations, and algebra underpinning professional subjects like structural mechanics, geotechnical engineering, and construction design. As technology evolves, the use of digital tools has become increasingly relevant, reflecting broader trends in digital education and the integration of technology in higher education (Johnson et al., 2014). These tools provide interactive platforms to enhance the understanding of complex mathematical concepts. However, the application is not used merely for the sake of digitalization, but as a tool to develop algorithmic and critical thinking. It serves as a medium to enhance students' ability to approach problems systematically, analyze data critically, and iterate solutions independently, bridging theoretical knowledge with practical problem-solving skills essential for engineering practice.

The Importance of Algorithmic and Critical Thinking in Education and Practice in Civil Engineering

Algorithmic and critical thinking play a key role in solving complex engineering problems in civil engineering. Algorithmic thinking involves the ability to break down a problem into smaller, manageable steps, systematically solve them, and iteratively improve solutions. It is a fundamental approach that allows students to develop a structured way of thinking, necessary for working with complex calculations, simulations, and optimization of civil engineering solutions. The emphasis on algorithmic thinking in education has become more prominent in recent years, as it equips students with tools for effectively solving complex tasks they encounter in the industry (Barr & Stephenson, 2011).

On the other hand, critical thinking enables students to assess the adequacy and accuracy of solutions, identify potential errors in data or procedures, and make informed decisions when confronted with incomplete or contradictory information. In civil engineering, this ability is reflected in analyzing the durability of structures, safety, and compliance with standards, as well as in the use of innovative solutions in practice (Jacquez et al., 2007). Critical thinking is essential for developing the ability to analyze and evaluate civil engineering solutions, especially when assessing the safety and durability of structures and dealing with contradictory data, which is common in the engineering profession (Loui, 2015).

In modern engineering education, it is important that these skills are not only developed in theory but also through practice. Digital tools, such as specialized software, allow students to simulate real-world problems, experiment with different approaches, and directly observe the impact of their decisions on final outcomes (Walcott et al., 2009). Moreover, they prepare them for the use of modern technologies, which are indispensable in the professional practice of civil engineering, where complex algorithms and digital analyses have become the standard (Varela et al., 2019). Thus, algorithmic and critical thinking are not only key to academic success but also to professional achievement in the industry.

A previous study on partially the same group of students (Mencinger et al., 2024) investigated the role of digital tools in improving students' mathematical competencies, specifically focusing on double integrals, and found no statistically significant difference between students using digital tools and those using traditional methods. However, the study raised questions about how digital competencies might influence learning outcomes, particularly in professional engineering courses. The study (Mencinger et al., 2024) compared the use of

digital tools with traditional learning methods in understanding double integrals among Civil Engineering students. While no statistically significant differences in exam performance were observed between the two groups, digital tools showed potential in engaging students when integrated effectively. Homework completion levels were a strong predictor of exam performance, indicating that practice and consistent effort play a vital role in mastering complex mathematical concepts. Moderate positive correlations were found between the double integral exam scores and homework scores as well as previous grades in mathematical subjects.

In this study, we aim to expand on those findings by applying similar experiment to partially the same group of students. Again, we use two learning methods which impact student performance in professional subjects on the topic which is highly related to mathematics. In the first task, the students had to verify the bearing capacity of the soil beneath a shallow foundation using the provided data. In the second task, they were required to determine the minimum foundation width that would ensure the soil's bearing capacity is not exceeded.

Additionally, we will compare the results from this study to the previous one, where the type of group (digital tools vs. classic tools or non-digital tools) was regulated according to the grade in the subject *Mathematics 1*, which was not the case here. Using mostly the same statistical methods we investigate correlations between grades and the use of digital/non-digital learning tools.

Methodology

Study Setup and Structure

The previous study was conducted during the *Mathematics 2* course, part of the first-year curriculum for civil engineering students at the University of Maribor. This course emphasizes advanced mathematical concepts that are directly applicable to professional engineering subjects. In the present experiment, 17 students who had participated in the *Mathematics 2* experiment described in (Mencinger et al., 2024) were included, along with 16 additional students, some of whom may have been older and had not taken part in the Mathematics 2 experiment. Altogether, a total of 33 students participated in this research.

Unlike the previous study, where students were partially randomly assigned to either a digital group (A) or a non-digital group (B) based on their grades in Mathematics 1, this study required each student to complete two tasks. One task was solved using traditional tools, such as textbooks, hand calculations, and calculators, while the other was solved using a digital platform specifically designed for civil engineering students to study foundation-related problems. The study focused on exploring the potential benefits of digital resources for independent self-study.

Test Design

In Mencinger, Cajnko and Repnik's study (2024), it was observed that simply using digital resources for homework tasks—such as applications or software capable of advanced computations—does not necessarily improve test performance, especially when the test setting limits students to using only a standard calculator. Building on this finding, the current research aimed to investigate whether such applications genuinely enhance students' problem-solving skills in addressing complex problems. To achieve this, each student was

assigned two tasks: one solved traditionally, without any digital aids, and the other completed using an application specifically designed for complex calculations related to the bearing capacity of foundations (Civil Engineering Bible).

A) **Non-digital task.** Evaluate the load-bearing capacity of a foundation using the following data: $\varphi'=35°$, $c'=5$ kPa, $\gamma=19$ kN/m³, $\delta_{found}=35°$, $B=1.7$ m, $d=0.6$ m, $V_{Gk}=220$ kN/m, $H_{Qk}=60$ kN/m, $\gamma_G=1.35$, $\gamma_Q=1.50$, $\gamma_\varphi=1.00$, $\gamma_c=1.00$, $\gamma_{R,v}=1.40$, $\gamma_{R,h}=1.10$.

B) **Digital task.** Determine the minimum foundation width with the following data to ensure the bearing capacity of the soil is not exceeded: $\varphi'=35°$, $c'=5$ kPa, $\gamma=20$ kN/m³, $d=0.6$ m, $V_{Gk}=200$ kN/m, $H_{Qk}=50$ kN/m, $\gamma_G=1.35$, $\gamma_Q=1.50$, $\gamma_\varphi=1.00$, $\gamma_c=1.00$, $\gamma_{R,v}=1.40$, $\gamma_{R,h}=1.10$, $B=?$ Use the application available at (Civil Engineering Bible).

Both tasks were assigned to the students as part of a seminar assignment and were completed independently at home. To prevent plagiarism, each student was given a unique set of numerical values, while the task descriptions remained identical.

The input and output screenshots of the application (Civil Engineering Bible) are shown in Figure 1 and Figure 2, respectively.

Figure 1: Screenshot of the Input Interface of Application [2]

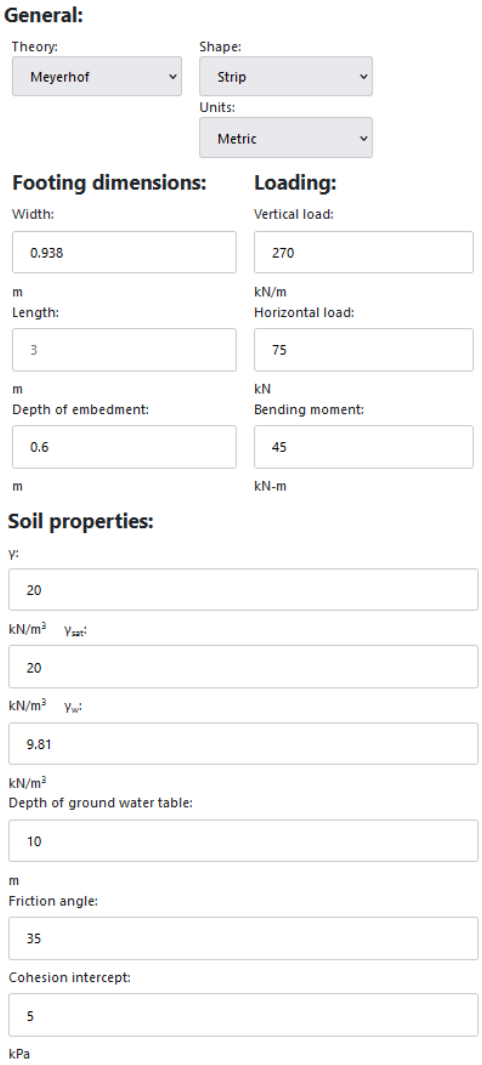


Figure 2: Screenshot of the Output Interface of Application [2]

Solution:

Read Meyerhof's bearing capacity theory and formulas here.

Factor of Safety against bearing capacity (FS) = 1.4035004711207
Factor of Safety against sliding($FS_{sliding}$) =0.16762048066785

Ultimate stress at bearing level (q_b) = **626.70087188963 kPa** = { N_c term: 218.12526473027 } + { N_q term: 325.75602802974 } + { N_γ term: 82.819579129613 }
Ultimate Load at bearing level (Q_b) = 378.94512720259 kN/m

Eccentricity = e_B = 0.16666666666667 m
Effective width = B' = B - $2e_B$ = 0.60466666666667 m
Inclination from vertical axis = θ = 15.524110996754°
Surcharge stress = q_0 = 12 kPa

Bearing Capacity Factors (N factors): [See formulas]
N_c = 46.123598689021
N_q = 33.296091491412
N_γ = 37.152403328439

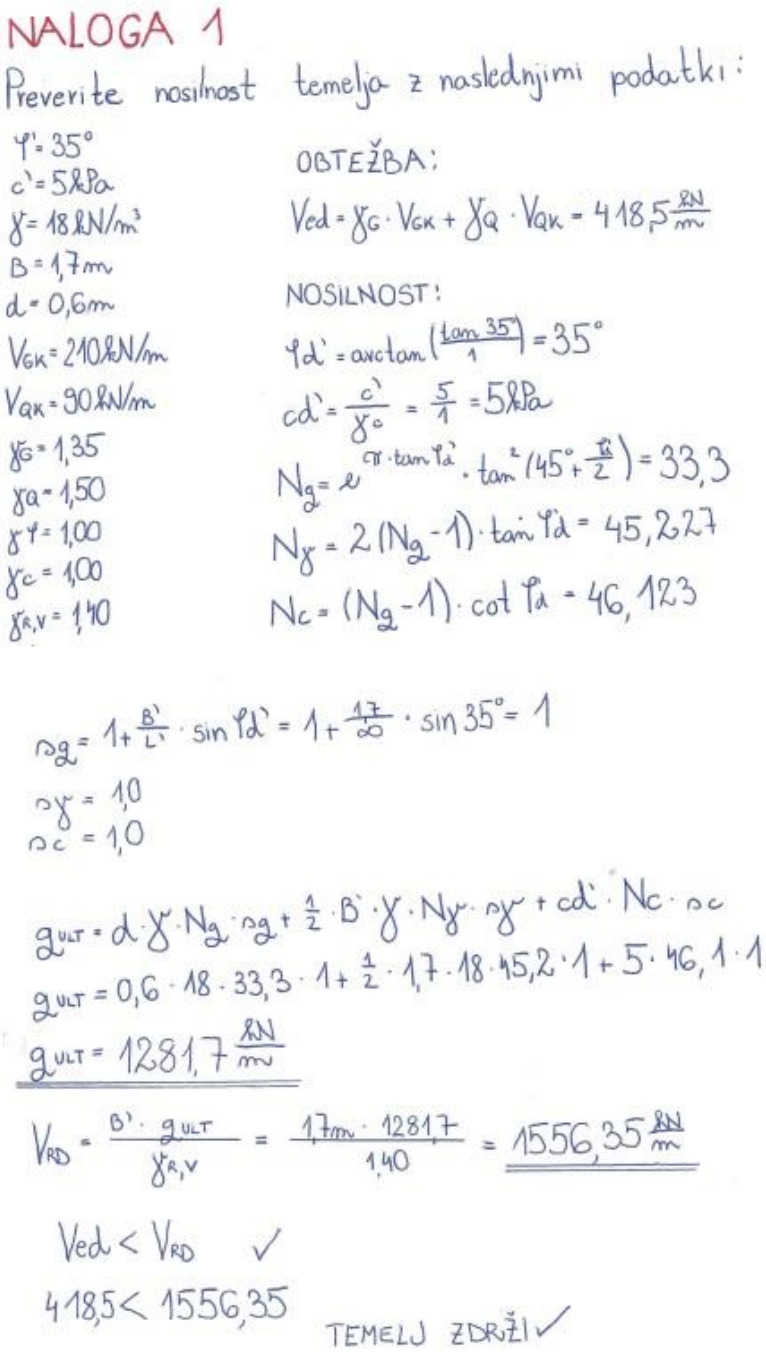
Shape factors: [See formulas]
S_c = 1 (Inclined loading)
S_q = 1 (Inclined loading)
S_γ = 1 (Inclined loading)

Depth factors: [See formulas]
d_c = 1.3812312931145
d_q = 1.1906156465572
d_γ = 1.1906156465572

Inclination factors: [See formulas]
i_c = 0.68477259787948
i_q = 0.68477259787948
i_γ = 0.30964102242184

An example of a solution to a classical (non-digital) problem is illustrated in Figure 3.

Figure 3: Example of a Solution to a Classical (Non-digital) Problem



Categories of Student Performance

Analysis of student results revealed three performance categories for the digital task:

a. **Low (0-1.75 points)**: Incorrect input data and no meaningful output.
b. **Medium (2-3.5 points)**: Correct input but no iterative refinement.
c. **High (3.75-5 points)**: Accurate input, effective output interpretation, and iterative process completion.

Only two out of 33 students successfully met all the requirements of the digital task, underscoring the need for more structured guidance and better integration of digital tools into regular teaching practices.

Mathematical Analysis of the Digital Tools Problem

In the digital task, one of the critical inputs involved calculating the overturning moment at the foundation base using horizontal and vertical forces, appropriate safety factors, and the foundation depth. Another essential input required ensuring that the groundwater level was sufficiently deep (i.e., significantly below the foundation depth). The primary input for the application was the foundation width (x_W). The resulting output was the safety factor f, which needed to exceed a value of 1.4. If the chosen width (x_W) resulted in a safety factor f less than 1.4, students had to increase x_W iteratively.

Theoretically, the digital task required determining the foundation width that ensured a sufficient safety margin. Simplified mathematically, the task could be expressed as solving the following problem: determine x_W such that $f \geq 1.4$, where x_W (width of foundation) was the main independent variable and f is defined in eq. (1). Additional variables x_L, x_D, x_{FV}, x_{FH} related to foundation dimensions were used to calculate the overturning moment x_M, which served as one of the key inputs into function (1). The remaining input constants: y_1, y_2, y_3, y_4, y_D represented soil properties, with an additional condition requiring that the groundwater depth (y_D) be significantly greater than the foundation depth (x_D). In real life, this condition ensures that the groundwater lies outside the failure line formed beneath the foundation: $y_D \gg x_D$.

Thus, the task required solving the inequality:

$$f = f(x_W, x_L, x_D, x_{FV}, x_{FH}, x_M(x_D, x_{FV}, x_{FH}), y_1, y_2, y_3, y_4, y_D(x_D)) \geq 1.4, \qquad (1)$$

where f was implicitly determined by the application.

While the application automated this iterative process, students could, in theory, perform the calculations manually. However, manual iteration would have been extremely time-consuming and impractical. This highlighted the efficiency and practicality of digital tools in managing complex, iterative engineering calculations.

Research Focus and Hypotheses

The research, designed as a seminar assignment, enabled the evaluation of not only digital skills but also students' algorithmic and critical thinking abilities, which is the main strength of the study. It is worth emphasizing that the non-digital task was relatively simple from an algorithmic and critical thinking perspective, as students had already learned about the topic during lectures. In contrast, the digital task required students to provide their own innovative input.

As a result, a strong correlation between the outcomes cannot be expected, nor can we assume a normal distribution of results. The hypotheses suggest that digital scores and non-digital (classical) scores are weakly correlated. Similarly, there is likely a weak correlation between the older digital and non-digital groups and the new scores for the digital task. In

contrast, no significant relationship is expected between the older groups (A and B) and the non-digital task, primarily due to the uniformity of the scores.

Therefore, the discussion will focus on exploring the reasons why students performed worse on the digital task.

Statistical Analysis

For all statistical analyses, SPSS 29 was utilized to ensure robust data processing and accurate results.

The data under study, for both digital and non-digital tasks the scores were found not to be normally distributed. To accommodate this, non-parametric tests were chosen as they do not require the normality assumption.

The Mann-Whitney U test, a non-parametric test for assessing whether two independent samples originate from the same distribution, was employed for comparisons between groups (digital vs. non-digital scores). This test was specifically chosen due to its efficacy in handling samples that are not normally distributed.

In addition to the Mann-Whitney U test, Spearman's rank correlation test was applied to explore the correlations between variables. This test is effective for measuring the strength and direction of association between two ranked variables. It is particularly useful in situations where the data does not meet the assumptions necessary for Pearson's correlation coefficient.

Table 1: Scores of the Seminar Paper in the Course "*Foundation Engineering*" and the Grade in the Course "*Mathematics 2*"

Mathematics 2 (grade)	Classic Tools Problem (max 5 pts)	Digital Tools Problem (max 5 pts)
10	5	0
6	5	4.5
7	5	2
8	5	1
5	5	0.5
6	5	0
5	4	0
6	5	0
6	5	0
5	5	1
7	5	1
6	2.5	1
5	5	2
8	5	1
6	5	1
7	5	1
5	5	1
5	5	1

6	5	2.5
7	5	2.5
6	5	0.5
8	5	0.5
7	4	1.5
7	5	1
9	5	2.5
5	5	1.5
5	5	0.5
9	5	3.5
6	5	0
8	5	4
7	5	0.5
9	5	2.5
6	5	1

Source: own

Note that for both columns the Shapiro-Wilk Normality Test was applied in order to test the data for normality. For classic tools the statistic was found to be 0.315, $p-$value< 0.001, yielding the data is not normally distributed as the $p-$value is far below 0.05. For digital tools the statistic was found to be 0.866 and corresponding $p-$value=0.001. Again, the data is not normally distributed, as the $p-$value is far below 0.05. Because both data are not normally distributed, we had to use the non-parametric test like Wilcoxon signed-rank test.

First, we applied Wilcoxon signed-rank test on digital and classic tools problem.

The test (Wilcoxon) statistics value of -5.04 and a $p-$value<0.001 indicate that the results in the digital group are statistically significantly lower, with a very low probability that this outcome is due to chance. Therefore, we reject the null hypothesis, which states that there is no difference between classic tools and digital tools.

The correlation coefficient for the grade in Mathematics 2 compared to the score on the digital assignment is a Pearson correlation coefficient of 0.284 and a Spearman correlation coefficient of 0.271 (both with a $p-$value of approximately 0.1), indicating a weak (statistically nonsignificant) correlation between these two variables. It is important to note that the $p-$values for the other two correlations (i.e., those involving classic tools) are close to 0.5. This is likely due to the scores for the non-digital assignment being highly uniform, which diminishes the variability needed to establish a meaningful correlation.

However, it is worth mentioning a contingency table where we compare (for the students who participated in both studies) whether the group partition (A-digital or B-classic/non-digital) had any impact on the digital score from the present study. For this purpose, we divide the digital scores into High and Low based on the average of 1.288. Contingency table for Groups from (Mencinger et al., 2024) and digital task (High - Low) is below.

Table 2: Contingency Table: Group (A-digital, B-classic) vs. High and Low Score on the Digital Problem

	Low	High
A	8	1
B	4	4

Source: own

Results of chi-squared test for Table 2 are the following: Chi-squared statistics was found to be 3.08**,** *p*-value was found to be 0.079**.** Consequently, there is no statistically significant association between the variables at the 0.05 significance level. However, the result may suggest a potential association, since the p-value is so close to 0.05.

We also performed a Mann-Whitney U test based on Group A or B (from study Mencinger et al., 2024) and compared the results for the digital assignment. The Mann-Whitney U statistic was 17.5, and the p-value was 0.06. Again, the p-value is close to the threshold, suggesting that a weak difference may exist, but it is not statistically confirmed at the 0.05 significance level.

Discussion

The study revealed several key insights into the use of digital tools for enhancing critical and algorithmic thinking in civil engineering education. While the non-digital task showed near-universal success among students, with an average score of 4.84/5 (97%), the digital task was significantly more challenging, yielding an average score of 1.28/5 (26%). This stark contrast highlights the complexities and potential learning barriers associated with independently exploring digital tools in academic tasks.

Factors Influencing Performance

The low performance on the digital task can primarily be attributed to incorrect input data rather than fundamental computational errors, suggesting students struggled with translating the problem requirements into accurate inputs. Furthermore, the iterative nature of the digital problem required students to make logical adjustments to their inputs to achieve valid results, a process that tested their algorithmic thinking and critical reasoning skills.

Additional reasons for the disparity in results include:

A. **Lack of Familiarity with the Application**: Students were not introduced to the application during lectures and had to independently explore its functionality, potentially impacting their ability to use it effectively.
B. **Limited Practice Time**: The seminar task required students to engage with an unfamiliar tool outside the structured classroom environment, offering limited guidance or opportunities for trial and error.
C. **Insufficient Exploration of Outputs**: Many students submitted incomplete solutions, failing to include critical components such as input data or the iterative process undertaken.

Algorithmic Thinking vs. Predefined Algorithms

The traditional task benefited from prior exposure during lectures, where students were guided through pre-established algorithmic procedures. In contrast, the digital task required

students to independently design and implement their own iterative procedures. This shift from predefined to self-constructed algorithms posed a significant learning challenge but also provided an opportunity to evaluate higher-order thinking skills. From the perspective of connectivism (Siemens, 2005), this approach aligns with the theory's emphasis on utilizing digital tools, online resources, and collaborative platforms to foster deeper learning.

Statistical Insights

Statistical analysis supported these observations, with significant differences between digital and non-digital task results (Wilcoxon signed-rank test, $p<0.001$). Weak correlations between digital task scores and prior mathematical grades or non-digital task scores further suggest that digital problem-solving requires distinct competencies beyond those tested in traditional methods.

Conclusions

This study underscores the critical role of digital tools in fostering algorithmic and critical thinking in civil engineering education. The findings reveal that while traditional methods provide consistent success due to their structured nature, digital tools challenge students to engage with problems in more complex and iterative ways, albeit with lower immediate success rates.

To effectively promote algorithmic and critical thinking in civil engineering, it is important that these skills are developed not only in theory but also through practice. One key strategy is the integration of digital tools into the curriculum, where students progressively advance from basic tasks to more advanced projects. The curriculum could include a gradual increase in task complexity, allowing students to develop their skills through various stages that connect to real-world challenges in civil engineering. In the initial stages, students would use simple digital tools for basic mathematical calculations, later progressing to more advanced simulations and analyses using specialized software solutions. In higher levels, students would focus on interdisciplinary tasks that require the use of multiple tools to manage complex engineering problems, thus preparing them to apply these techniques in a professional environment.

Key conclusions include:

1. **Need for Guided Integration**: Students require structured exposure to digital tools during lectures to build familiarity and confidence.
2. **Skill Development Beyond Mathematics**: Digital tasks test a unique blend of competencies, including problem translation, input accuracy, and iterative thinking, which may not directly correlate with mathematical performance.
3. **Potential for Long-Term Skill Gains**: Despite initial challenges, digital tools hold promise for cultivating independent problem-solving abilities essential for professional practice. This aligns with the principles of hands-on learning, where students actively engage in the process of creating and applying digital solutions to real-world problems (Wirth & Repnik, 2015). Such approaches have been shown to foster innovation and deeper understanding, as well as to develop critical thinking skills and strengthen the connection between theoretical knowledge and practical application. This is particularly evident in the digital task, which required students to critically analyze data, iteratively refine their inputs, and directly apply theoretical concepts to solve a complex, real-world engineering problem.

Future research should focus on developing teaching strategies that balance the challenges of digital tool use with adequate support, ensuring students acquire both foundational and advanced skills necessary for engineering applications.

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Gradual Simulation Integration in Physics Education: Enhancing Conceptual Understanding and Digital Competences

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Abstract
The integration of simulations in physics education plays a crucial role in improving the understanding of abstract concepts and the development of digital competences. While simulations do not replace traditional experiments, they significantly support and enrich the learning experience. In our study, we focus on the effectiveness of digital skills development depending on the depth of simulations used. The introduction of different levels of simulations is important to promote a comprehensive understanding of physics concepts and gradually build digital competences. Firstly, animations are still important in physics as they allow students to re-watch content at home, focus on multiple factors, pause when needed and watch slow motion footage. These tools are essential for understanding complex concepts. The next stage is the use of pre-built simulations such as PHET, which not only provide animations but also allow parameters to be adjusted and hypothetical situations to be explored. Going deeper is the use of simulation environments such as Algodoo, which allow students to create their own simulations, although these are usually limited to 2D. In this process, learning takes place in two stages: when creating the simulation and when testing and refining the simulation. Finally, the highest level is the programming of custom simulations, which requires a deep understanding of physics but offers fewer limitations. Recently, support from artificial intelligence has also proved useful in this context. Overall, the strategic use of various simulation tools in physics promotes both conceptual understanding and digital literacy, making it an indispensable part of modern teaching.

Keywords: Simulations, Physics Education, Digital Competences

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Introduction

Simulations have become a vital component of physics education, acting as powerful tools for conveying abstract and complex concepts that are often challenging to understand through traditional methods alone. The ability to visualize phenomena, manipulate variables, and test hypotheses within a controlled digital environment makes simulations essential for enhancing conceptual understanding and digital literacy. The increasing focus on 21st-century skills (European School Education Platform, n.d.) in education further emphasizes the importance of students developing competences in technology use and problem-solving, areas in which simulations excel.

The primary objectives of incorporating simulations into physics education are twofold. Firstly, to enhance comprehension of abstract physics concepts by providing dynamic and interactive representations of phenomena, and secondly, to equip students with digital competences that are relevant to the ever-evolving technological landscape.

It's important to note that simulations are intended to complement traditional experimental methods rather than replace them, ensuring a balanced and comprehensive learning experience.

Simulations facilitate learning by enabling students to engage with and observe physical phenomena in ways that are often impractical or impossible in conventional classroom settings. For instance, concepts such as electromagnetic waves, quantum mechanics, or planetary motion can be effectively illustrated through simulations that permit real-time visualization and manipulation of variables. The interactive nature of simulations provides a dynamic learning environment where students actively engage with the content, making learning more participatory rather than passive (Repnik et al., 2020). This engagement is crucial for deepening conceptual understanding. When students can manipulate variables, visualize abstract concepts, and observe outcomes in real-time, they are more likely to grasp complex ideas. For example, students learning about the laws of motion or chemical reactions can directly interact with simulation, testing their hypotheses and observing results firsthand. This active learning approach helps students better internalize the material and apply it to real-world contexts (Chiu & Linn, 2011; Repnik, 2018a; Rutten et al., 2012) As a result, they develop a deeper, more intuitive understanding of the principles being taught, which is foundational for further learning.

Additionally, student engagement through simulations encourages curiosity, critical thinking, and problem-solving. By creating environments where students can explore without the constraints of traditional lab setups or equipment limitations, simulations provide opportunities for inquiry-based learning, where students drive their own investigations and conclusions. This approach helps cultivate a sense of ownership over their learning process, further increasing motivation and persistence in the subject matter (Repnik et al., 2020).

The role of simulations in fostering digital literacy is equally significant. By engaging in these tools, students gain hands-on experience with the technology they will encounter in various professional and academic fields. Digital literacy involves the ability to navigate and use digital tools effectively for communication, collaboration, and content creation. Simulations provide a platform for students to practice these skills in real-time. For example, students can use simulations to collaborate with peers, analyze data, create digital content, and communicate findings, all of which are competences outlined in the DigComp 2.2

framework (Vuorikari et al., 2022). In previous study (Klemencic et al., 2024a) we presented opportunities for integrating simulations into physics experiments and classes and showed how simulations often provide large datasets that students can manipulate, analyze, and interpret, developing their data literacy in the process. In addition, simulations encourage students to work together in shared virtual environments, fostering teamwork and communication skills in a digital context, and allows students to engage in the creation and modification of digital content, enhancing their creative and technical skills. These competences are critical for future success in both higher education and the workforce, as digital tools become increasingly integrated into every field.

In this paper, we emphasize the importance of gradual progression of simulations in physics education, which helps building both conceptual understanding and digital literacy. In addition, we discuss the importance of equipping students and future teachers with sufficient knowledge to provide long-term results across the whole formal education vertically.

Levels of Simulation-Based Learning in Physics

Effective integration of simulations into physics classroom requires carefully planned, gradual progression. This process begins with basic tools, such as animations, and advances to more sophisticated methods, including interactive simulations and custom programming platforms. Each stage serves distinct educational purposes and contributes to the development of students' understanding and digital competences.

Animations serve as the foundational level of simulation-based learning. They provide static or pre-determined visualizations of phenomena, enabling students to:

- re-watch content at their own pace,
- focus on multiple interacting factors (content, video, audio, interaction with the surroundings, security aspects),
- pause and resume as needed,
- observe phenomena in slow motion or by varying animation’s speed,
- observe phenomena in reverse, and
- lighten or darken animation, change the contrast.

In the classroom, animations serve as valuable visual aids to enhance teachers’ explanations of physics phenomena, especially when real-world demonstrations are impractical or impossible (Teplá et al., 2022). Ideally, educators should integrate both animations and physical experiments whenever possible, as each approach provides unique opportunities for students to deepen their understanding of physics concepts. Numerous JavaScript-based physics animations and videos available on educational platforms can effectively illustrate complex phenomena. For example, animations have proven particularly effective in teaching Newtonian mechanics, thermodynamics, and wave phenomena by offering clear and focused visual representations. Additionally, by using animations independently, students enhance their digital competence, particularly in the domain of Information and Data Literacy as defined in DigComp 2.2 framework.

The next step involves interactive pre-built simulations, such as those provided by platforms like PhET Interactive Simulations (n.d.), The Physics Classroom (n.d.), oPhysics (Walsh, n.d.) and others. These tools offer a more engaging learning experience and allow students to actively manipulate parameters and explore hypothetical scenarios, bridging the gap between passive observation and active experimentation (Repnik, 2018b).

Interactive simulations can be integrated into various teaching phases:

- During Lectures: To visualize phenomena and enhance conceptual understanding.
- Before Laboratory Work: To prepare students for experiments by familiarizing them with relevant concepts and procedures.
- After Laboratory Work: To test hypothetical scenarios or explore experiments that cannot be performed with standard school equipment.

For instance, PHET's "Circuit Construction Kit" enables students to simulate and analyze electrical circuits before conducting actual experiments. Similarly, after laboratory sessions, students can use simulations to explore scenarios like temperature-dependent resistivity, superconductors, or idealized perfect conductors – experiments that are often impractical in classroom settings.

Physics frequently involves the use of minimal models, focusing on ideal cases (e.g., neglecting air resistance or friction for a point mass). While real-world experiments often deviate from these conditions, simulations can illustrate idealized cases, reinforcing theoretical concepts, and enable exploration of complex scenarios beyond the capabilities of school equipment. Some simulations also generate numerical results and graphs, helping students visualize variable interconnections. By providing qualitative insights without requiring advanced mathematical derivations, these tools are particularly effective for students at introductory educational levels. Research has shown that simulations enhance inquiry-based learning, critical thinking, and problem-solving competences (Wieman et al., 2010). These also align with Problem-Solving skills outlined in DigComp 2.2 framework (Klemencic et al., 2024a).

The next stage involves using simulation environments, such as Algodoo (n.d.), which empower students to design and create their own simulations (Repnik, 2018c; Repnik et al., 2006). This approach involves a two-stage learning process:

- Creation: Students design simulations based on specific physics principles.
- Refinement: They iteratively test and improve their simulations, deepening their understanding through experimentation.

While these platforms are often limited to 2D representations, they foster creativity, critical thinking, and problem-solving skills. For example, students can simulate concepts such as momentum conservation or energy transfer, making abstract principles more tangible. These activities contribute to Digital Content Creation and Problem-Solving, as defined in DigComp 2.2 framework.

However, it is important to acknowledge the additional time required for students to familiarize themselves with the platform and build their simulations. To ensure efficiency, educators should strategically determine the frequency and depth of platform use within the classroom.

The most advanced level of simulation-based learning involves programming custom simulations. This approach demands a solid foundation in both physics concepts and coding skills, making it particularly suitable for higher levels of education or specialized learning tracks. At this stage, students transition from passive consumption of pre-designed content to actively creating dynamic, customizable simulations. This process fosters deep conceptual understanding and develops essential digital competences.

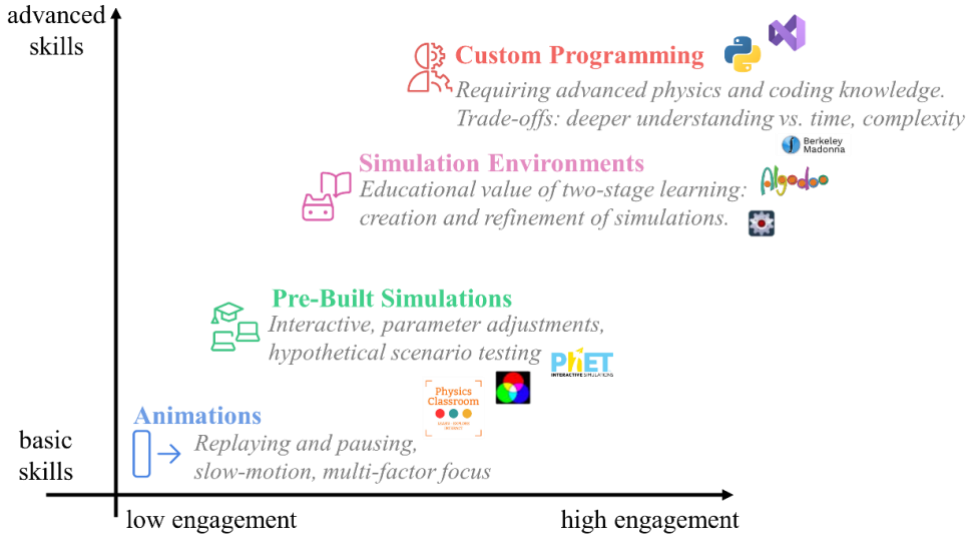
Students can use versatile programming languages such as Python, JavaScript, or C#, which are widely adopted in educational and professional settings. These languages are often enhanced by powerful libraries and frameworks tailored for simulation development, such as Pygame (ideal for simple physics simulations), VPython (for 3D visualizations), and Matplotlib (for plotting data and graphs). These tools allow students to design highly customizable and interactive simulations tailored to specific physics principles This approach aligns directly with "Digital Content Creation" and "Programming Skills", as defined in the DigComp 2.2 framework.

By programming their own simulations, students engage deeply with physics concepts, as they must translate theoretical principles into code. This process requires a detailed understanding of equations, initial conditions, and the interplay of variables, fostering higher-order thinking and problem-solving skills. Unlike pre-built simulations, custom programming offers students complete creative control, allowing them to explore unique scenarios, test hypotheses, and refine their work iteratively. Additionally, programming simulations integrate knowledge from multiple disciplines, including physics, mathematics, and computer science. This interdisciplinary approach equips students with transferable skills valuable in STEM careers, such as computational thinking, debugging, and project management. Custom simulations often produce data outputs, such as numerical results or time-series data, which students can analyze using graphing tools. This process helps bridge the gap between theoretical predictions and experimental results, further reinforcing their understanding of physics phenomena.

Recent advancements in artificial intelligence (AI) have significantly streamlined the process of programming simulations. AI-assisted coding platforms, such as GitHub Copilot or ChatGPT’s Code Interpreter, provide contextual suggestions and error corrections, reducing technical barriers for students new to programming. These tools allow students to focus on conceptual design rather than syntax or debugging, quickly iterate on their simulations, and explore more advanced coding techniques with guided assistance. AI integration also aligns with emerging trends in education, where technology is leveraged to enhance personalized learning and reduce cognitive load during complex tasks (Johnson et al., 2022). Moreover, the use of AI fosters collaboration between students and technology, a key competency for 21st-century learners.

While programming custom simulations offer numerous educational benefits, it also presents challenges in time investment and resource availability. Students require time to learn programming basics before they can focus on simulation design. Educators should provide structured lessons or tutorials on essential coding concepts. Additionally, access to programming tools and platforms may vary. Schools and educators should prioritize open-source or low-cost solutions, such as Python, to ensure inclusiveness. To prevent students from feeling overwhelmed, educators should provide clear objectives, templates, and step-by-step guidance during the early stages of learning.

Figure 1: Levels of Simulation-Based Learning in Physics Considering Students' Engagement and Needed Skills



The successful integration of simulations in physics education requires careful planning and a strategic approach to ensure a positive impact on students' learning experiences. Simulations must align with educational objectives, complement traditional experiments, and encourage collaboration to maximize their benefits. Teachers should consider a variety of strategies to effectively incorporate simulations into their classrooms, focusing on gradual progression, blended learning approaches, and teacher preparedness.

While simulations are powerful tools, they should not replace traditional experiments entirely. Instead, a blended learning approach that combines physical experiments with simulations is most effective. Simulations and experiments can play complementary roles in reinforcing theoretical knowledge through hands-on application. The integration of simulations into physics education not only enhances conceptual understanding but also paves the way for a seamless transition to blended learning. By progressing from basic animations to interactive simulations and finally to programming custom models, students develop both theoretical and practical skills. This structured approach ensures that when they engage in traditional experiments, they already possess a deeper understanding of the underlying principles. Simulations act as preparatory tools, reinforcing theoretical knowledge before students encounter real-world experimental challenges. As a result, a well-balanced combination of virtual and hands-on learning experiences maximizes educational impact and student engagement.

- Supplement Physical Experiments: Simulations can help students visualize abstract or complex concepts before conducting hands-on experiments.
- Replace Impractical Experiments: When safety, cost, or scale make physical experiments impractical, simulations can serve as effective alternatives. Topics such as nuclear reactions or astronomical phenomena, which are difficult or impossible to replicate in a school laboratory, can be explored safely and effectively through simulations.
- Upgrade Real Experiments: Simulations can enhance the scope of traditional experiments by allowing students to explore scenarios beyond the limitations of physical setups. For example, in simulations, students can adjust gravitational

constants or friction coefficients to study their effects on planetary motion, providing insights that are otherwise unattainable in the classroom.

This blended approach ensures students benefit from both the tactile experience of real-world experiments and the flexibility and scalability of simulations.

Teacher Education and Professional Development

To implement simulations effectively, teachers need to be well-equipped with the necessary skills, tools, and pedagogical strategies. Comprehensive teacher education study programs are essential to ensure educators can confidently integrate simulations into their lesson plans.

During Teacher education study programs students should be introduced to a wide range of simulation tools, from animations to programming platforms, emphasizing their educational value and practical applications. In addition to technical skills, developing leadership competencies among teachers plays a crucial role in the successful adoption of innovative methods. The study of the teacher education program at University of Maribor (Svetec et al., 2019) highlights that information communication technology (ICT) should complement, rather than replace, hands-on experimental work in physics education. The emphasis is on improving teachers' digital literacy and their ability to effectively utilize various educational technologies. Key findings from the study indicate the importance of balanced ICT usage, fostering digital competences and science literacy, as well as promoting entrepreneurship skills through the integration of educational technologies. In addition, research by Rahman and colleagues (2025) indicates that leadership skills, participation, and trust are key factors in accelerating innovation and knowledge sharing in educational settings. Encouraging these competencies among educators can foster a collaborative environment that supports the effective integration of simulations into physics teaching. This includes understanding when and how to use simulations to complement traditional teaching methods and align with specific learning objectives. Students, future teachers, should also have opportunities to practice using simulations in controlled teaching environments. This hands-on experience allows them to refine their techniques, troubleshoot potential challenges, and develop confidence in using simulations as teaching aids. Teacher education should align with digital competence frameworks such as DigComp 2.2 framework to ensure educators develop skills such as “Information and Data Literacy,” “Digital Content Creation,” and “Problem Solving.” These competences are essential for guiding students in the effective use of simulations.

Document analysis of teacher education study program at University of Maribor (Klemencic et al., 2024b), showed most study units incorporate skills that support the development of digital competences, primarily through teaching and learning methods such as the use of ICT and simulation environments. Digital competences are further enhanced by various digital tools for work planning, organization, communication, teamwork, and problem-solving. Students actively engage with online quizzes, online classrooms, and interactive whiteboards. ICT is also employed for preparing seminar and project assignments, presentations, and for using software tools for data processing, analysis, result visualization, graphic displays, and modeling. However, there is room for improvement in explicitly integrating more digital competences into the content of specific courses. Students of the Educational Physics track have three compulsory courses Computer in Physics, Physics of Complex Systems, and Information Communication Technology.

Ongoing professional development for in-service teachers is equally important. Workshops on emerging technologies, such as virtual reality (VR) and artificial intelligence (AI)-driven simulations, can help educators stay updated on the latest tools and practices. Additionally, creating communities of practice where teachers can share resources, experiences, and strategies can further enhance the effective use of simulations in education.

Challenges and Future Directions

While simulations offer transformative benefits in education, several challenges persist. Limited access to technology and internet resources in some regions creates inequities, particularly in underfunded schools or rural areas (UNESCO, 2023). Additionally, effective integration of simulations requires extensive teacher training to ensure alignment with pedagogical objectives. Over-reliance on simulations could risk diminishing the hands-on experience vital to developing practical skills and understanding real-world applications (Rutten et al., 2012).

Emerging technologies like VR and augmented reality (AR) offer promising solutions, enabling immersive and interactive experiences that extend beyond traditional 2D simulations. For instance, AR can overlay digital information onto physical spaces, enhancing understanding of complex spatial phenomena, while VR creates fully immersive environments, beneficial for exploring scenarios like planetary motion or subatomic interactions (Freina & Ott, 2015). Similarly, AI-driven simulations can adapt in real time to learners' progress, providing personalized feedback and scaffolding that addresses individual learning needs (Yaseen et al., 2025).

Future research should examine the long-term impacts of simulation-based learning on students' conceptual understanding, engagement, and digital competence. Comparative studies between traditional methods and simulation-enhanced approaches are essential to identify best practices for curriculum design, particularly regarding the optimal balance between hands-on experimentation and virtual simulations (Repnik, 2018c). Moreover, addressing the digital divide and developing low-cost, accessible simulation platforms must remain priorities to ensure equitable opportunities for all learners globally.

Conclusion

The integration of simulations into physics education represents an important shift in how students engage with and understand the subject. Traditionally, physics concepts are abstract and can be challenging for students to grasp through theoretical learning alone. Simulations break down these barriers by providing dynamic, interactive, and visually engaging environments that help students conceptualize and experiment with these ideas in a controlled, virtual setting.

However, it is essential to emphasize that physics is an experimental science, where hands-on experiences play a crucial role in learning. The process of acquiring knowledge in physics should always involve direct observation of physical objects and phenomena in nature, as this strengthens students' skills in scientific inquiry and critical thinking. Since direct observation is sometimes impractical due to constraints such as scale (too large or too small), time, safety, or cost, schools recreate these phenomena in laboratory settings. Traditional experiments remain indispensable for fostering essential competencies such as data collection, measurement accuracy, experimental technique, and teamwork. At the same time, simulations

provide an excellent complement and extension of experimental learning. Their flexibility allows students to explore physics phenomena beyond the constraints of laboratory equipment. Simulations enable pre-laboratory preparation, helping students predict system behavior based on selected parameters before conducting real experiments. They also serve as an effective tool for homework, flipped learning, and research projects, allowing students to explore complex concepts independently and reinforce their understanding. When used strategically, simulations can deepen students' insight into the laws of physics and promote inquiry-based learning, where students actively investigate and test hypotheses.

A structured and progressive integration of simulations into physics education ensures that students develop both fundamental knowledge and advanced technical skills. Gradually moving from basic animations to interactive simulations and finally to custom model programming, students acquire a spectrum of competences—from conceptual understanding to digital literacy and computational thinking. The use of simulations at different levels also fosters a range of digital competences, which are developed to varying degrees depending on the learning goals. These skills are becoming increasingly relevant in the modern world, where technology and physics are deeply interconnected.

To successfully integrate simulations into teaching, educators themselves must first develop strong digital competences. Teachers need continuous professional development to confidently navigate simulation tools, design effective lesson plans, and align digital learning with educational objectives. Teacher education should focus on both pedagogical strategies and technical skills, ensuring that teachers can effectively guide students through various levels of simulation-based learning. In addition, collaborative professional networks and communities of practice should be encouraged to facilitate the exchange of best practices, resources, and teaching methodologies.

In conclusion, simulations are not a replacement for traditional experiments but a powerful enhancement that bridges the gap between theory and practice. By integrating both hands-on experiments and digital simulations, educators can offer students a rich and well-rounded educational experience, preparing them for the scientific and technological challenges of the future. The synergy between experimental and digital learning approaches ensures that students develop essential physics knowledge, critical thinking skills, and digital competences, equipping them for a world increasingly shaped by technology and scientific advancements.

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A Competency Framework for Energy Literacy, Sustainability, and Green Transition in Higher Education

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Abstract
Current policies and strategies emphasize the critical importance of advancing a green transition, cultivating sustainability skills, and enhancing energy literacy to effectively address global environmental challenges. Consequently, there is a growing demand for professionals equipped with comprehensive competences in these areas. We have established an integrated framework for assessing competences in sustainability, energy literacy, and biodiversity, organized into five main categories: systems thinking in energy systems, biodiversity, resource management, technology, and policy and regulation. By quantifying these competences, educators and employers have a valuable tool to evaluate and improve graduate preparedness. Our framework was applied to students from three study programs at the University of Maribor in Slovenia: Physics, Mathematics, and Subject Teacher. Using questionnaires, we assessed the competence levels of these students and compared them with market expectations. The findings suggest that, overall, students align well with market requirements, although some variations exist among the individual study programs. Importantly, we identified gaps in policy knowledge and competences related to biodiversity across all programs. These results highlight the necessity of enhancing curricula to better prepare graduates for sustainability-focused careers. By addressing these gaps and refining educational offerings, we can better equip future professionals to navigate and lead in sustainability-driven fields, making a meaningful contribution to global environmental protection and the pursuit of sustainable development goals.

Keywords: Competence Framework, Sustainability, Biodiversity, Energy Literacy, Higher Education

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Introduction

In recent years, the urgent need to address environmental challenges such as climate change, biodiversity loss, and resource depletion has prompted a shift toward sustainable practices across various sectors (United Nations Environment Programme, 2021). Governments, organizations, and educational institutions globally recognize that transitioning to greener practices is essential for achieving ecological balance and economic stability. Policies such as the European Green Deal (European Commission, 2019), the United Nations Sustainable Development Goals (2015), and various national environmental agendas underscore the importance of sustainability-focused actions. These initiatives advocate for the broad development of sustainability skills and enhanced energy literacy to equip individuals and communities for active participation in the green transition. These competences empower individuals and organizations to adopt behaviors and technologies that reduce environmental impact, improve resource efficiency, and support transitions to sustainable energy systems, which are essential for achieving global climate goals such as net-zero emissions by 2050.

Sustainability literacy refers to an individual's understanding of principles and practices that support the maintenance of ecological, economic, and social systems, while energy literacy involves a comprehension of energy sources, usage, conservation, and impact on the environment (Cotton et al., 2015; UNESCO, 2017). Building literacy in these domains is essential as societies transition to low-carbon economies. As a result, there is a growing demand for a workforce skilled in green competences, particularly in energy and sustainability literacy, resource management, and biodiversity conservation. For instance, the International Labour Organization (Strietska-Ilina et al., 2011) projects that green policies could create 24 million jobs globally by 2030 but notes that workforce readiness in green competences remains a barrier. Employers increasingly seek individuals who can navigate complex environmental regulations, design sustainable systems, and engage in effective resource management. Market demand for sustainability-related skills varies across industries, with sectors such as energy, manufacturing, transportation, and finance actively seeking expertise in environmental management, regulatory compliance, and energy efficiency (UNESCO, 2017).

Additionally, the need for energy literacy is pronounced in engineering and design fields, where professionals can incorporate renewable energy sources and energy-efficient processes into product development and building design.

Global initiatives, including the United Nations Sustainable Development Goals and the European Green Deal, stress the integration of sustainability education to support ecological stability and economic resilience. However, current educational curricula often inadequately prepare graduates for these roles, creating a pressing need for educational models that equip future professionals with the necessary knowledge, skills and attitudes.

There are several established frameworks designed to assess sustainability competences, each with a unique focus. Key frameworks often consider sustainability literacy as part of broader environmental education, encompassing ecological knowledge, ethical considerations, and action-oriented skills (Shephard, 2008). UNESCO's Education for Sustainable Development (2017) focuses on fostering a comprehensive understanding of sustainability within educational contexts by developing the capacities of learners to address sustainability challenges through critical and systems thinking, self-awareness, and integrated problem-solving. It specifies the following competences: systems thinking, anticipatory, normative,

strategic, collaboration, critical thinking, self-awareness, and integrated problem solving. Meanwhile, the European GreenComp Framework (Bianchi et al., 2022) identifies 12 competences organized into four areas:

1. embodying sustainability values (valuing sustainability, supporting fairness, promoting nature),
2. embracing complexity in sustainability (systems thinking, critical thinking, problem framing),
3. envisioning sustainable futures (futures literacy, adaptability, exploratory thinking),
4. acting for sustainability (political agency, collective action, individual initiative).

For energy literacy, the North American Association for Environmental Education (NAAEE) provides the Guidelines for Excellence in Environmental Education, which includes energy concepts crucial for informed decision-making on energy use, sources, and conservation (NAAEE, 2010). Additionally, DeWaters and Powers (2011) propose an energy literacy framework encompassing cognitive, affective, and behavioral dimensions of energy-related knowledge and values, further underlining the importance of holistic education that encompasses scientific understanding, personal responsibility, and action-taking capacities.

Based on the U.S. Department of Energy (2014), energy literacy is defined as an understanding of the nature and role of energy in the universe and in our lives. It also encompasses the ability to apply this understanding to answer questions and solve problems. In this framework, seven essential principles are emphasized: 1) energy is a physical quantity that follows precise natural laws, 2) physical and biological processes on Earth are driven by energy flow through the Earth system, 3) energy is essential to life and all human activities, 4) various sources of energy can be harnessed for use by humans, each with costs and benefits, 5) energy decisions are influenced by economic, political, environmental, and social factors, 6) the amount of energy used by human society depends on many factors, and 7) the quality of life of individuals and societies is affected by energy choices. An energy-literate individual uses these principles to make informed decisions about energy use and policies, contributing to a more sustainable future.

Existing frameworks offer comprehensive guidelines for fostering green transitions and promoting sustainability; however, they often lack the specificity needed to address emerging market demands for energy literacy and biodiversity expertise.

To develop the framework, we conducted a comprehensive document analysis (Klemenčič et al., 2024). Focusing on natural sciences programs, we selected three study programs at the Faculty of Natural Sciences and Mathematics (FNM), University of Maribor. Selected study programs are the bachelor's programs in Physics and Mathematics, and the unified master's program for Subject Teacher with tracks in Educational Physics and Educational Mathematics. Graduates of Physics and Mathematics are typically employed in academic and research institutions, the technology and engineering sector, the finance and banking sector, or through self-employment, while graduates of Subject Teacher programs are mostly employed in education sector. The objective of the document analysis is to assess the extent to which the current curricula, the fundamental goals of the programs, and the competences of graduates align with the principles of energy literacy, sustainability, and the green transition. Additionally, we administer questionnaires to graduates to gather their perceptions regarding the development of these competences during their studies and their relevance to the demands of their current professional roles.

Building on these findings, we proposed a tailored framework to evaluate competences in sustainability, energy literacy, and biodiversity, with a particular focus on natural sciences and engineering programs. The framework emphasizes five key dimensions: systems thinking of energy systems, biodiversity, resource management skills, technological competence, and policies and regulations awareness. These dimensions are essential for equipping students with the practical skills needed to effectively address complex sustainability challenges. By applying this framework to three study programs at the University of Maribor, Slovenia, our goal is to identify both strengths and gaps within current curricula. The insights gained will inform targeted improvements, ensuring alignment with industry and societal needs while enhancing graduates' abilities to contribute meaningfully to global sustainability objectives.

Program Specific Competence Overview

We analyzed curricula and the accreditation documents of selected study programs to assess their fundamental goals, and the competences expected of their graduates. We specifically examined how these goals and competences align with digital, natural science, and computational skills, as well as energy literacy.

In the Physics Bachelor's study program, 90% of competences align with science literacy, 57% with computational competences, 10% with digital competences, and only 5% with energy literacy.

In the Mathematics Bachelor's study program, none of the core objectives or competences address energy literacy. Most goals align with computational and natural science competences (88%), with 59% linked to digital competences.

In the Subject Teacher program (Unified Master's degree), we analyzed competences for Educational Physics and Educational Mathematics tracks. Educational Physics focuses primarily on natural sciences (60%) and digital (55%) competences, with 35 % in computational competences. Energy literacy appears in subject-specific competences, representing 40% - the highest proportion across all programs studied. Educational Mathematics track emphasizes digital (100%) and computational (75%) competences, with 38% linked to natural science but none to energy literacy.

Curricula analysis by Klemenčič and colleagues (2024) revealed that most course units in the Physics (BSc) and Subject Teacher (Educational Physics) programs include content and teaching methods that promote the development of natural science competences, which is expected given the focus of the studied programs. Competences related to algorithmic, logical, and abstract thinking are present in some course units, particularly in the study programs Mathematics and Subject Teacher (Educational Mathematics), but they are not explicitly stated in the majority of course units. A significant portion of the course units also incorporate skills supporting the development of digital competences, which are explicitly mentioned mainly in the teaching and learning methods (e.g., use of ICT, simulation environments). Energy literacy is the least represented competence in the course units analyzed. It is explicitly mentioned in only one unit, this is Environmental Physics, which is an elective course in the study program Physics but a compulsory course in the Subject Teacher - Educational Physics program. Similarly, findings related green transition indicate that "green content" is directly included only in the course unit Environmental Physics, suggesting a limited focus on sustainability topics across the study programs.

Graduates' Perception on Acquired Competences and Market Needs

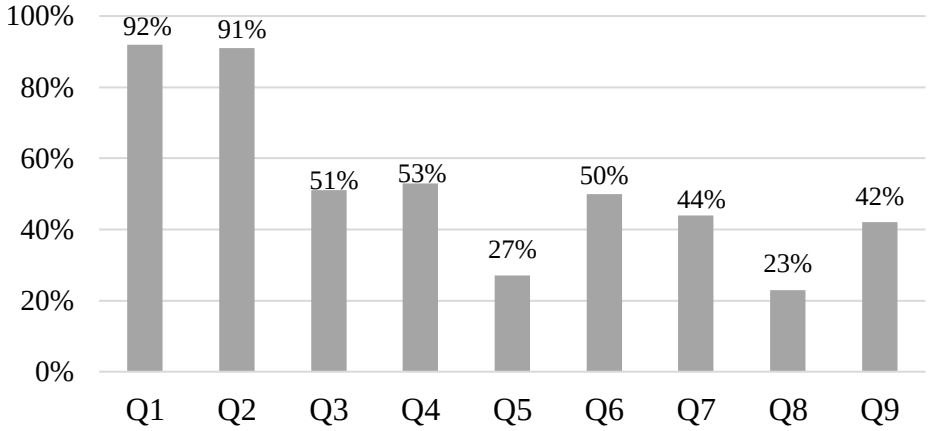
The structured questionnaire for graduates featuring close-ended questions was designed to obtain graduates' opinions on whether their studies adequately developed the skills needed for the labor market. The survey was conducted using a convenience sample of graduates. A total of 166 graduates from the FNM participated, including 94 from pedagogical study programs and 72 from non-pedagogical programs.

Graduates were inquired about whether their academic programs provided them with the necessary skills and competences in the following areas:

Q1) Critical thinking skills
Q2) Problem-solving skills
Q3) Energy-saving skills
Q4) Knowledge of energy sources
Q5) Understanding of energy policies
Q6) Awareness of climate change
Q7) Sustainability concepts
Q8) Circular economy
Q9) Energy efficiency

Most graduates felt that their study programs placed adequate emphasis on critical thinking and problem-solving skills. However, they expressed lower levels of confidence regarding their knowledge and skills related to energy literacy. For most of the other questions, graduates' responses were more divided. The lowest percentage of graduates who considered their competences sufficient were in the areas of Q5) understanding of energy policies and Q8) circular economy. Figure 1 presents the percentage of graduates who considered the knowledge and skills acquired during their studies to be sufficient for entering the labor market.

Figure 1: Perceived Sufficiency of Competences Acquired During Studies for Entering the Labor Market



Competency Framework in Energy Literacy, Green Transition, and Biodiversity

The proposed competency framework emphasizes the knowledge and skills that graduates in natural sciences, physics, and mathematics should acquire to foster energy literacy,

sustainability, and contribute to the green transition. It highlights the importance of key competences such as system thinking, which enables students to understand the interconnectedness of environmental, economic, and social systems; critical thinking, which empowers graduates to analyze complex issues, challenge assumptions, and make informed decisions; and problem-solving, which equips them to design innovative solutions for real-world challenges related to sustainability. Additionally, the framework stresses the significance of mathematical modeling as a tool for simulating and predicting the behavior of systems, aiding in decision-making processes for sustainable development. Furthermore, the framework fosters attitudes and awareness regarding the pressing issues of the "triple planetary crisis"—climate change, biodiversity loss, and pollution—encouraging graduates to be proactive, and solutions-oriented in their approach to these challenges.

The proposed competency framework consists of 12 specific competences organized into five thematic areas: System Thinking of Energy Systems, Biodiversity, Resource Management Skills, Technological Competence, and Policies and Regulation Awareness. The framework aims to guide the development of knowledge, skills, and measurable outcomes for students across three competences levels: Basic, Intermediate, and Advanced. For each of the 12 competences, we have developed descriptors that outline students' progression of knowledge and skills, ranging from foundational understanding (basic) to application and innovation (advanced). The descriptors for each thematic area are listed in Tables 1-5.

Table 1: System Thinking of Energy Systems Competences With Descriptors

Competence	*Basic*	*Intermediate*	*Advanced*
1.1 Understanding systems	Recognize the basic relationships, cause-effect relationships, feedback loops, and energy flows within environmental systems	Analyze relationships, cause-and-effect links within and between systems and use models (e.g., stock-flow diagrams) to understand system dynamics.	Plan and take part in problem-solving (e.g., using mathematical modelling), seek proposals, and design solutions that consider long-term sustainability (interdisciplinarity).
1.2 Understanding the concept of energy	Understand the basic physics concepts of energy, list renewable energy sources, know that solar energy is stored in fossil fuels and biomass.	Explain energy conversions, energy losses and the importance of different energy sources, explain the ways of generating electricity and knows that energy can be stored for later use in diverse ways.	Understand that different energy sources and different forms of energy conversion, transport and storage have their advantages and disadvantages, analyze the efficiency of energy systems and the impact on the environment (carbon footprint).

1.3 Understanding physical processes on earth driven by energy flows	Understand that the sun is a key energy source, and that an internal or external energy source is needed for the flow of matter on Earth.	Understand that energy flows change our planet and knows the most important energy sources for processes on Earth (solar, radioactivity, rotation).	Explain and critically assess the impact of greenhouse gases on energy flows and understand that changes in energy flows at the system-wide level are not at once detected.
1.4 Understanding biological processes on earth driven by energy flows	Know that the sun is the primary energy source for organisms and ecosystems, and that food is biofuel for organisms.	Understand that energy in food chains flows one-way from producers to consumers, know the response of ecosystems to the availability of energy and nutrients.	Understand how ecosystems respond to the availability of energy and nutrients and is aware of the dependence and influence of humans on energy flows through these systems.

Table 2: Biodiversity Competences With Descriptors

Competence	*Basic*	*Intermediate*	*Advanced*
2.1 Understanding biodiversity	Know the basic concepts of biodiversity and is aware of its importance.	Analyze the factors that affect biodiversity and link biodiversity with the energy efficiency of systems.	Formulate and implement strategies for the conservation of biodiversity.
2.2 Biodiversity management	Recognize the basic principles of biodiversity management (protected areas, etc.).	Apply biodiversity management practices in different contexts (species diversity in urban areas, etc.).	Plan and develop biodiversity management programs.

Table 3: Resource Management Skills Competences With Descriptors

Competence	*Basic*	*Intermediate*	*Advanced*
3.1 Sustainability of resource management	Understand the importance of conserving resources (water, energy, etc.).	Identify and apply measures for the sustainable management of resources (e.g., rainwater harvesting, waste management, circular economy).	Analyze and optimize sustainable resource management measures (life cycle analysis, carbon footprint quantification).
3.2 Efficient use of energy	Recognize the day-to-day activities that consume energy, know the basics of saving energy consumption and is aware that the need for energy is growing, and energy resources are limited.	Know that social and technological innovations have an impact on the amount of energy consumed by society, identify and implement energy efficiency measures, is aware of how much energy is used to conduct activities and where energy is obtained from.	Know and use approaches for calculating, measuring, and monitoring the amount of energy consumed, plan and develop methods for efficient use of energy and optimization of energy processes (e.g., in the energy efficiency of buildings, life cycle of buildings)-

Table 4: Technological Competences With Descriptors

Competence	*Basic*	*Intermediate*	*Advanced*
4.1 Understanding renewable energy technologies	Know the basic operation of renewable energy technologies.	Understand and analyze the operation of renewable energy technologies.	Plan and develop innovative solutions for the use of renewable energy sources.
4.2 Understanding green technology	Know the basic green technologies and their advantages (electric vehicles, sustainable materials, etc.). Know the concept of carbon footprint.	Understand basic green technologies and analyze their strengths and weaknesses (e.g., material life cycle analysis).	Plan, develop, and optimize green technologies.

Table 5: Policies and Regulations Awareness Competences With Descriptors

Competence	Basic	Intermediate	Advanced
5.1 Understanding policies	Understand basic environmental policies and regulations, is aware that decisions about the choice and use of energy sources affect the quality of life of individuals and society.	Explain the environmental policies that support the green transition and recognize that economic, political, environmental, and social factors influence decisions on the choice and use of energy sources.	Analyze and predict factors influencing decisions on the exploitation of energy resources, assesses risks, formulates the development of environmental policies at regional, national, or international level.
5.2 Green business	Understand the basics of green business and sustainable entrepreneurship.	Analyze examples of good practices in green business and sustainable entrepreneurship.	Plan and develop strategies for green business and sustainable entrepreneurship.

Students' Assessment of Competences

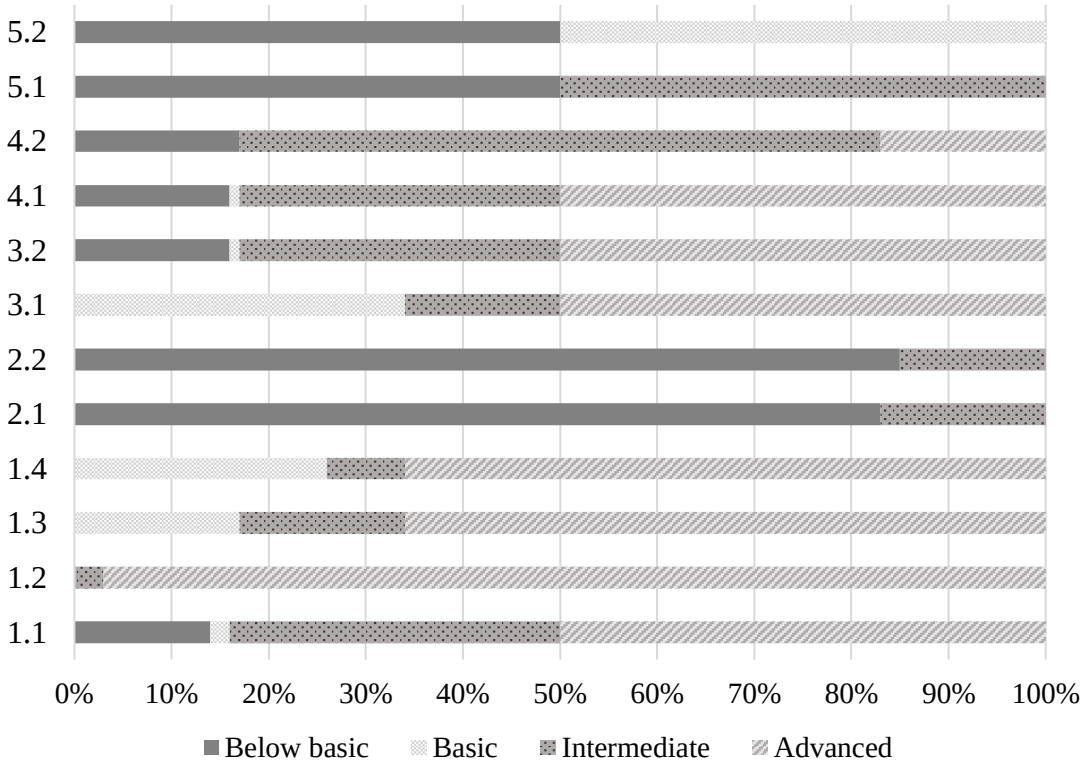
We applied the developed framework to assess the competences of physics and mathematics students at the FNM during the final years of their bachelor's studies. A total of seven students participated. Although the sample size is small, it represents 47% of the cohort. Our aim was to determine the competency levels students achieved based on their self-perceptions. To collect data, we used a close-ended questionnaire in which students evaluated specific competences using a Likert scale ranging from 1, meaning "strongly disagree," to 5, meaning "completely agree".

Table 6 presents the average values and standard deviations for each competence and its level. For clearer visualization, Figure 2 shows the percentage of students achieving basic, intermediate or advanced levels for each competence.

Table 6: Students Answer to Competence Level Using Likert's Scale From 1 (Strongly Disagree) to 5 (Completely Agree)

Competence	*Basic*		*Intermediate*		*Advance*	
	average	st. dev	average	st. dev	average	st. dev
1.1	4,3	0,8	4,0	0,6	3,5	0,5
1.2	5,0	0,0	4,8	0,4	4,7	0,5
1.3	4,8	0,4	4,2	0,8	4,0	0,9
1.4	4,7	0,5	3,8	0,8	3,8	1,2
2.1	3,0	1,3	2,7	1,4	2,2	1,3
2.2	2,2	1,6	2,0	1,3	1,8	1,0
3.1	5,0	0,5	3,7	1,5	3,5	1,0
3.2	4,5	0,8	4,3	0,8	3,5	1,0
4.1	4,5	0,8	4,2	0,8	3,5	0,5
4.2	3,8	0,8	4,3	0,8	2,2	1,3
5.1	3,1	1,7	2,8	1,7	1,5	0,8
5.2	3,0	1,5	1,5	0,8	1,5	0,8

Figure 2: Percentages of Students Achieving Basic (Light Gray), Intermediate (Gray-Dotted), or Advanced (Gray-Dashed) Level. The Percentage of Students Below Basic Level Is Presented With Darker Gray.



Students exhibit a strong performance in competences related to understanding energy systems, particularly at the Basic and Intermediate levels. For example, the competence "Understanding the concept of energy" (1.2) received near-perfect scores, indicating a solid grasp of fundamental concepts such as energy conversions, energy losses, and renewable energy sources. Similarly, students are confident in their understanding of renewable energy technologies (4.1) and the efficient use of energy (3.1 and 3.2). These findings suggest that the curriculum effectively imparts both foundational and practical knowledge about energy systems, an essential domain for addressing global challenges such as climate change and the green transition.

In contrast, the results reveal significant gaps in biodiversity-related competences (2.1 and 2.2), particularly at the Intermediate and Advanced levels. Students scored below 2.5 on average in these categories, indicating limited understanding of biodiversity management and the factors influencing biodiversity. Competences related to environmental policies (5.1) and green business strategies (5.2) also scored low across all levels, with particularly weak scores at the Advanced level. Students' limited confidence in these areas highlights a gap in their understanding of the socio-economic and regulatory frameworks that underpin sustainable practices.

Moreover, there is a noticeable decline in self-assessed competences at the Advanced level across most domains. This may reflect a lack of exposure to complex, interdisciplinary problem-solving or a lack of confidence in applying theoretical knowledge to real-world scenarios. Advanced competences, such as designing innovative solutions for renewable energy systems or optimizing resource management measures, require not only technical

expertise but also critical thinking, creativity, and collaborative skills. To bridge this gap, it is important to include experiential learning opportunities, such as capstone projects, internships, and collaborative research initiatives. These experiences can help students apply their knowledge in practical contexts, build confidence in their abilities, and develop the interdisciplinary skills needed to address sustainability challenges effectively.

Conclusion

In this study, we proposed a competency framework centered on natural sciences and mathematics studies, to equip students with the skills and knowledge they need to address global sustainability challenges and navigate and lead the green transition. The framework outlines twelve competences across five thematic areas: System Thinking of Energy Systems, Biodiversity, Resource Management Skills, Technological Competence, and Policies and Regulation Awareness. By structuring competences across three levels, the framework enables to track students' progress, from basic understanding to advanced innovation.

To assess the applicability of proposed framework, we administered a close-ended questionnaire to final-year bachelor's students. The findings reveal a strong foundation in some areas of energy literacy, but significant gaps in biodiversity competences, policy awareness, and green business knowledge. Given the importance of biodiversity for ecosystem resilience and sustainability, the limited understanding of biodiversity management among students is concerning. Additionally, the findings suggest that students face challenges at the advanced level, indicating a need for greater exposure to interdisciplinary problem-solving and real-world applications of theoretical knowledge.

To address these gaps, curricula should be revised to include biodiversity, energy policy frameworks, regulations, and their global impact. This could be achieved through the involvement of policy experts, policy simulation exercises, and collaborations with governmental and non-governmental organizations engaged in energy policy. Similarly, strengthening the teaching of circular economic principles would enable graduates to gain a more comprehensive understanding of sustainability practices. Universities could introduce case studies, real-world projects, and partnerships with companies that implement circular economy models. Encouraging students to take courses across disciplines, such as environmental science, economics, and engineering, would broaden their perspectives and enhance their competences in these areas. To ensure academic programs remain aligned with labor market needs, institutions should continuously gather feedback from both graduates and industry professionals. This feedback is essential for identifying areas that require improvement and for ensuring curricula remain responsive to the evolving demands of the workforce.

In conclusion, this study highlights both strengths and gaps in student competences and underscores the critical role of a comprehensive, interdisciplinary, and experiential approach to curriculum design. By addressing gaps in energy literacy, biodiversity, policy awareness, and advanced-level skills, study programs can better prepare graduates to contribute effectively to sustainability initiatives and the green transition.

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A Development of Training Curriculum to Create Instructional Innovation According to an Active Learning Approach for Teachers in Phayao Schools

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Abstract
The Thai education system is currently emphasizing the development of "competencies" in order to provide students with the necessary skills to adapt to the ever-changing demands of modern society. Therefore, teachers must modify their instructional approaches to incorporate active learning. Therefore, the purpose of this study is to develop a training curriculum for teachers in Phayao schools that incorporates an active learning approach. Additionally, it aims to investigate the cognitive outcomes of teachers using educational innovations based on an active learning approach, to examine teaching process skills, and to assess the satisfaction of teachers who have implemented the previously developed training curriculum. The research sample consisted of teachers from Phayao schools in the 2023 academic year, selected through cluster random sampling from a random group (N=176), which included a total of 35 teachers. The training curriculum, teachers' cognitive outcomes pre- and post-tests, a teaching observation form, and a satisfaction evaluation form collected the data. The data were statistically analysed using the relative gain GS (%), average, and standard deviation. The results revealed that teachers who received the development through training curriculum had an average relative gain of 75, developed strong learning management abilities, and were predominantly satisfied with this method. The results show that the introduction of this training curriculum facilitates the application of “active learning” for teachers.

Keywords: Training Curriculum, Innovator Teachers, Active Learning Approach, Learning Achievement

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Introduction

The training curriculum development is a process of planning learning activities in order for people to change the behaviour of personnel to see whether they have achieved their aims and objectives or not, so that those responsible will gain the knowledge required to find the proper solutions and continue to improve. Training will help refresh previous knowledge and obtain new information along with an exchange of opinions and experiences. Causing each individual to develop higher abilities (Pareek & Roast, 1980) as in training, there must be a training course, which is a program that compiles knowledge and experience to provide to the individual. Access to training has changed according to the stated objectives (Koson et.al, 2013). English teachers used knowledge management processes and develop competencies in creating a curriculum for young local tour guides, and was found that in the trial of the training curriculum development: 1) According to the findings, teachers had a greater understanding of training principles than before the training, 2) Teachers have skills in curriculum preparation higher than 75 percent, which is a good level for all competencies. 3) Teachers have higher attitudes towards curriculum preparation after training than before. All are statistically significant at the .01 level.

Active learning is an instructional method in which students are encouraged to engage in learning activities to create understanding by connecting learners with factual knowledge, concepts, and skills through activities in which learners' practice and engage in a process of thinking, researching, seeking knowledge, reflecting, discussing exchanging opinions, and (Think Hard) about what they have done. Learners are therefore important players in creating methods for learning on their own (Office of the Basic Education Commission, 2017).

The Phayao Provincial Education Office is an educational institute responsible for overseeing, promoting, and supporting education at all levels. It coordinates and cooperates with all agencies in Phayao Province and is responsible for the administration. It promotes and supports education in private schools in Phayao Province. They saw the importance of teacher development and gave importance to teacher development training in the form of self-development by using the classroom as a space for developing teaching and learning arrangements. With a team of experts that provide support, guidance, help and encouragement in the performance of work, in accordance with Mahawong (2022), who studied the current conditions and needs of private teachers for receiving assistance and support from educational supervisors from the Phayao Provincial Education office as its highest priority is to provide technical support and teaching methods, and media production and innovation development.

Research Questions

In this study, the following research questions were used: 1. What are the needs of teachers in carrying out their duties, including their teaching work? 2. Should the curriculum follow the training needs of teachers, include evaluation for quality, and be useful to the teachers in their daily work? 2.1 Does the training course include the components where problems experienced by teachers may be addressed? 2.2 Is the quality and relevance of the training curriculum is appropriate? 3. Is the course syllabus effective in meeting the needs of the teachers? 3.1 Is the teachers' knowledge of the subject sufficient? 3.2 Are the teacher' able to organize and manage their teaching and learning innovations 3.3 Is the quality of the learning management innovations sufficient? 3.4 What are the achievements of the students in the

class? 3.5 Were the participants in the training course satisfied with their attendance of the course?

Objectives

1. To analyse the essential requirements in the training curriculum
2. To enhance the calibre of the training curriculum, inclusive of:
    2.1 To analyse the constituents of the training curriculum
    2.2 To examine the quality of the training curriculum
3. To study the effectiveness of the training course, consisting of:
    3.1 Teachers' knowledge and understanding in creating learning management innovations
    3.2 The ability to organize teaching and learning using learning management innovations
    3.3 Quality of learning management innovations
    3.4 The academic achievements of students in the class
    3.5 The satisfaction of the teachers who participated in the training course

Methodology

The research and development process are carried out in three steps:

Step 1: Needs Assessment Study

The study of the problems and needs necessary to develop the innovator teachers training curriculum to create instructional innovation according to an active learning approach to enhance learning achievement.

The population used in this stage of the study includes 328 teachers teaching at the basic education level in private educational schools in Phayao Province.

The sample group used in the research is comprised of teachers in private schools in Phayao province that provide basic education to students. Using a questionnaire of 176 people, the sample was defined using a table (Chiagchee as cited in Srisuk, 2009) at a 95% confidence level and stratified samples, using the school as a random layer.

Research Instrument

The questionnaire of the problems and needs necessary of the teachers to create instructional innovation according to an active learning approach to enhance learning achievement. It has been examined by 5 experts to check content validity. All questions in the questionnaire can be used. Index of item objective congruence (IOC) as between 0.60-1.00 and the questionnaire was tested with 30 teachers who were not in the sample group for this research to find the reliability of the entire questionnaire using the Cronbach alpha coefficient method. It was found that the reliability of the entire questionnaire was 0.86.

Data Collection

The researcher sent the questionnaire to the Faculty of Private Education. Under the jurisdiction of the Phayao Provincial Education Office to send questionnaires to all schools that provide basic education in private schools in Phayao Province.

Data Analysis

The researcher identified needs (Need identification) using the Modified Priority Needs Index (PNI modified) formula. Using the Likert Scale, the expected level of each item was set to be equal to 5, which is the maximum. Prioritizing needs is high. They require more development attention than less valuable indices. The criteria for considering the PNI modified index with a value of 0.30 or higher is considered an urgent need that must be developed.

Step 2: Training Curriculum Development

The researcher studied relevant documents and research on teacher development and training. Training curriculum development process, approach of creative instruction innovations, enhance academic achievement and the theory of constructivism. A synthesis of documents was also done, including information obtained from studying the basic information in step 1, obtained from inquiries to determine details according to the structure of the training curriculum. A synthesis of information obtained from documentary studies, and related research, with information obtained from studies of teacher needs, which was derived from step 1 to determine the content structure of the training curriculum.

Research Instruments

Two draft training curricula quality assessment forms, consisting of:

1. An assessment form on the suitability of the draft training curriculum: It is a 5-point rating scale with 25 items and has open-ended questions to allow experts to provide additional feedback by checking the suitability of the following items 1) principles, 2) aims, 3) scope of content, 4) training activities, 5) learning materials and resources, 6) supervision and motoring follow up 7) Measurement and evaluation.
2. An assessment form for consistency of the draft training curriculum. It has 10 items and has open-ended questions to allow experts to provide additional feedback.

Data Collection

The researcher prepared a letter to 9 experts requesting assistance in inspecting the quality of the training curriculum to assess the appropriateness and consistency of the training curriculum. Through sending evaluation documents by mail to experts and scheduling appointments to critique draft training courses in an online forum.

Data Analysis

Data analysis was collected from two quality assessment forms of the training curriculum draft and analysis in average form ($\overline{X}$) and standard deviation (S.D.) In terms of additional suggestions from the open-end form questionnaire, a content analysis method was used.

Step 3: Study on the Effectiveness of the Training Curriculum

One group pre-test / post-test was designed and applied in this study consisting of the following:

1. The population used in this stage of the study includes 328 teachers and 6,385 students from 18 private schools in Phayao province in 2023.
2. The sample groups are composed of 35 teachers. The participants volunteered to attend on their own. By giving a quota of 2 teachers per school, holding majors in science, mathematics, Thai language, foreign language (English), or social science. There were 795 students who learn from the teachers.

Research Instrument

1. The innovator teachers training curriculum to create Instructional innovation according to active learning approach to enhance learning achievement of private schools in Phayao province.
2. The test examines the knowledge and understanding of learning management innovations according to the active learning approach: 25 multiple choice questions multiple choice.
3. The evaluation form of teaching ability uses innovative learning management according to the active learning approach. It is a check of items on a 3-level rating scale with 8 items.
4. The satisfaction assessment form for using the training curriculum in 3 areas, totalling 28 questions, is a 5-level rating scale.

Data Collection

There are three phases in this process:

In the first phase, teachers received training with expert lecturers providing knowledge and practice in a conference room.

In the second phase, teachers apply learning innovations based on the active learning approach to teaching in schools. Supervisors visit the schools to provide materials and other aid including advice for preparing teaching materials. In this step, teachers' performance is monitored both online and on-site. Teachers were assessed on their teaching behaviour, and students were tested on their knowledge before and after class.

In the third phase, teachers display their work in a symposium. Teachers were tested on their knowledge. All teachers' learning management innovations are evaluated and receive feedback. Awards are given for outstanding performances, and teachers assessed their satisfaction with the use of the training curriculum developed by the researcher.

Data Analysis

Analyse the relative scores of the test of knowledge and understanding of learning management according to the active learning management approach. Before and after receiving training, use the relative development score (Relative Growth: RG) using the formula of Kanjanawasee (cited in Ruangtrakul, 2003) and interpreting the meaning of the score.

Analyse the ability to organize learning according to the active learning approach and the quality of the learning management innovation according to the active learning management approach by finding the average ($\overline{X}$) of the evaluation of the educational supervisors.

Analyse satisfaction with the innovator teacher training course in creating innovative learning management according to the active learning approach to raise academic achievement. By finding the mean ($\overline{X}$) and standard deviation (S.D.) and analysing them using SPSS and interpreting them against the specified criteria.

The training curriculum will be revised and improved based on expert recommendations, and findings from the training curriculum will be disseminated and expanded upon.

Results

The results of the study showed that:

1. The results of the needs analysis are necessary to develop a curriculum to train teachers of innovators in creating innovative learning management based on an active learning approach to enhance the learning achievements of private schools in Phayao Province. It was found that the essential demand index is between 0.37 and 1.73, with the list of essential needs in descending order being the choice and creation of multimedia media, such as videos, applications for learning management (1.73), the development of multimedia and video applications for learning management (1.67), and the selection of innovative learning management techniques and methods of solving the problem of learning management (1.03), respectively.
2. The results of the developed curriculum to train teachers of innovators in creating innovative learning management based on an active learning approach to enhance learning achievement of private schools in Phayao Province.
    2.1 The training curriculum consists of 7components: 1) the principles of the curriculum, 2) the aims of the course, 3) the structure of the content and course, 4) the training activities, 5) the media and learning resources, and 6) supervision. 7) Assessment.
    2.2 Evaluation outcomes of the innovator teacher training curriculum to create instructional innovation according to an active learning approach to enhance learning achievement of private schools in Phayao province. The evaluation of the overall suitability of the draft training curriculum has achieved the highest average level ($\overline{X}$=4.61, S.D. 0.48) .The highest average aspect was the training activities ($\overline{X}$=4.87, S.D. 0.35), followed by media and learning resources ($\overline{X}$=4.85, S.D. 0.36) and the principles of the training courses ($\overline{X}$=4.81, S.D. 0.50), which were equal to the aims of the training courses ($\overline{X}$=4.81, S.D. 0.40), respectively. And the evaluation of the overall consistency of the draft training curriculum has achieved the highest level ($\overline{X}$=4.59, S.D. 0.46). The highest average aspect was the need to develop a training course with the content structure of the training ($\overline{X}$=4.85, S.D.=0.55), followed by the aim of the training with the content structure of the training. It has an average value of ($\overline{X}$=4.83, S.D.=0.47) and the aim of training with training activities ($\overline{X}$=4.74, S.D.=0.71), respectively.

The Effectiveness of the Experiment

Cognitive outcomes in creating innovative learning management based on active learning approaches to raise academic achievement to a high-level multiple choice the relative development score is 75.

The assessment results of learning management ability according to the active learning approach to enhance learning achievement by assessing from two educational supervisors has achieved the high average level ($\bar{x}$=4.58), using media and learning resources ($\bar{X}$=4.58), followed by learning management design ($\bar{X}$=4.56) and learning management ($\bar{X}$=4.51), respectively.

The efficacy of instructional innovation according to enhance learning achievement of 33 teachers. It was determined that 7were of high quality while the remaining 26 met the standard criterion.

Results from evaluating teachers' satisfaction with the training curriculum to create instructional innovation according to an active learning approach to enhance learning achievement. Overall, it is at the highest level. The highest average was inputs ($\bar{X}$=4.82, S.D.=0.47), followed by output ($\bar{X}$=4.71, S.D.=0.49) and process ($\bar{X}$=4.70, S.D.=0.44), respectively.

Conclusion

This training formula has been developed through a thorough development process. Teacher training has been proven to be really effective, in raising the level of academic achievement. Teachers are satisfied with the use of the developed training curriculum. Suggestions for applying research results:

When planning on-site training, organizers need to plan beforehand. This is due to the fact that the training combines both classroom instruction and practical application. It could take a while to finish each task. As such, effective time management and the team of lecturers' support are critical.

The atmosphere used in organizing activities must be conducive to learning. Motivate teachers to participate in training and have materials and equipment ready for all trainees to practice.

In supervising and following up on the teaching and learning arrangements of teachers, in order to achieve comprehensive results, educational supervisors should coordinate with the school's principal or academic supervisor to participate in supervising, monitoring, and evaluating learning activities.

Trainees must use technological media at a standard level in order to get a sample group that is suitable for competency development.

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Enhancing 3C Skills Through Generative AI and Metaverse in Higher Education: An Innovation Project

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Abstract
This study investigates an innovative educational project aimed at enhancing university students' critical thinking, collaboration, and communication (3C) skills through the integration of Generative Artificial Intelligence (AI) and Metaverse. Conducted at a Japanese university, the project planned and implemented by five professors from three different faculties of the university brought together students from the three faculties to collaboratively address social issues using cutting-edge digital tools. The research adopted a mixed-methods approach with pre- and post-project surveys and focus group interviews to investigate whether they perceived they had improved the 3C skills. The results of the analysis of the surveys and interviews showed that the students perceived an improvement in their 3C skills. They perceived that they had demonstrated enhanced capabilities in presenting structured arguments, engaging in complex discussions, and delivering impactful presentations. This research underscores the potential of these emerging technologies to prepare students for the demands of the modern workforce by fostering essential skills in problem-solving, teamwork, and digital communication. The findings contribute to the growing body of knowledge on technology-enhanced education, offering valuable implications for educators and policymakers. Future iterations aim to refine instructional approaches, expand international collaboration, and explore the long-term impacts of technology integration on higher education outcomes.

Keywords: Critical Thinking, Collaboration, and Communication (3C) Skills, Generative AI, Metaverse

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Introduction

The rapid evolution of digital technologies has profoundly transformed how individuals learn, communicate, and collaborate. In the realm of education, these advancements present unique opportunities to address long-standing challenges in skill development, particularly in fostering communication, collaboration, and critical thinking (3C) skills. These competencies are increasingly vital in a globalized and interconnected workforce that demands effective interdisciplinary problem-solving and adaptable communication strategies. Despite their importance, traditional educational methods often fall short of adequately preparing students in these areas.

Conventional classroom settings are frequently constrained by rigid structures that prioritize theoretical knowledge over practical application. Students are seldom exposed to real-world challenges requiring dynamic problem-solving, and opportunities for cross-disciplinary collaboration are often limited. These limitations create a gap between academic learning and the practical demands of modern professional environments. Generative Artificial Intelligence (AI) and Metaverse are two cutting-edge technologies with the potential to redefine educational practices. Generative AI, represented by tools like ChatGPT, enables interactive and personalized learning experiences, offering resources for creative problem-solving and adaptive content delivery. The Metaverse, a network of immersive virtual environments, facilitates collaboration and interaction beyond the constraints of physical space, fostering engagement and experiential learning. Together, these technologies provide powerful tools to enhance education, particularly in developing 3C skills.

This study explores the integration of Generative AI and Metaverse into higher education through a structured framework designed to cultivate students' 3C skills. Focusing on university students engaged in an interdisciplinary project addressing real-world social issues, the study examines how the project helped the students improve 3C skills. This paper details the design and implementation of this innovative project, analyzes its impact on students' 3C skill development, and discusses its implications for future educational practices.

Generative AI, defined as a deep learning technology capable of creating human-like content in response to various prompts (Lim et al., 2023), represents a transformative advancement in educational technology. ChatGPT-4, developed by OpenAI, exemplifies this innovation through its capacity to process and generate content across multiple modalities, including text, audio, image, and video (OpenAI, 2024). This capability has paved the way for unprecedented opportunities in personalized learning and skill development. Tools such as ChatGPT can function as virtual tutors, study aids, and assessment tools, providing students with immediate feedback and tailored support (UNESCO, 2023). Recent research highlights the pivotal role of Generative AI in fostering collaborative and task-based learning environments. Sako (2024) demonstrated that AI-assisted collaborative language learning enhances critical thinking by encouraging students to analyze, synthesize, and present ideas effectively. Similarly, Ruiz-Rojas et al. (2024) found that Generative AI tools enhance team-based problem-solving and foster deeper engagement in higher education contexts. These tools facilitate collaborative learning by adapting to diverse educational needs and promoting student-driven inquiry. Generative AI has also shown promise in integrating into project design and collaborative processes.

Metaverse, defined as the convergence of virtual reality (VR) and augmented reality (AR) technologies enabling multimodal interactions with virtual environments, digital objects, and

people (Mystakidis, 2022), has emerged as a transformative platform in education. Meta (2022) envisions Metaverse as a space that allows individuals to "socialize, learn, collaborate, and play in ways that go beyond what we can imagine." Its immersive environments offer students interactive and experiential learning opportunities that promote collaboration and creativity. Metwally et al. (2024) emphasized Metaverse's potential to facilitate project-based learning, where students work collaboratively to solve complex challenges. By providing a shared virtual space, Metaverse enables seamless interaction, fostering teamwork and critical thinking. Onu, Pradhan, and Mbohwa (2024) highlighted Metaverse as an advanced educational platform, emphasizing immersive environments that enhance engagement and collaboration. Metwally et al. (2024) further explored how Metaverse enables collaborative, project-based learning while promoting creativity and critical thinking through team-based initiatives.

Although the potential of integrating Generative AI and Metaverse has been discussed in recent studies, no research has specifically examined an interdisciplinary group project in which university students from different departments collaboratively explore how these technologies can be used to solve real-world issues and present their ideas. Additionally, no study has investigated the impacts of such projects on students' communication, collaboration, and critical thinking (3C) skills. Therefore, this study examines whether an interdisciplinary group project, where students consider how Generative AI and Metaverse can be utilized to address societal challenges, can enhance their 3C skills.

Methods

This study adopted a mixed-methods approach to investigate the integration of Generative AI and Metaverse technologies into higher education and their impact on students' communication, collaboration, and critical thinking (3C) skills. The methods section outlines the project design, participant recruitment, and data collection and analysis procedures. Quantitative data from questionnaires measured skill development, while qualitative insights from focus group interviews explored students' experiences and challenges. This approach ensured a comprehensive evaluation of the project's effectiveness in fostering interdisciplinary collaboration and enhancing 3C skills.

Project Background and Design

In today's rapidly evolving digital society, it is essential for university students to acquire a deep understanding of cutting-edge technologies such as Generative AI and Metaverse, not only to enhance their academic development but also to prepare them for future societal roles. Additionally, cultivating students' competencies in communication, collaboration, and critical thinking (3C) skills is essential for their success in a globalized world. To help students acquire knowledge about the latest technologies, such as Generative AI and Metaverse, and to develop 3C skills, five professors from three different departments at a private university in Japan have initiated a project. In this project, students from the three departments work collaboratively in groups to discuss how Generative AI and Metaverse can be used to solve global problems. This interdisciplinary approach also addresses the challenge of limited opportunities for interdisciplinary collaboration and skill-building among students at our university, which has campuses spread across different locations. Furthermore, the project incorporates global perspectives by engaging students in collaborative projects with international peers, thereby enhancing their English communication skills and preparing them for leadership roles in a globalized world.

The project is conducted in two phases. Phase 1, from March to July 2024, involved Japanese university students from the three departments. These students worked in interdisciplinary teams to design solutions to social issues using Generative AI and Metaverse technologies. This phase culminated in a competitive ideathon where teams presented their ideas and received expert feedback. The ongoing Phase 2 extends the project to include international collaboration with a U.S. university. Cross-cultural teams have been formed to address global challenges, designing solutions to social issues using Generative AI and Metaverse technologies. This phase also features an ideathon where teams present their solutions and engage in peer-to-peer learning. This paper will focus on Phase 1.

Participants of the Study

To recruit students from the three departments, a brochure about the project was created and shared through a Learning Management System as well as distributed by the five faculty members. Initially, 34 students from the three departments applied for the project. Since the expected number of participants was approximately 35, all applicants were selected. The 34 students were divided into six groups. However, one group did not function well because all its members were too busy. Consequently, the remaining five groups, comprising 27 students, continued to work on the project and participated in the ideathon.

Data Collection and Analysis

A mixed-methods approach was used to evaluate the project of Phase 1. To investigate whether the project contributed to improving the participants' communication and collaborative skills, a questionnaire survey was conducted. A focused group interview was also conducted to explore whether the project helped them improve communication, collaborative and critical thinking skills. In this section, first, the data collection of the questionnaire and its analysis is explained. Following that, the data collection of the interview and its analysis is provided.

Data Collection and Analysis of the Questionnaire. The questionnaire on Communication and Collaboration skills was developed with reference to the Common European Framework of Reference for Languages (CEFR) Companion Volume (Council of Europe, 2020). The Can-Do descriptors used as a reference covered B1 to C2 levels, focusing on sustained monologue, informal discussion, formal discussion, goal-oriented online transactions and collaboration, online conversation and discussion, and addressing audiences.

For sustained monologue, the B1 and B2 levels were referenced. For example, at the B2 level, learners "can develop an argument systematically with appropriate highlighting of significant points, and relevant supporting detail." In terms of informal discussion, the B2 and C1 levels were included. At the B2 level, participants "can take an active part in informal discussion in familiar contexts, commenting, putting a point of view clearly, evaluating alternative proposals and making and responding to hypotheses." For formal discussion (meetings), the B2 level was referenced. For example, individuals at this level "can keep up with an animated discussion, identifying accurately arguments supporting and opposing points of view." Regarding goal-oriented online transactions and collaboration, the B1 to C1 levels were included. At the B2 level, they "can collaborate online with a group that is working on a project, justifying proposals, seeking clarification and playing a supportive role in order to accomplish shared tasks." For online conversation and discussion, the B2 and C1 levels were referenced. At the B2 level, learners "can engage in online exchanges between several

participants, effectively linking their contributions to previous ones in the thread, provided a moderator helps manage the discussion." Finally, for addressing audiences, the B2 to C2 levels were referenced. At the B2 level, speakers "can give a clear, systematically developed presentation, with highlighting of significant points, and relevant supporting detail."

A five-point Likert scale with 5=strongly agree, 4=agree, 3=neither agree nor disagree, 2=disagree, and 1=strongly disagree was used for both a pre- and post-questionnaire. For the questionnaires, 25 students answered the pre-questionnaire, and 24 students answered the post-questionnaire.

Data Collection and Analysis of the Interviews. To investigate whether the project helped promote participants' communication, collaboration, and critical thinking skills, a focused group interview was conducted with the five groups. The interviews followed a semi-structured format, including both prepared and additional questions related to these three skill domains.

For example, in the communication domain, participants were asked, "How were you able to communicate effectively with students from other faculties?" and "What specific measures did you take to ensure smoother interactions during online meetings?" In the collaboration domain, questions included, "How did your team divide roles and cooperate throughout the project?" and "What specific strategies or approaches were particularly helpful when brainstorming ideas as a team?" Additionally, to examine online collaboration, participants were asked, "What efforts or measures did you take to ensure that all team members actively participated in the online environment?" For the critical thinking domain, participants were prompted with questions such as, "Through the preparation and progress of the ideathon, what changes occurred in your way of thinking?" and "How did you deepen your own thoughts or experience situations where you accepted others' opinions?"

The semi-structured format was chosen for its balance between structure and openness, allowing for consistent data collection across groups while also providing flexibility to explore unexpected yet relevant themes that emerged during the interviews (Gillham, 2005). This approach provided a comprehensive understanding of how the project influenced the development of communication, collaboration, and critical thinking skills.

Following the interviews, the data were analyzed with a specific focus on critical thinking skills. While questions related to communication and collaboration provided valuable context for understanding the broader team dynamics, the analysis of this study focuses on identifying themes and patterns that demonstrated growth in participants' critical thinking abilities.

Thematic analysis was employed to categorize and interpret the data, with particular attention given to participants' reflections on how their thought processes evolved throughout the project. The analysis utilized a combination of content analysis and thematic analysis to systematically examine both the manifest content of the reflections and uncover recurring themes. As Kvale and Brinkmann (2009) explain, "Content analysis is a technique for a systematic quantitative description of the manifest content of communication" (p. 203). Key aspects examined included the ability to evaluate diverse perspectives, the integration of feedback, and evidence of higher-order thinking such as analysis, synthesis, and evaluation. By combining the structured nature of content analysis with the depth of thematic analysis,

the study was able to capture both the explicit elements of participants' responses and the underlying themes that signified growth in critical thinking skills.

Results

In this section, the findings from the study are presented in two parts. First, the results of the questionnaire are analysed to evaluate the measurable improvements in participants' self-assessed communication and collaboration skills. Then, the insights derived from focus group interviews provide a qualitative understanding of the development of critical thinking abilities.

Results of the Questionnaire

The results of the questionnaire analysis demonstrate statistically significant improvements in communication and collaboration skills following the intervention. This section presents an overall comparison of pre- and post-questionnaire scores, detailed item-specific findings, and an analysis of effect size.

The mean score for the pre-questionnaire was 2.97, which increased to 3.27 in the post-questionnaire, reflecting a mean difference of 0.30. The effect size, as measured by Cohen's d, was 0.67, indicating a medium effect size. This suggests that the observed improvements are both statistically significant and practically meaningful. A paired t-test analysis revealed a p-value of 0.023, indicating that the improvement in participants' self-assessed skills is unlikely to have occurred due to random variation.

A closer examination of individual questionnaire items highlights significant improvements across multiple areas. Table 1 summarizes the items with statistically significant differences between the pre- and post-questionnaire scores, along with their corresponding p-values. For instance, Item 1 ("I can present organized arguments by clearly identifying the main points") shows a mean difference of 0.42 (p=0.012), while Item 26 ("I can give well-prepared and clear presentations, explain specific viewpoints, and discuss the pros and cons of various options") shows a mean difference of 0.41 (p=0.005).

Table 1: Statistically Significant Items in the Questionnaire

Items	Pre-Mean	Post-Mean	Mean Difference	P-Value
1. I can present organized arguments by clearly identifying the main points.	2.96	3.38	0.42	0.012
3. I can briefly explain the reasons for my opinions.	2.88	3.25	0.37	0.037
4. I can participate in and contribute to complex discussions with other participants in group discussions, even on abstract and difficult topics.	2.80	3.29	0.49	0.018
7. I can accurately express my ideas and opinions and persuasively explain and respond to complex arguments.	2.76	3.25	0.49	0.023
10. I can effectively participate in online discussions about complex and abstract issues by asking for or providing further details as needed.	2.84	3.29	0.45	0.015

14. I can participate in online collaboration and provide clear instructions to achieve objectives.	2.88	3.29	0.41	0.047
19. I can use visual materials to communicate with project partners or small groups online and explain complex concepts in an easy-to-understand way.	2.84	3.25	0.41	0.017
21. I can confidently and clearly explain complex topics to listeners who may lack prior knowledge	2.72	3.12	0.40	0.033
22. I can give clear and well-structured presentations on complex topics, using supporting points, reasons, and relevant examples.	2.92	3.23	0.41	0.020
26. I can give well-prepared and clear presentations, explain specific viewpoints, and discuss the pros and cons of various options	2.92	3.33	0.41	0.005

In summary, the intervention enhanced participants' self-assessed communication and collaboration abilities. Improvements were observed across a range of areas, including the ability to present arguments, participate effectively in discussions, collaborate online, and deliver structured presentations. These results underscore the positive impact of the intervention in achieving its objectives.

Results of the Focused Group Interviews

To evaluate the development of critical thinking skills among participants, focused group interviews were conducted following a semi-structured format. This method combined pre-prepared questions with spontaneous follow-ups and the interviews were analyzed using a combination of thematic and content analysis. The analysis revealed three main themes related to critical thinking development: incorporating new perspectives, preparation through research and understanding challenges, and improving critical thinking habits. Each theme is detailed below, supported by participants' direct quotes.

Incorporating New Perspectives. One of the key outcomes was the participants' ability to broaden their perspectives through interactions with peers and external experts. The questions designed for the interviews specifically prompted reflections on how participants integrated diverse opinions into their thought processes, which revealed notable growth in their critical thinking.

> During the presentation, there were individuals in other teams who had experienced school absenteeism, and one of the Microsoft persons also shared her personal experience of school absenteeism. This kind of feedback, based on real-life experiences, provided insights that I could not have discovered on my own or through online research. It allowed me to incorporate new perspectives. (Group B)

> There were moments when my way of thinking changed through discussions with other group members. For instance, we investigated supporting information and incorporated new perspectives to enhance the feasibility of our claims and ideas. (Group C)

These insights demonstrate how participants gained new perspectives through collaboration, which enriched their understanding of complex issues and informed their decision-making.

Preparation Through Research and Understanding Challenges. Another major theme was the role of research and problem-solving in fostering critical thinking skills. Interview questions targeting the preparation phase of the ideathon uncovered participants' reflections on how they identified and addressed challenges through in-depth analysis and evidence gathering.

> With the theme of the metaverse and AI, I had never worked on such business or idea generation projects before. As a result, I feel that my critical thinking skills in this field significantly improved. (Group B)

> I learned to understand and focus on the limitations of Generative AI, such as its opacity and black-box nature, recognizing these as significant issues to address. (Group C)

> When presenting our ideas, we decided to include legal and technical issues during Phase 1. We managed to incorporate supporting facts and evidence to address these challenges. (Group D)

These examples illustrate how participants engaged in research to deepen their understanding of critical issues, evaluate potential solutions, and refine their approaches, all of which contributed to the development of critical thinking.

Improving Critical Thinking Habits. The interviews also highlighted participants' ability to cultivate habits that supported critical thinking. Questions focusing on shifts in participants' thought processes revealed progress in their ability to critically evaluate their ideas, balance competing considerations, and adopt more analytical approaches to decision-making.

> By listening to various opinions, I became able to critically evaluate my own ideas, such as recognizing risks or flaws in my thinking. (Group A)

> Rather than focusing solely on the positive aspects, I developed the ability to consider problems critically, allowing for more balanced and rational decision-making. (Group C)

> I developed the habit of staying calm and not focusing solely on the positive aspects, which allowed me to think more critically. (Group D)

These reflections underscore how participants improved their capacity for higher-order thinking by challenging their assumptions, integrating feedback, and adopting a more reflective approach to decision-making.

Summary of the Interview. The use of semi-structured interviews allowed for a comprehensive exploration of participants' experiences, capturing both structured responses and unexpected insights into their critical thinking development. The combination of thematic and content analysis revealed three distinct dimensions of growth: incorporating diverse perspectives, leveraging research to address challenges, and cultivating critical thinking habits. These findings demonstrate how the ideathon project provided a conducive environment for fostering critical thinking, equipping participants with skills relevant to collaborative and real-world problem-solving.

Discussion and Conclusion

This study investigated how integrating Generative AI and Metaverse technologies into an interdisciplinary educational project contributed to the development of students' communication, collaboration, and critical thinking (3C) skills. The results demonstrated measurable improvements in participants' communication and collaboration abilities, as evidenced by statistically significant increases in their self-assessed skills following the intervention. Participants reported enhanced abilities to articulate arguments, present ideas clearly, and engage in online collaboration effectively.

Focus group interviews revealed significant development in participants' critical thinking skills, a central objective of the project. Participants described how engaging with diverse perspectives deepened their understanding of complex issues and informed their decision-making. These reflections support the findings of Sako (2024) and Ruiz-Rojas et al. (2024), who emphasized the importance of collaborative environments in fostering critical engagement. Participants also demonstrated their ability to analyze and address challenges, such as incorporating technical and legal considerations into their project ideas. Furthermore, participants noted improvements in reflective habits, such as questioning assumptions, critically evaluating ideas, and balancing competing viewpoints. These habits, essential for cultivating higher-order thinking, were evident in participants' ability to identify and address weaknesses in their reasoning. The project also facilitated interdisciplinary collaboration, allowing participants to effectively divide roles, manage online teamwork, and incorporate feedback from team members and external experts. Through this project, participants engaged in conceptualizing how Generative AI and Metaverse could be applied to address societal challenges. This reflective process encouraged creativity and critical analysis, demonstrating the value of envisioning technological applications.

This study has several limitations. First, the findings are based on self-reported data from participants, which may introduce biases such as overestimation of their skills. Additionally, while the study explored the potential of Generative AI and Metaverse, the analysis did not include an in-depth exploration of how participants' knowledge of these technologies evolved during the project, even though related data were collected in the interviews. Addressing these gaps in future analyses could provide a more comprehensive understanding of the learning process.

Future research will address these gaps and expand on the findings. The next phase of this project (Phase 2) includes the participation of university students from the United States, fostering a more diverse and international collaboration. The ideathon will also be conducted in English, enabling us to examine improvements in English communication and international collaboration skills. These new dimensions provide an opportunity to explore how language and cross-cultural interactions influence the development of 3C skills. Longitudinal research is also needed to investigate the sustained impact of such interventions on students' professional competencies and their adaptability to dynamic technological and collaborative environments.

This study highlights the transformative potential of combining Generative AI and interdisciplinary collaboration to enhance essential 21st-century skills. By encouraging students to conceptualize how these technologies could address real-world challenges, educators can create learning experiences that bridge theoretical knowledge and practical application. This approach fosters interdisciplinary collaboration, critical thinking, and

reflective learning, preparing students for the complexities of a globalized, technology-driven workforce.

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Effective Prompts for EFL Writers: Leveraging ChatGPT for Writing Aid

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The IAFOR International Conference on Education in Hawaii 2025
Official Conference Proceedings

Abstract
Generative AI tools like ChatGPT have significantly influenced teaching and learning since their release in late 2022. Over the past two years, educators have explored ways to integrate these tools into classrooms. Among these efforts, crafting effective prompts—targeted commands to optimize ChatGPT's responses—has proven key to improving students' academic writing skills. Drawing from four semesters of experience teaching ChatGPT-integrated EFL writing to undergraduates in Tokyo, this paper highlights 1) how ChatGPT supports the writing process, and 2) specific prompts that enhance EFL academic writing. Additionally, it addresses academic integrity challenges and introduces practical motivational strategies that have demonstrated success in classrooms.

Keywords: EFL Academic Writing, GenAI-Assisted Writing, Prompt Engineering

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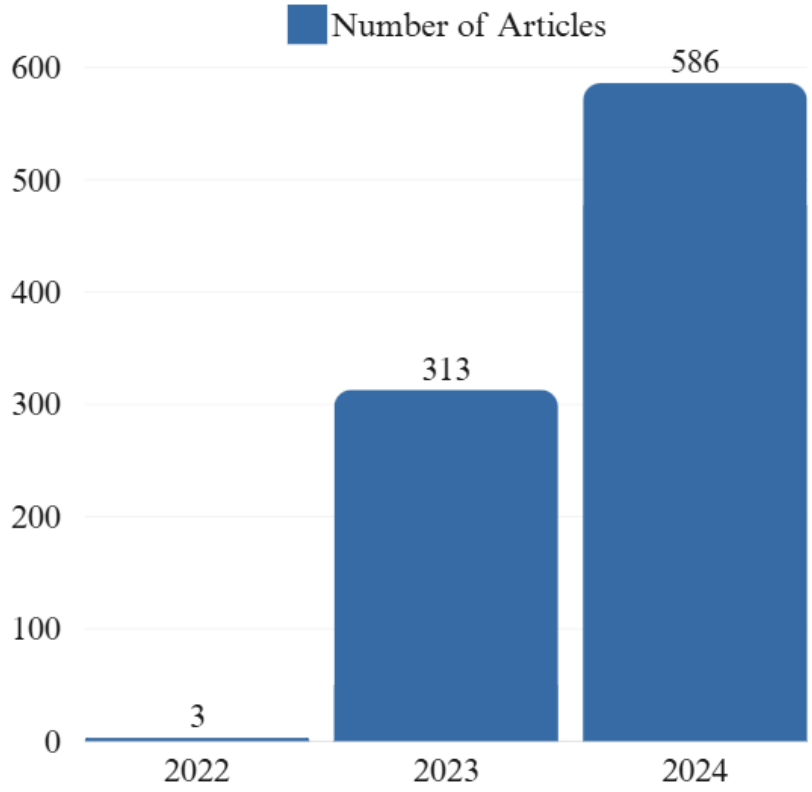
Introduction

With their unprecedentedly vast knowledge and versatility, Generative AI tools like ChatGPT (hosted by OpenAI) have rapidly transformed teaching practices. Research integrating these tools into education, particularly in EFL (English as a Foreign Language) writing, has significantly grown. A Scopus database search using the keywords 'ChatGPT' AND 'writing,' limited to articles and conference papers, reveals this trend: Three articles in 2022, 313 in 2023, and 586 in 2024 as of November 2024. These figures highlight the increasing academic focus on leveraging Generative AI in education (Figure 1).

Figure 1: Scopus Database Records for 'ChatGPT' and 'Writing' (2022-2024)



Amid these developments, the potential of Generative AI to reshape teaching and learning methods has sparked heightened expectations. This paper contributes to the growing field by sharing practical tips for implementing ChatGPT in the academic writing process, with a specific focus on crafting effective prompts. It also addresses challenges and proposes potential solutions based on teaching practices conducted in an EFL undergraduate context in Japan across 2023 and 2024.

ChatGPT's Role in Academic Writing

A review of research articles (2023–2024) on ChatGPT's use in academic writing identified two primary workflows in EFL instruction:

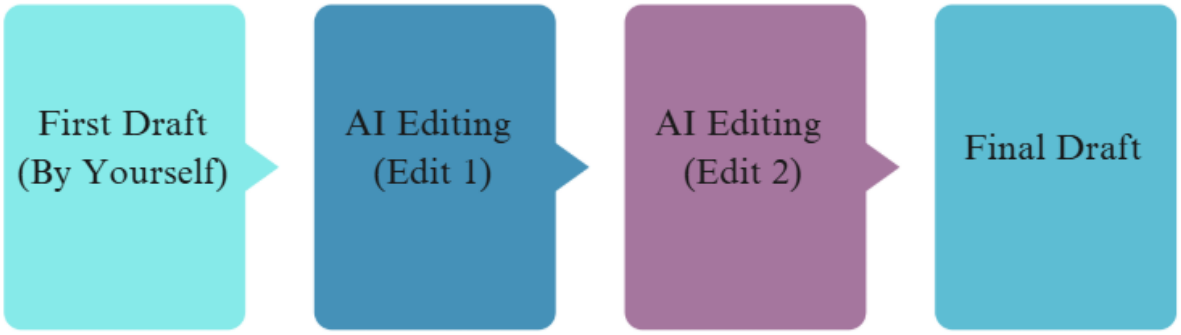
1. **Initial Draft by GenAI**: EFL learners modify a draft created by ChatGPT.
2. **Initial Draft by Learners**: ChatGPT refines a draft created by EFL learners.

Each workflow offers distinct advantages and challenges.

The first workflow helps students polish well-structured model writing, allowing for time-saving edits and minimizes the risk of disorganization. This workflow is particularly effective for business writing, where clarity and efficiency are paramount. However, it may undermine creative efforts, as students rely on pre-written content. The second workflow requires learners create original drafts, promoting higher engagement and creative effort. ChatGPT then assists in refining tone, organization, and content. While this approach encourages deeper learning, it requires greater time and energy investment from learners.

In this study, the second workflow was implemented for in-class instruction (Figure 2). Students began by drafting original texts on assigned topics using MS Word (licensed by the university). They then refined their drafts using Grammarly (free version) for additional grammar and vocabulary checks. The iterative process continued until the drafts were polished at the micro-level. Finally, students sought meta-level refinements—such as tone, content, and organization—from ChatGPT.

Figure 2: Stepwise Writing Process Integrating AI Tools

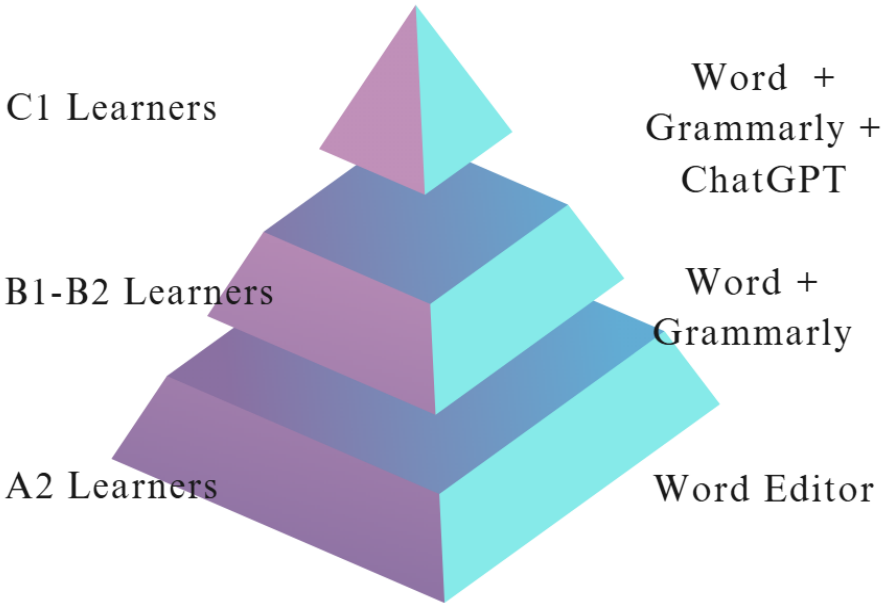


The application of AI tools varies according to learners' English proficiency (Figure 3). This study included students with diverse CEFR levels (Council of Europe, 2025), ranging from A2 (beginner) to C1 (advanced). A tailored approach to AI tools was recommended:

- **A2 Learners**: Focused on MS Word to practice basic syntax and vocabulary. The use of GenAI was optional but not prohibited to prioritize foundational writing skills.
- **B1-B2 Learners**: Combined MS Word and Grammarly for micro-level editing, with guided use of GenAI for meta-level refinements.
- **C1 Learners**: Fully utilized all tools, integrating MS Word, Grammarly, and ChatGPT to optimize their academic writing.

This tailored approach aligns with principles of language acquisition, recognizing that basic learners often benefit from more practice constructing sentences independently before leveraging advanced tools.

Figure 3: Tailored AI Tool Usage for Different CEFR Levels



Effective Prompts for EFL Writers

Types of Prompts That Improve Academic Writing Skills

A structured set of model prompts helps students understand GenAI's capabilities while discouraging unproductive usage. The following prompts, tested in EFL writing classes, have proven effective in guiding students through the academic writing process. Breaking down prompts by specific features of draft writing helps students analytically approach problem areas.

Grammar vs. Natural Flow.

- **For Grammar Corrections**: *Can you correct the grammar? Please keep the original sentences as intact as possible.*
- **For Natural Flow**: *Can you edit this to make it sound more natural?*

Tip: These prompts help students differentiate between grammatical correctness and the natural flow of language, highlighting that they are distinct dimensions of writing. This differentiation helps foster a deeper understanding of linguistic nuances.

Writing vs. Speaking.

- **For Essay Writing**: *Can you revise this to make it suitable for essay writing?*
- **For Speech Presentation**: *Can you modify this to make it appropriate for a speech presentation?*

Tip: These prompts emphasize the need to adjust tone and structure based on whether the output is for written essays or spoken presentations. This helps students improve their ability to adapt writing for different contexts.

Content vs. Structure.

- **To Improve Content**: *Can you provide advice on improving the content?*
- **To Improve Structure**: *Can you offer advice on improving the structure?*

Tip: These prompts help students identify whether their writing issues stem from content inadequacy or disorganization of ideas. Through this process, students can focus separately on content and structure, reducing confusion and enhancing revision quality.

Extending GenAI Utility for Language Learning

- **For Simplicity and Ease**: *Can you respond in a way that is shorter and simpler to understand?*
- **For Writing Style Adjustments**: *Can you rewrite this abstract in a casual, everyday conversational tone in Japanese?*
- **For Multilingual Interaction**: *Please respond to my post in a language I specify.*

Tip: These prompts encourage students to explore the multilingual and stylistic capabilities of GenAI. Students were encouraged to test multiple prompts on the same original writing to compare the outputs and assess the tool's versatility in real-world applications.

These prompts were shared with students through PowerPoint slides and made available via the Moodle course platform. Students were encouraged to test various prompts on their original writing to systematically analyze the effects. The results showed that clear, goal-oriented prompts fostered meaningful engagement with GenAI, enhancing both skill development and analytical thinking.

Addressing Academic Integrity

Since GenAI became publicly accessible in late November 2022, concerns persist about its pros and cons in EFL writing, including issues of proper attribution when using GenAI-generated content in academic work. Two years have passed since the public accessibility of GenAI in late November 2022, and some global publishers announced their publication policies in GenAI use. Three major guidelines available as of January 2025 are referenced.

Guidelines by Global Publishers

IEEE (2025). The use of AI systems for editing and grammar enhancement is considered common practice by IEEE and generally does not require disclosure. However, other uses, such as generating figures, code, or partial content, require appropriate disclosure. This includes identifying the AI system used, specifying its contribution, and indicating the sections of the article where AI assistance was applied.

IEEE allows individual societies and chapters to develop detailed policies tailored to their specializations. For instance, the IEEE Robotics & Automation Society (2025) supports the use of AI tools by non-native speakers to improve text readability, whether for spelling correction, text reduction, or translation. While encouraging such use, the policy emphasizes that authors remain fully responsible for the final work.

Elsevier (2025b). Elsevier (2025b) allows the use of GenAI under strict conditions, emphasizing that human oversight and accountability are essential. Authors must disclose any use of GenAI or AI-assisted technologies in the writing process, but such tools should only be used to enhance readability and language—not to replace key authoring tasks like producing scientific insights or drawing conclusions. GenAI cannot be credited as a co-author or cited as the author of a reference. Additionally, Elsevier prohibits the use of GenAI-generated or AI-modified figures, images, or artwork in manuscripts, except when explicitly part of the research methodology, with full disclosure and reproducibility in the methods section.

For the peer-review process, Elsevier (2025a) prohibits the use of GenAI. Peer reviewers are not allowed to upload manuscripts under review or review reports into a GenAI tool, even for readability improvements. This restriction stems from concerns about AI influencing critical decisions and breaching confidentiality.

Springer Nature (2025). Springer Nature's AI guidelines focus on authorship, images, and peer review processes. While GenAI tools cannot claim authorship, their use for copy editing does not require disclosure. However, any content created using GenAI must be documented in the Methods section or another appropriate part of the manuscript. The guidelines generally prohibit AI-generated images unless they are obtained through agencies with legal agreements or when the research specifically focuses on AI-generated content. In such cases, these images must be clearly labeled.

For peer review processes, Springer Nature advises against uploading manuscripts into GenAI tools due to concerns about accuracy, outdated knowledge, and data sensitivity. Any use of AI tools during manuscript evaluation must be explicitly disclosed in the peer review report. Recognizing the evolving capabilities of GenAI, Springer Nature is exploring the development of secure AI tools tailored for peer reviewers, reflecting the publisher's commitment to adapting its policies as technology advances.

Summary of Global Publisher Policies

The main points of these guideline policies are summarized in Figure 4. It is important to note that their core focus lies in ensuring transparency and disclosure regarding AI use, rather than a complete prohibition or dissuasion of its utility. Springer Nature explicitly acknowledges the possibility of further amendments to its policies, emphasizing the need for flexibility as the capabilities of GenAI continue to evolve. Given the rapid advancements in GenAI, careful monitoring of changes in global digital publication policies remains paramount. This continuous evolution necessitates a dynamic approach to academic integrity and AI usage in education.

Figure 4: GenAI Use Policies in Academic Publishing

Aspect	IEEE	Elsevier	Springer Nature
Editing	✓	✓	✓
Authorship	✗	✗	✗
Figures	✓	✗	(limited exceptions)
Peer-Review	(Unclear)	✗	✗

Motivational Measures to Foster Honest Use

The EFL writing process in this study requires students to produce an original draft first. This is followed by the use of AI editing tools for basic editing and then for more advanced content and structural refinements. This approach is grounded in the concept of "forced output" (Swain, 1985), which aims to impose a higher cognitive load to facilitate target language acquisition.

The key is to develop a framework that integrates each writer's originality into assignments. Strategies were developed to prevent undesirable GenAI usage while encouraging meaningful and productive engagement. Approximately 120 students across various CEFR levels (A2-C1) per semester across five undergraduate EFL classes over the course of four semesters helped form the following strategies.

The following core strategies were implemented to promote honest use of GenAI:

1. **Requiring Both Initial and Final Drafts**: Demonstrating the student's initial effort and development through the writing process.
2. **Assigning Topics with Original Content**: Encouraging personal opinions, experiences, or creative thinking to ensure originality.
3. **Conducting Pre- and Post-Writing Proficiency Tests**: Measuring progress in writing skills at the beginning and end of the semester.

These strategies evolved gradually over the four semesters. Initially, students often felt overwhelmed by the speed and volume of AI-generated corrections and suggestions. However, after an initial period of adjustment, students began focusing more on the quality and originality of their writing. They recognized that acquiring proficiency in the target language is essential for effectively using and overseeing AI-generated outputs. For instance, students need to identify nuanced errors in grammar, word choice, and tone that AI might miss. Without this oversight, AI-produced corrections can include unintended meanings or generic content that, while grammatically correct, lack personality and depth.

In later semesters, the following additional measures were introduced:

4. **Submitting Reflection Reports**: Analyzing their writing process, including how they used AI tools, fosters critical thinking about their learning process and allows the teacher to monitor individual progress.

5. **Providing Screenshots of AI Tool Usage**: Verifying their engagement through screenshots of the tools encourages students to communicate with GenAI in the target language (English) as much as possible.

These measures help students critically assess the strengths and weaknesses of each AI tool, tailoring their use to different stages of the writing process.

The gradual implementation of these five strategies over four semesters culminated in their full application during the fourth semester. While effective, this approach demands a higher level of commitment from both students and teachers, who must review and evaluate all outputs. To optimize resources, class size, and student levels, it is advisable to selectively apply the most appropriate strategies for each teaching context.

Conclusion

This paper presented a specific process design for integrating generative AI, such as ChatGPT, into EFL writing instruction. It emphasized that crafting targeted prompts is key to enabling students to effectively engage with various aspects of language learning. The proposed preventive measures foster academic integrity while leveraging GenAI's capabilities. As generative AI continues to evolve, its multilingual and multimedia potential offers educators a transformative tool to address diverse educational needs. Thoughtful integration of generative AI can foster innovation and create a more inclusive and enriching global educational landscape.

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

This manuscript was prepared with the assistance of generative AI and AI-assisted technologies. ChatGPT (OpenAI) was used for refining the structure and improving the clarity of the text. Additionally, Gemini and Claude were utilized for reviewing and suggesting enhancements to specific sections. Canva and Pictory.ai were employed for creating visual materials accompanying this research. The final content of the manuscript was carefully reviewed and edited by the author to ensure accuracy, originality, and alignment with the research objectives.

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Enhancing Communication and Documentation: An Impact Study of Feature Writing and Basic Photography Training among NIA Personnel

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Abstract
This study aimed to evaluate the impact of feature writing and basic photography training on the communication capabilities of National Irrigation Authority (NIA) personnel. Conducted in 2021, the research employed a descriptive-evaluative design to assess the effectiveness of the training program. Data were gathered through participant evaluation forms and training documentation. Results indicate that the training significantly enhanced participants' writing and photography skills, as evidenced by their positive feedback and the production of news articles. The acquired skills were deemed relevant to their daily work, particularly in crafting project reports and other official documents. Consequently, the study concludes that the training program effectively improved the communication abilities of NIA personnel. It is recommended that similar training programs be regularly conducted to sustain and further develop the employees' communication competencies.

Keywords: Feature Writing Training, Basic Photography Training, Communication Skills

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Introduction

Effective communication is pivotal in the successful operation of any organization, and government agencies is no exception. The National Irrigation Authority (NIA), tasked with managing and developing the country's irrigation systems, relied heavily on clear and concise communication to carry out its mandate. To this end, equipping its personnel with essential communication skills was paramount. This study underscored the significance of impact assessment in evaluating the efficacy of training programs, particularly in the public sector. By assessing the impact of a feature writing and basic photography training program on NIA personnel, this research aimed to determine the extent to which the training enhanced their communication abilities and contributed to the organization's overall performance.

The study focused on the National Irrigation Authority due to its crucial role in agricultural development and food security. Effective communication within the agency was essential for disseminating information to farmers, coordinating with local government units, and reporting on project progress. It was hypothesized that enhancing the communication skills of NIA personnel through targeted training would lead to improved internal and external communication, ultimately contributing to the agency's overall effectiveness. This research sought to fill a knowledge gap by providing empirical evidence on the impact of communication skills training on government employees, particularly in the context of a technical agency like the NIA.

By examining the training outcomes and assessing participants' perceptions, this study contributed to the body of knowledge on capacity building initiatives in government organizations. The findings were valuable for policymakers, training institutions, and the NIA itself in designing and implementing future training programs aimed at improving employee communication skills. Ultimately, this research sought to demonstrate the positive impact of well-designed and implemented training programs on organizational performance and public service delivery.

Methodology

This study employed a descriptive-evaluative research design to assess the impact of feature writing and basic photography training on thirty NIA personnel. A descriptive approach was used to characterize the training program, while evaluative methods were employed to determine its effectiveness in enhancing communication skills.

The participants of this impact study were NIA personnel, specifically engineers, staff, and field officers, who underwent the feature writing and basic photography training in 2021. The impact assessment was primarily conducted through the analysis of participant evaluation forms and training documentation. The evaluation forms captured participants' perceptions of the training's relevance, effectiveness, and impact on their work. The training documentation, including attendance records, course outlines, and training materials, provided contextual information about the program.

To assess the impact of the training on communication skills, the study analyzed the participants' written outputs, such as news articles produced during the training. These outputs were evaluated for clarity, coherence, and adherence to journalistic standards. However, it is important to note that this study relied heavily on self-reported data from

participant evaluations, which may have limitations in terms of objectivity and generalizability.

Findings

Table 1: Summary of Participant Evaluations

Evaluation Criteria	Rating	Number of Respondents
Relevance of the Training	Strongly agree	30
Effectiveness in enhancing writing skills	Strongly agree	30
Effectiveness in enhancing photography skills	Strongly agree	30
Overall satisfaction with the training	Strongly agree	30

The findings highlight a significantly positive reception from NIA personnel regarding the training program. Participants expressed improved confidence and proficiency in drafting clear and structured reports. These findings suggest that the training was instrumental in enhancing their professional communication skills.

These findings align with previous research emphasizing the importance of perceived relevance and usefulness in determining the effectiveness of training programs (Kirkpatrick & Kirkpatrick, 2006). By tailoring the training to the specific needs of NIA personnel, the program was able to demonstrate a significant impact on participant satisfaction and perceived learning outcomes.

The positive impact of communication skills training on employee performance has been well-documented in the literature. For instance, Connor & Wentworth (2012) found that employees with strong communication skills are more likely to be promoted and receive higher salaries. Similarly, Henry & Swanson-Biearmann (2022) demonstrated a positive correlation between communication skills and job satisfaction. By enhancing the communication capabilities of NIA personnel, the training program likely contributed to increased job satisfaction and overall employee morale.

Moreover, effective communication is crucial for knowledge sharing and collaboration within organizations (Sims, 1993). The ability to articulate ideas clearly and concisely is essential for fostering innovation and problem-solving. The training program may have equipped NIA personnel with the necessary skills to contribute more effectively to team-based projects and knowledge management initiatives.

It is important to note that the present study relied heavily on self-reported data from participant evaluations. While these data provide valuable insights into participants' perceptions, they may not accurately reflect the actual impact of the training on job performance and organizational outcomes. To strengthen the research, future studies could incorporate objective measures of communication skills, such as pre- and post-training assessments or analysis of written communication products.

Additionally, the study did not include a control group, which could have provided a comparison point for evaluating the effectiveness of the training. Future research could incorporate a control group design to establish a causal relationship between the training and improved communication outcomes.

Despite these limitations, the findings of this study provide valuable insights into the potential benefits of feature writing and basic photography training for NIA personnel. The positive evaluation by participants suggests that the training has the potential to enhance communication capabilities and contribute to the organization's overall performance.

Participant feedback further reinforces the positive impact of the training. Several participants commented on how the training improved their ability to write clear and concise reports, which are essential for effective communication within the agency. Additionally, participants expressed appreciation for the practical photography skills acquired, which they believe will be useful for documenting project progress and creating visual materials for presentations.

Qualitative insights from participant feedback further reinforce the significant impact of the training. Participants described how the program enriched their understanding of technical writing and photography, allowing them to document project developments with precision. These insights align with prior research on the role of targeted training in skill enhancement.

These findings align with previous research highlighting the positive impact of communication skills training on employee performance and organizational outcomes. Studies by Bowers & Moffett (2012) and (Moore et al., 2019) have demonstrated that enhanced communication skills lead to increased job satisfaction, improved collaboration, and better overall organizational performance. Additionally, research by Greenberg et al. (2003) emphasizes the role of effective communication in knowledge sharing and innovation.

The specific outcomes observed in this study, such as improved writing and photography skills and increased confidence, are consistent with these broader findings. By empowering NIA personnel with these essential communication tools, the training has laid a foundation for enhanced organizational performance and improved public service delivery.

These comments highlight the direct application of the training to the participants' daily work responsibilities. By enhancing their writing and photography skills, the training has empowered NIA personnel to communicate more effectively and efficiently.

Conclusion

The findings of this study demonstrate that the feature writing and basic photography training significantly enhanced the communication capabilities of NIA personnel.

Participants exhibited a strong positive response to the training, expressing its relevance to their roles and its effectiveness in improving their writing and photography skills. The ability to produce clear, concise reports, coupled with the capacity to effectively capture and document project activities through photography, has empowered NIA staff to communicate more effectively both internally and externally. These results underscore the importance of investing in communication skills training for government employees and highlight the potential for similar initiatives to be implemented in other government agencies.

Qualitative findings further reinforced the positive impact of the training, with participants expressing increased confidence and a clear understanding of how to apply their new skills in practical work settings. The training not only improved technical skills but also fostered a deeper appreciation for the importance of effective communication in achieving organizational goals.

Recommendations

Based on the findings of this study, it is recommended that the NIA continue to invest in communication skills training for its personnel. The positive outcomes demonstrated the clear return on investment of such programs. To maximize the impact of future training initiatives, it is essential to incorporate regular assessments and evaluations to measure their effectiveness and identify areas for improvement. Additionally, exploring opportunities for mentorship and coaching programs can further enhance knowledge transfer and skill development among employees.

To strengthen the research base on the impact of communication skills training in government agencies, future studies should focus on longitudinal designs to track the long-term effects of training programs. Incorporating control groups and utilizing objective performance metrics will also enhance the rigor of research in this area. By conducting more comprehensive and in-depth studies, policymakers and organizations can make informed decisions regarding the allocation of resources for communication skills development.

Disseminating the findings of this study to other government agencies can encourage the adoption of similar training programs. Sharing best practices and lessons learned can contribute to a broader improvement in communication capabilities across the public sector. Furthermore, collaboration with academic institutions can foster research partnerships and facilitate the development of evidence-based training interventions.

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

AI-assisted tools were utilized in this manuscript solely for grammar checking, coherence refinement, and citation formatting. The primary tool used was OpenAI’s ChatGPT. However, all research conceptualization, data analysis, discussion, and interpretation were conducted manually. The AI assistance was strictly limited to linguistic refinements and did not contribute to the intellectual or analytical content of the paper.

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A Comparative Study of University Students' Awareness of Data Privacy: Japan and the USA

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The IAFOR International Conference on Education in Hawaii 2025
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Abstract
This study examines university students' perceptions of data privacy in Japan and the United States, focusing on their awareness, trust in institutions, and understanding of institutional data use policies. Based on a survey of 1,200 Japanese university students and a comparative analysis with EDUCAUSE data from the United States, we found key differences in attitudes toward data privacy. Japanese students generally reported higher levels of trust in their institutions' handling of personal data and a greater familiarity with data privacy policies. In contrast, U.S. students demonstrated more doubt and uncertainty about how their universities use personal data, with a higher proportion responding "don't know" when asked about institutional practices. These differences may be attributed to variations in educational approaches, policy transparency, and cultural attitudes toward data governance. Our findings emphasize the need for more transparent communication regarding institutional data use and the implementation of targeted educational programs to enhance students' understanding and trust in both contexts. Future research should explore the effectiveness of such initiatives in shaping students' attitudes toward data privacy.

Keywords: Data Privacy, Institutional Trust, Student Perceptions

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Introduction

In the age of technology and big data, learning analytics (LA) research aims to enhance educational practices by collecting and analyzing data about learners and their contexts. This includes traditional Learning Management Systems (LMS) data and innovative sources like learners' behavior and biometric information collected through sensor devices and mobile terminals. Ethical considerations are crucial, requiring researchers to obtain learners' consent and process data anonymously or using pseudonyms. However, university students may feel coerced to consent due to their vulnerable relationships with teachers, universities, and researchers.

Our research, which involved an online survey, aimed to delve into university students' attitudes toward data privacy and copyright awareness. The survey covered students' knowledge about copyright, social media habits, understanding of terms of service, and attitudes toward their university's privacy and data usage policies. Furthermore, our research offers a comparative perspective on data privacy awareness among university students in Japan, drawing from a similar survey conducted by Educause in the United States (EDUCUASE, 2022a).

Survey Implementation

We designed the survey to compare Japanese and United States perspectives, referencing the EDUCAUSE survey (EDUCAUSE, 2022b). Additionally, we included some original questions to assess awareness of copyright issues. To further enhance the comparative analysis, questions were also posed to working adults to contrast their perceptions with those of university students.

We conducted the online survey using the "Freeasy" service of IBRIDGE Corporation in Japan. After screening 4,000 students, we conducted the primary survey with 1,200 university students (600 males and 600 females). The working adult group comprised 400 individuals (200 males and 200 females) (Inoue, 2024). This study significantly exceeds the sample size of the EDUCAUSE survey, which had 820 respondents.

Survey Result

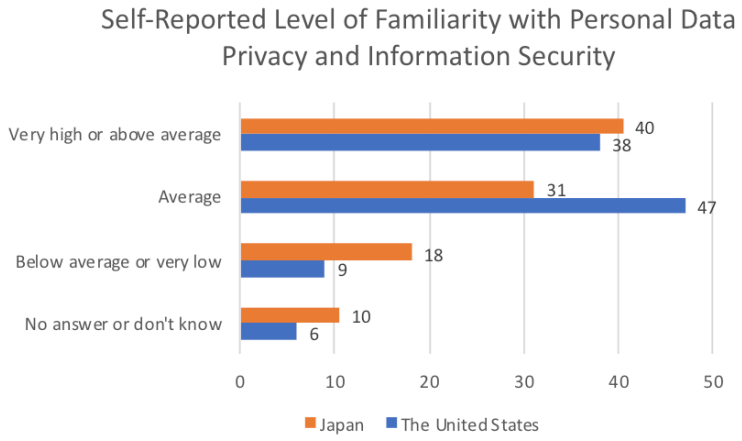
The original responses were categorized as "very high," "above average," "average," "below average," "very low," "don't know," and "no answer." However, in the EDUCAUSE survey results, the categories were consolidated into "very high or above average," "average," "below average or very low," and "no answer or don't know." The Japanese survey results were also adjusted to align with the EDUCAUSE format to ensure consistency and comparability.

Self-Reported Level

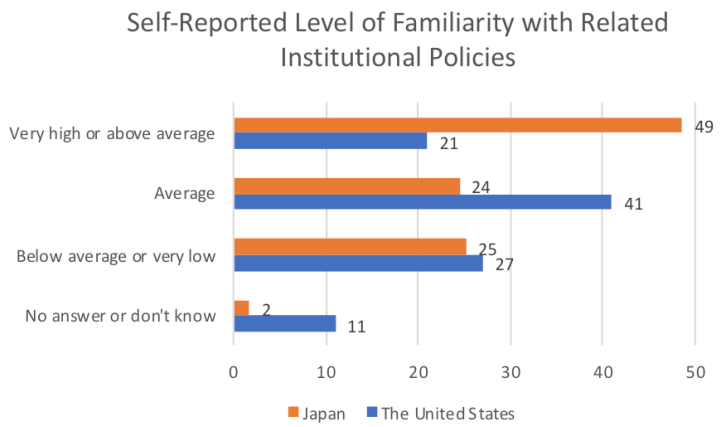
Figure 1 shows the self-report level of familiarities with personal data privacy and Information security, and related institutional policies.

Figure 1 (a), (b): Self-Reported Level

(a)



(b)



Familiarity With Personal Data Privacy and Information Security. In Japan and the United States, approximately 40% of students rate their knowledge of personal data privacy and information security as "high," indicating a general awareness of data privacy issues in both countries. However, there are notable differences between the two countries. In Japan, 18% of students consider their knowledge to "low," significantly higher than the 9% reported in the United States. This disparity suggests that practical education on information security may be lacking in Japanese educational settings. Conversely, a more significant proportion of students in the United States rate their knowledge as "average" compared to Japan, implying that general security knowledge appears to be more widely disseminated in the United States. Additionally, the proportion of students who responded with "don't know" is higher in Japan at 10%, compared to 6% in the United States, which may indicate differences in student engagement or interest in data security topics. One possible explanation for this difference is that Japanese students rely more on institutional trust than actively seeking data privacy information.

Familiarity With Related Institutional Policies. Many students in Japan and the United States feel that their understanding of institutional policies is "average" or above, reflecting a shared recognition of the importance of these policies. However, differences emerge in the degree of familiarity. Japanese students report higher rates of "very high or above average" familiarity, suggesting greater trust and transparency in institutional policies. In contrast, United States students exhibit a higher proportion of "very low or below average" familiarity,

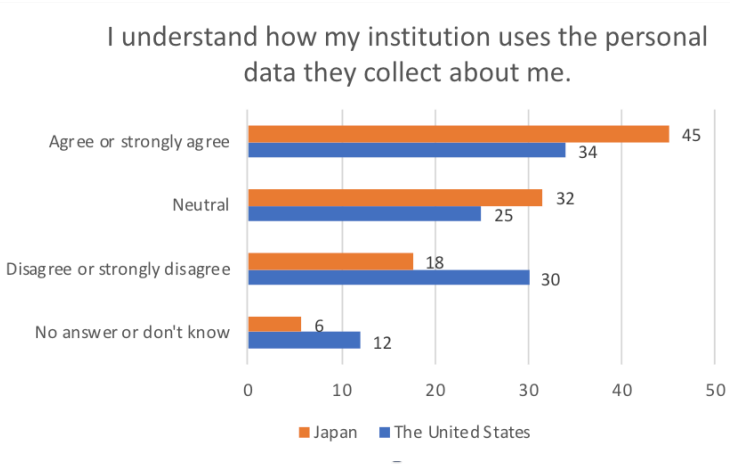
indicating potential distrust or a lack of clear policy communication within their institutions. Cultural differences in education may explain this discrepancy.

Understanding of Institutional Data Use

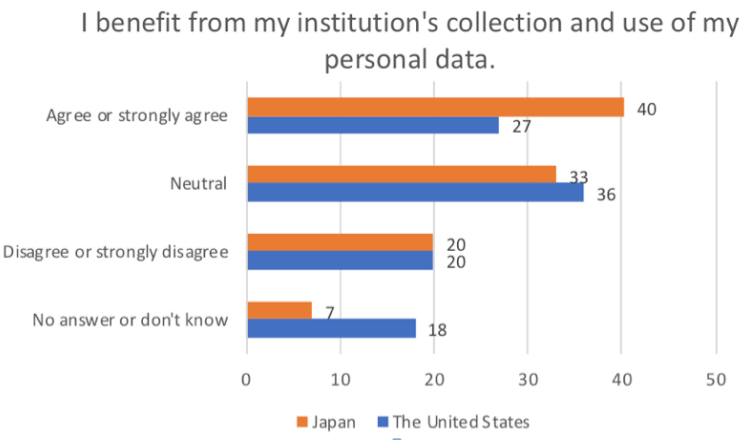
Figure 2 shows the level of agreement with statements about the collection and use of personal data.

Figure 2 (a), (b): Level of Agreement With Statements About the Collection and Use of Personal Data

(a)



(b)



Understanding of Institutional Data Use. A significant number of students in both Japan and the United States adopt a "neutral" stance when asked about their understanding of how their institutions use their data. However, Japanese students demonstrate a higher level of agreement with the statement, indicating stronger trust in institutional data handling. On the other hand, more United States students express disagreement, reflecting concerns about the transparency of university data use policies.

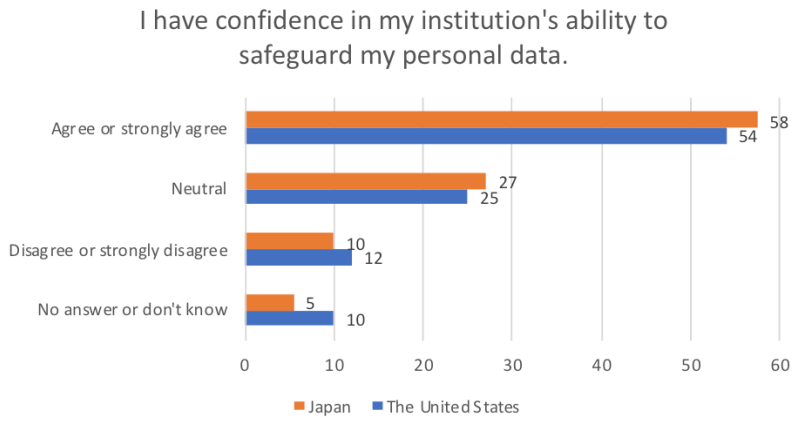
Perceived Benefits From Institutional Data Use. In both countries, about 20% of students feel that they do not personally benefit from their institution's use of their data. However, Japanese students report a higher percentage of perceived benefits, with 40% agreeing that data use positively impacts them. This suggests that data-driven student support initiatives may be more effective in Japan. In contrast, the United States sees a higher proportion of "don't know" responses (18%), which may indicate lower engagement or awareness of how data policies impact students.

Understanding of Institutional Data Use

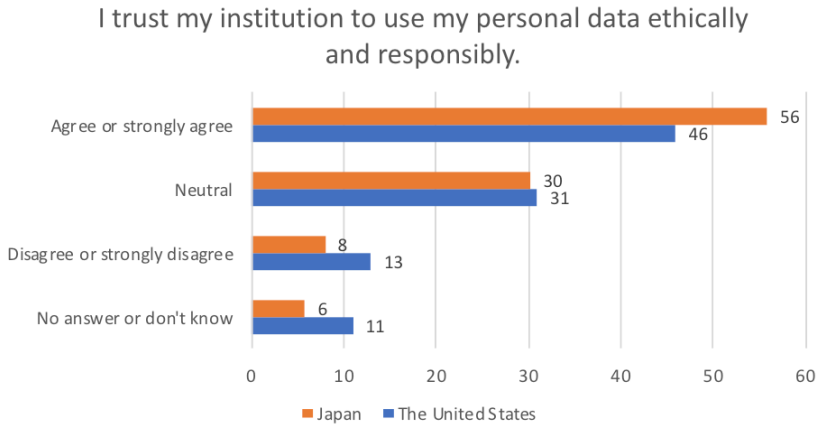
Figure 3 shows the level of agreement with statements about confidence and trust in institutional personal data practices.

Figure 3 (a), (b): Level of Agreement With Statements About Confidence and Trust in Institutional Personal Data Practices

(a)



(b)



Confidence in Safeguard Data. Over half of the students in both Japan and the United States express trust in their institution's ability to protect their data. However, confidence levels are higher among Japanese students, which may reflect the effectiveness of institutional initiatives aimed at data security. In contrast, the United States has a higher proportion of students who responded with "don't know," suggesting a potential disinterest or lack of awareness regarding data protection measures in their institutions.

Trust in Ethical Data Use. While Japanese and United States students demonstrate significant levels of trust in their institutions' ethical use of data, Japanese students exhibit a higher trust rate 56% compared to 46% in the United States. Conversely, United States students display more significant skepticism, with a higher percentage expressing concerns, potentially influenced by past incidents of data misuse or a lack of transparency in institutional policies.

Conclusion and Consideration

The comparative analysis reveals that Japanese students generally exhibit higher trust and familiarity with data privacy and institutional policies than American students. This disparity highlights the impact of institutional transparency, policy communication, and cultural attitudes toward data governance.

Japan

- Japanese students tend to show higher trust in their universities regarding data usage and protection, with a majority expressing confidence in their institution's ethical use of data.
- While trust levels are high, some students remain neutral, indicating that some may not have strong opinions.

United States

- While trust levels in the U.S. are lower compared to Japan, a significant portion of students still express confidence in their institutions.
- Many students in the U.S. adopt a neutral stance or choose not to answer, suggesting uncertainty or a lack of strong opinions about data privacy policies.

Acknowledgments

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The Role of Social Media in Financial Literacy and Decision-Making: Insights From Behavioral Finance

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Abstract
The paper examines how social media influences financial literacy and decision-making, focusing on the role of financial influencers ("Finfluencers"). As Germany faces increased personal responsibility for retirement planning, financial literacy has become crucial in enabling individuals to make informed choices in a complex financial landscape. The study analyzes the growing impact of social media on younger generations, who increasingly turn to platforms like YouTube and TikTok for financial guidance. It explores how financial influencers affect users' knowledge and actions by providing easily accessible content that simplifies complex financial topics. Empirical analysis through logistic regression shows that financial literacy levels, trust in social media, and employment type significantly affect the likelihood of using social media for financial information. Findings indicate that social media use is positively associated with higher financial literacy and decision-making confidence, with self-employed individuals more likely to engage in financial discussions online than students. Additionally, high trust in financial influencers correlates with increased social media usage for financial advice, though the potential risks of misinformation remain. The study concludes that while social media presents a valuable resource for financial education, particularly among younger users, strategic regulation is needed to mitigate misinformation. These insights highlight the potential of digital platforms to support financial literacy initiatives and the need for verified content to build informed, resilient financial behaviors.

Keywords: Financial Literacy, Financial Decision-Making, Social Media, Influencer, Financial Influencer

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Introduction

The demographic shift is more relevant than ever and is set to impact various sectors in Germany (Lang et al., 2022). This change is driven by factors such as rising life expectancy, the ratio of birth to death rates, and the migration balance between immigration and emigration (Rebeggiani et al., 2020). Improved healthcare, a negative balance between births and deaths due to a stagnating birth rate, and a positive immigration balance—which mitigates but does not fully offset this demographic shift—are leading to a situation where an increasing number of retirees are supported by a shrinking number of contributors to the pension system (Statistisches Bundesamt, 2022).

This presents a major challenge to Germany's social insurance system, which includes health, accident, pension, unemployment, and long-term care insurance (Keck, 2015). Particularly affected is the pay-as-you-go pension system, based on the intergenerational contract, where current pensions are financed by the contributions of the working population. As a result, the younger generation faces an increasing financial burden (Blüm, 2004). Future retirees are therefore encouraged to close the retirement gap through the three-pillar retirement system, consisting of the statutory pension insurance as the basic provision, supplemented by occupational and private pensions. This self-reliance in securing financial stability in old age is essential to prevent old-age poverty (Jäger, 2007; Möller, 2019; Schneider et al., 2022).

However, this approach assumes a certain level of financial knowledge. In an increasingly complex world, individuals are confronted with a vast array of financial products and must make decisions that could have irreversible consequences for their financial futures. The years following the financial crisis highlighted that poor financial decisions can have significant consequences, not only for individual well-being but for society as a whole. A fundamental factor in financial decision-making is financial literacy, which significantly influences how well individuals can make and implement financial decisions, whether in saving, investing, spending, borrowing, or retirement planning (Huston, 2010). This goes beyond the typical associations of financial knowledge gaps with education, gender, or income, as often highlighted in research (Lusardi & Mitchell, 2014). In many countries, low levels of financial literacy are linked to ineffective spending habits, poor financial planning, and costly credit behaviors and debt management (Lusardi, 2019). Financial education can help improve the well-being of retirees by equipping them with the information and skills needed to make profitable investment decisions, both in their pension plans and personal savings (OECD, n.d.).

Currently, Germany lacks comprehensive, scientifically supported educational strategies to improve financial literacy (Kaiser & Menkhoff, 2021). This places the country among the few OECD nations without a national strategy, leading to a scenario where employees bear greater responsibility for securing their own financial future without a consistent strategy to impart and strengthen the necessary knowledge and understanding (Serena & Hastenteufel, 2022).

The exponential growth and increasing importance of social media in today's modern society have not only influenced daily life but also how people make financial decisions and educate themselves financially. With the rise of digital platforms and social networks, access to information and connections has become easier than ever (Khatik et al., 2021). During the COVID-19 pandemic, there was a surge of interest in stocks and investment. The Deutsches Aktieninsitut reported a significant increase in investors, particularly among those under 30,

in 2020. At the same time, financial topics were increasingly discussed on social media, with platforms like YouTube being used by many as sources of information (Balonier et al., 2021). Finfluencers are gaining importance, as various population groups use social media channels to inform themselves about financial topics (Kim, 2022). The content and opinions of these finfluencers carry significant weight with users, who attribute a high degree of credibility to them, which can be crucial in shaping their financial decisions (Gaßmann & Zureck, 2023).

In this context, the present study examines the role of social media in financial decision-making and financial education. The study provides insights into behavioral finance and identifies possible recommendations and directions for future research based on the findings.

Theoretical Framework

Behavioral Finance, complementing traditional theories like Modern Portfolio Theory and the Efficient Market Hypothesis, integrates psychology and sociology to explain irrational financial decisions and market anomalies (Humra, 2016; Khatik et al., 2021).

As information volume and speed increase, investors increasingly rely on heuristics—intuitive, experience-based decision shortcuts that can lead to incomplete information (Pompian, 2012) The Prospect Theory (Tversky & Kahneman, 1991) further explains decision-making under uncertainty, emphasizing loss aversion, where individuals fear losses more than they value gains (Levy, 1992). This effect intensifies after financial crises, reducing risk appetite and financial system participation (Thaler et al., 2016).

Financial Literacy

Financial literacy fundamentally encompasses the ability to effectively use knowledge and skills to manage one's financial resources for lifelong financial security, distinguishing between actual and perceived knowledge (Huston, 2010).

Financial retirement planning in Germany is a complex issue that is highly individualized. Each legally insured person is responsible for taking appropriate measures to secure their retirement (Deutsche Rentenversicherung, 2022; Oehler et al., 2021). Financial knowledge is generally considered a prerequisite for making sound financial decisions, forming a crucial foundation for wealth building and necessary retirement planning (Bachmann et al., 2021).

Stolper and Walter (2017) argue that financial literacy should be understood as a two-dimensional concept, encompassing both the understanding of financial concepts and their practical application. A significant portion of financial marketing aims to confuse consumers or reinforce bad habits, such as impulse buying, which hinders the implementation of knowledge into action (Emmons, 2005).

Financial education provides opportunities for broader participation in economic growth and prosperity. It supports personal life management and empowers individuals to minimize risks and seize opportunities (Bundesfinanzministerium, 2024). Especially given today's market volatility, which is largely beyond individual control, the ability to manage one's money effectively is crucial. This was particularly evident during the 2008 financial crisis, which exposed the lack of personal savings among consumers (Remund, 2010).

Individuals with high financial literacy are able to make informed decisions about financial products and manage their personal finances effectively. Good financial knowledge helps avoid risks such as over-indebtedness and plays a crucial role in personal retirement planning. A better understanding of finances promotes investment behavior and wealth building, thus supporting economic development (Lusardi & Mitchell, 2014). This not only contributes to individual well-being but also enhances the stability of the financial system, as more consumers make responsible decisions (Lusardi & Mitchell, 2011c).

The assessment of financial knowledge was based on Lusardi and Mitchell's "Big Three" questions but was expanded to include seven additional questions related to risk, inflation, and compound interest (Lusardi & Mitchell, 2011a).

Influencing Factors of Social Media and Influencers

In today's world, social media has undergone a significant transformation, evolving far beyond its original function of communication with friends and potential employers (Ismail et al., 2018). It now holds a central role in the daily media consumption of people in Germany, with 50% of the population using social media at least once a week, and this figure rises to 88% among those aged 14 to 29 (Koch, 2022). Popular platforms include YouTube, Facebook, and Instagram, with usage preferences varying across age groups. YouTube and Facebook are the most widely used across all age groups, while younger generations increasingly favor newer platforms like TikTok and Snapchat (Arnoldy et al., 2018).

One of the characteristics of social media is that the publication of ideas and opinions is generally unchecked or uncensored. This dynamic can significantly influence opinions and decision-making (Power & Phillips-Wren, 2011). As a result, calls for stricter regulations that govern social interactions and protect consumers are becoming louder. A prominent example of where tighter regulations are necessary is the financial influencer sector (Neuerer, 2024).

This subset of influencers focuses on financial topics, a growing niche on social media platforms, particularly since the COVID-19 pandemic and the associated stock market crashes (Jonas et al., 2022). Platforms like YouTube have become key information sources for younger generations, with around 33% of digital users in Germany finding social media recommendations helpful when searching for information. Financial influencers play an important role in this by providing simplified, multimedia content on complex financial topics (Jonas et al., 2022). Since the term "Finfluencer" is not legally defined, the quality of information shared varies significantly, ranging from credible sources to dubious ones (Neuerer, 2024). Many of these influencers imply that they possess extensive financial knowledge, which they may not actually have (Neuerer, 2024).

Their deep involvement in a particular subject often makes them seem like experts within their communities, and they enjoy high levels of trust from their followers (Ruisinger, 2020). As role models and figures of identification, influencers can have a social impact on their followers and can shape opinions through their statements on various social media platforms (Schach, 2018). They also have a potential to affect stock prices. A notable example is Elon Musk's influence through his activity on the social platform X (formerly Twitter), which has been shown to correlate with the stock price movements of Tesla (Šević et al., 2023).

However, regulatory authorities such as the Bundesanstalt für Finanzdienstleistungen (BaFin) have expressed concern over the rise of financial influencers and have issued warnings about

the potential for misleading information. BaFin urges consumers to critically evaluate the motivations behind influencer content, as many recommendations may be driven by financial incentives, similar to influencer marketing, where posts are sometimes influenced by advertising or partnership deals (Bundesanstalt für Finanzdienstleistungsaufsicht). Depending on the nature of the content, financial influencers may also be subject to additional regulations related to financial advice, including mandatory disclosures when offering investment recommendations (Anger, 2022).

Empirical Research

This paper examines the impact of social media on financial literacy and decision-making, with a particular focus on financial influencers. It explores how social media facilitates financial knowledge dissemination and whether influencers enhance their followers' financial literacy.

Additionally, the study investigates the relationship between users' financial education needs and the knowledge provided by influencers. It assesses the extent to which users make informed financial decisions through social media and identifies the type of financial education necessary for long-term decision-making.

A quantitative empirical research design was employed to collect and analyze data, evaluating the influence of social media and financial influencers on users' knowledge, decisions, and trust in financial information.

Data Sample and Collection

A survey was designed to assess the impact of social media on financial literacy and decision-making while ensuring scientific validity through objectivity, reliability, and validity (Hussy et al., 2013). The questionnaire, a core component of this study, comprises six sections covering data protection consent, sociodemographic characteristics, social media usage, financial decision-making influences, and financial literacy, including self-assessment and knowledge-based questions.

Data Operationalization and Analysis

A pretest was conducted to enhance data collection and ensure data quality. Based on feedback, the survey was refined to reduce dropout rates, improve reliability, and minimize inaccuracies. The finalized questionnaire was administered electronically over eight weeks, yielding 362 valid responses after excluding incomplete data.

To comprehensively assess participants' characteristics, behaviors, and attitudes, various control variables were operationalized. This step was essential for effectively addressing the research questions and testing the hypotheses. Details on the operationalization of control variables are provided in Appendix 1.

For the analysis, a logistic regression model was applied to examine the influence of social media on financial literacy and decision-making. Two logistic regressions were conducted, with financial literacy (FL) and financial decision-making (FE) as explanatory variables. FL was measured using ten questions, covering both basic Lusardi and Mitchell (2011a) to advanced financial literacy Lusardi (2008), as outlined in Table 1.

Table 1: Questions for Measuring Financial Literacy

No.	Question		Correct Answer
22	Interest	Suppose you have €100 in a savings account, and the interest rate is 2% per year. What do you think you would have in the account after one year if you leave the money in the savings account? Assumption: No fees are applied. a) More than €102 b) Exactly €102 c) Less than €102 d) I don't know	b)
23	Inflation	Imagine the interest rate on your savings account is 1% per year and inflation is 2% per year. What do you think you would be able to buy with the money in this account after one year? a) More than today b) Exactly the same amount c) Less than today d) I don't know	c)
24	Diversification	Is the following statement true or false? Buying stocks from a single company generally offers a safer return than an equity fund.	false
25	Function of the stock market	Which of the following statements correctly describes the primary function of the stock market? a) The stock market helps to predict stock returns b) The stock market results in a rise in stock prices c) The stock market brings buyers and sellers of stocks together d) None of the above statements	c)
26	Investment funds	Which of the following statements is correct? a) Once you've invested in an investment fund, you cannot withdraw money from it in the first year b) Investment funds can invest in various asset classes, such as stocks and bonds o Investment funds pay a guaranteed return that depends on the fund's past performance c) None of the above statements d) I don't know	b)

27	Interest Rates and Bond Prices	When the key interest rate falls, what happens to bond prices? a) Prices increase b) Prices remain constant c) Prices fall d) None of the above statements e) I don't know	a)
28	Risk	Is the following statement true or false? Stocks are generally riskier than bonds.	true
29	Return	Over a longer period (e.g., 10 or 20 years), which asset typically has the highest return? a) Savings account b) Bonds c) Stocks d) I don't know	c)
30	Fluctuations	Which asset typically shows the highest fluctuations over time? a) Savings account b) Bonds c) Stocks d) I don't know	c)
31	Risk and Diversification	If an investor diversifies their money across various asset classes, what happens to their risk of losing all the money? a) The risk of losing money increases b) The risk of losing money remains constant c) The risk of losing money decreases d) I don't know	c)

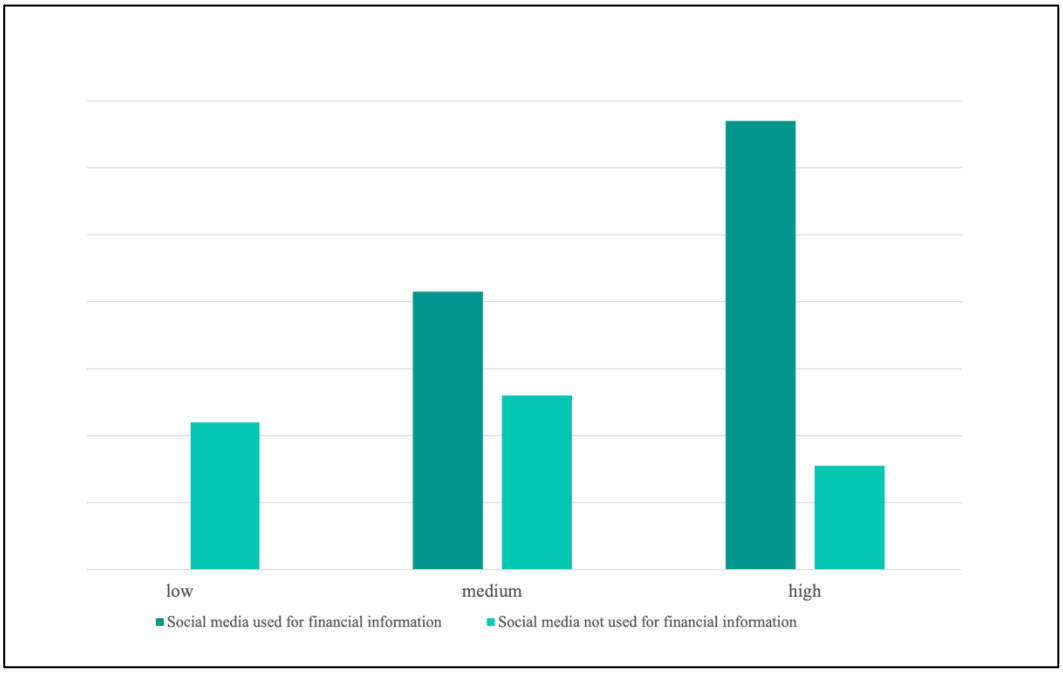
Questions 23, 24, and 31 had the highest number of correct answers, while question 27 had the most incorrect and "I don't know" responses. The fewest incorrect answers were recorded for questions 22 and 23.

To assess financial literacy, a negative scoring system was used: correct answers=1, incorrect =-1, and "I don't know"=0. This helped analyze overconfidence. The financial literacy score (FL_K) ranges from -4 (lowest) to 10 (highest), with most participants scoring 6, 8, or 10, indicating moderate to high financial literacy.

Figure 1 categorizes financial literacy as "low" (-4 to 3), "medium" (4 to 7), and "high" (8 to 10). Social media users tend to have higher financial literacy, suggesting a possible positive

correlation. These categories are numerically coded (Low=1, Medium=2, High=3) for statistical analysis and included as the independent variable (FL) in logistic regression.

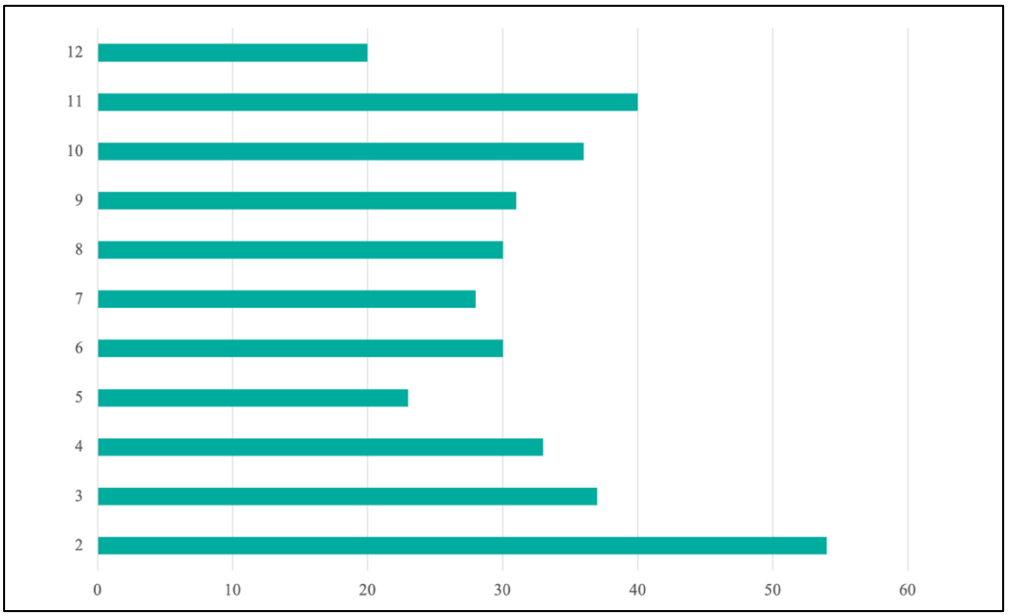
Figure 1: Competence Level Financial Knowledge II



For the second logistic regression, financial decision-making (FE) serves as an additional independent variable.

Participants were asked if they had made financial decisions based on advice and whether they believed social media positively impacts decision-making, rated on a Likert scale (1=Strongly Disagree, 6=Strongly Agree). The financial decision-making score (FE) ranges from 2 (low) to 12 (high), with most responses at scale points 2 and 11, as shown in Figure 2.

Figure 2: Key Figures for Financial Decision-Making



Applied Methodology of the Empirical Study

Logistic Regression I

This research employs quantitative methods to examine the role of social media in financial literacy and decision-making. With 362 observations, the analysis is conducted through logistic regressions. The first regression investigates the extent to which social media influences financial literacy, while the second focuses on its impact on financial decisions. The analysis is performed in RStudio, based on the dependent variable "SM" (social media) and the independent variables "FL" (financial literacy) and "FE" (financial decision-making).

Formula 1: Logistic Regression I

$$SM_i = -4.087_i + 1.24914 * SM\_FLimprov_i + 2.056 * SM_{ressourcen_i} - 1.954 * BESCHAEFTIGUNGstudent_i + 0.797 * FL_i - 0.221 * BILDUNG_i + 0.34 * SM_{vertrauen_i} - 0.294 * OC_i + 1.136 * VERMOEGENk.A._i - 0.728 * EINKOMMENmittel_i + 1.798 * BESCHAEFTIGUNGselbstst_i + 0.218 * INTENS_i - 0.902 * VERMOEGENhoch_i + 1.134 * BESCHAEFTIGUNGsonstig_i - 0.602 * BESCHAEFTIGUNGbeamt_i - 0.012 * \text{ALTER}_i - 0.266 * \text{EINKOMMENniedrig}_i + 0.312 * EINKOMMENk.A._i - 0.072 * GESCHLECHTweiblich_i + 0.091 * VERMOEGENmittel_i - 0.014 * BESCHAEFTIGUNGrente_i + \in_i \quad (1)$$

To minimize model risks, such as overfitting, variables with potentially low significance (e.g., "MOTIV," "NUTZUNG") were excluded. Extensive regression diagnostics were conducted to test assumptions, including sample size adequacy (Hosmer et al., 2013), and to identify influential observations through Pearson residuals (Fox, 2016), with no significant outliers identified. Linear relationships between the variables were also examined, and the majority displayed no significant non-linear effects. Another aspect of regression diagnostics before applying linear regression involves testing for multicollinearity using Generalized Variance Inflation Factors (GVIF), indicating that multicollinearity is not present.

The logistic regression results demonstrate that financial literacy (FL) and the variables "SM_FLimprov" and "SM_ressourcen" have significant positive effects on the use of social media as a financial information source. Conversely, the variable "BESCHAEFTIGUNGstudent" is associated with lower social media use. A detailed presentation of the results can be found in the Appendix 2.

The odds ratios reveal specific strengths of influence; for instance, self-employed occupations (OR: 6.035) significantly increase the likelihood of using social media as a financial source. A "Likelihood Ratio Test" evaluated the model fit, confirming the significance of the full model compared to a reduced model.

This study uses the Bayesian Information Criterion (BIC) to evaluate a sample of 362 observations, comparing the model against a null hypothesis for goodness of fit. The null model's BIC value is 475.01, whereas the proposed model's BIC is significantly lower at 307.39, indicating a better fit, consistent with the BIC principle that lower values reflect stronger model alignment with the data (Gehrke, 2022).

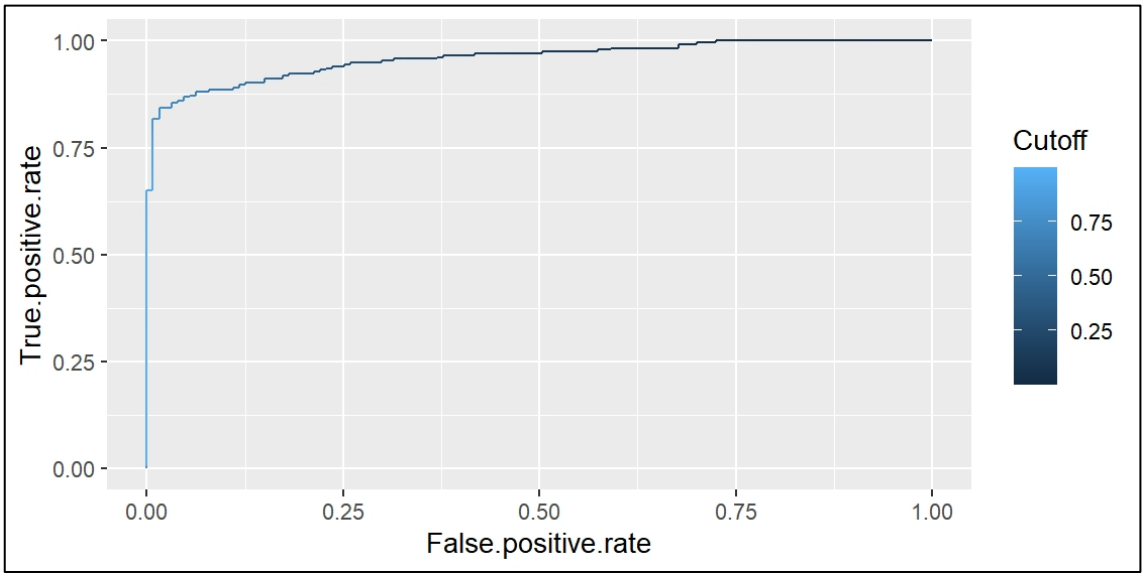
The model also shows a McFadden's R-squared of 0.621, which generally signifies a well-fitting model, although it should be interpreted alongside other model evaluation metrics

rather than in isolation. Additionally, the Receiver Operating Characteristic (ROC) curve systematically varies the classification threshold from 0 to 1, allowing the calculation of sensitivity and specificity for each threshold. As depicted in Figure 3, the ROC curve highlights the trade-off between sensitivity (true positive rate) and 1-specificity (false positive rate) (Groß, 2007).

With a threshold of 0, all cases are classified as positive, leading to a sensitivity of 1 and a specificity of 0, represented as the point (1,1) on the ROC curve. Conversely, a threshold of 1 results in all cases being classified as negative, yielding a sensitivity of 0 and specificity of 1, corresponding to the point (0,0).

A ROC curve diverging significantly from the diagonal, which indicates random classification, demonstrates better model performance. The Area Under the Curve (AUC) serves as a key metric, ranging from 0.5 (random classification) to 1 (perfect classification) (Groß, 2007). The model's AUC of 0.9582 indicates strong discriminatory power, approaching a nearly perfect classification. According to Hosmer et al. (2013), this suggests that the model has exceptional predictive capacity regarding the impact of social media on financial literacy.

Figure 3: ROC Curve 6



Logistic Regression II

A second logistic regression analysis was conducted to examine the influence of social media on financial decision-making. This analysis used the same dataset as before but included the variable "VIP_findec" to consider the impact of public figures, particularly financial influencers. The dependent variable remained whether social media is used for financial decisions (SM), while "financial decision-making" (FE) continued to be analyzed as an independent variable. The distribution of financial decision-making was measured on a scale from 1 to 12 (Median=7, Mean=6.63, Standard Error=3.3).

Formula 2: Logistic Regression II

$$SM_i = -2.321_i + 1.651 * SM_{ressourcen_i} + 0.801 * SM_{FLimprov_i} - 0.473 * OC_i - 1.719 * BESCHAEFTIGUNGstudent_i + 0.222 * FE_i + 0.51 * VIP_{findec_i} + 1.501 * VERMOEGENk.A._i - 0.941 * EINKOMMENmittel_i + 2.267 * BESCHAEFTIGUNGselbstst_i - 0.131 * BILDUNG_i + 0.206 * SM_{vertrauen_i} + 0.472 * VERMOEGENniedrig_i - 0.913 * * VERMOEGENhoch_i + 1.149 * BESCHAEFTIGUNGsonstig_i - 0.015 * \text{ALTER}_i + 0.156 * INTENS_i + 0.408 * VERMOEGENmittel_i - 0.455 * \text{EINKOMMENniedrig}_i - 0.236 * GESCHLECHTweiblich_i + 0.461 * BESCHAEFTIGUNGrente_i - 0.402 * EINKOMMENk.A._i - 0.147 * BESCHAEFTIGUNGbeamt_i + \in_i \quad (2)$$

The model equation is based on logistic regression and shows significant effects for the variables "SM_ressourcen" ($p<0.001$), "SM_FLimprov" ($p<0.01$), "OC," and "BESCHAEFTIGUNGstudent" ($p<0.05$), as well as for "VIP_findec" ($p=0.052$) and "FE" ($p=0.099$). These variables indicate that both social resources and specific employment groups play a significant role in using social media for financial decisions. A detailed presentation of the results can be found in the Appendix 3.

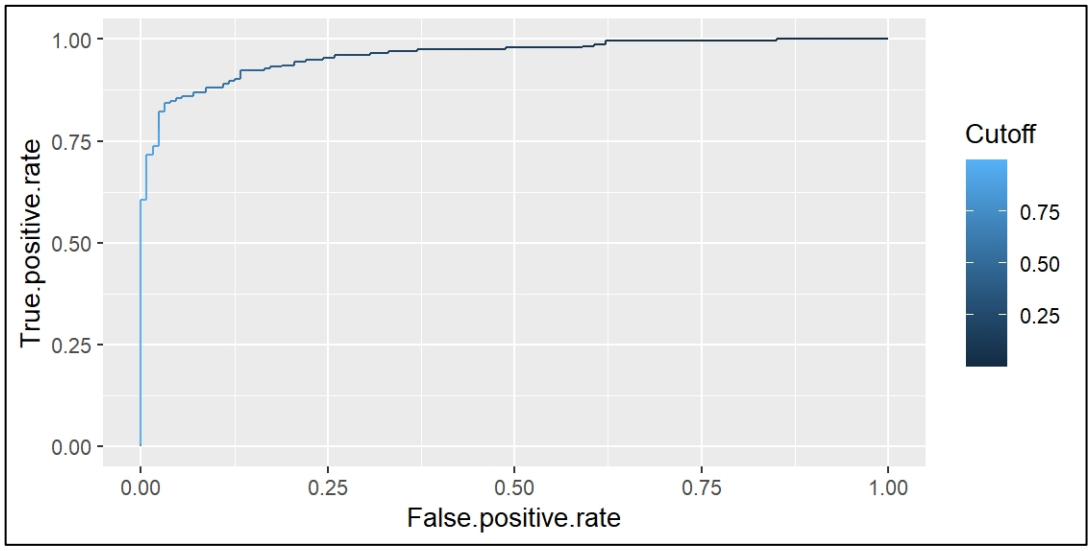
The odds ratio analysis revealed that the probability of using social media as a financial information source increases by a factor of 1.25 with each increment in "FE," while "BESCHAEFTIGUNGselbstst" shows a notably high increase by a factor of 9.65, indicating a strong association between self-employment and the use of social media for financial decisions.

To assess model fit, a comprehensive diagnostic test was conducted, including outlier and multicollinearity tests. No significant outliers or multicollinearity were found, strengthening the model's reliability. The analysis of non-linear relationships showed no significant deviations, so the model is considered predominantly linear.

A test for multicollinearity (GVIF) further confirmed that no variables exceed acceptable limits, and model fit was rated as good, with a McFadden's R-squared value of 0.53. Likelihood Ratio Tests (LRT) showed that the variables "SM_FLimprov," "SM_ressourcen," "VIP_findec," "OC," and "FE" significantly impacted the model, while other control variables such as gender and education played a lesser role.

The model suggests that social media, particularly under the influence of prominent financial influencers and specific occupational backgrounds, can significantly impact personal financial decision-making. Comparison of model fit with the BIC (null model 475.01 vs. own model 310.13) underscores the model’s significant improvement and robustness in predicting social media as a factor in financial decisions. Additionally, the ROC curve, illustrated in Figure 4, and the AUC of 0.9597 further reflect the model’s high discriminatory power and nearly perfect classification ability. This indicates that the model excels in predicting the influence of social media on financial decision-making.

Figure 4: ROC Curve II



Discussion

Interpretation of Results

Before addressing the limitations of this study, the next section provides an analysis and interpretation of the findings.

In Germany, individuals will increasingly need to take personal responsibility for their retirement planning, making sufficient financial resources in old age essential. Financial literacy has been shown to have a positive impact on this preparation, as prior studies by van Rooij et al. (2012), Sekita (2011), Bucher-Koenen Bucher-Koenen & Lusardi (2011) and Lusardi & Mitchell (2011c) demonstrate. These studies found that individuals with financial literacy are better equipped to handle the complexities of wealth-building, highlighting the benefits of improving financial education.

Analyzing comments under videos by financial influencers reveals distinct thematic areas, particularly wealth-building, explained through diverse strategies and tips on topics like real estate, cryptocurrencies, ETFs, insurance, and financial behavior. Compared to traditional educational programs, these videos offer possible advantages, such as cost-free, immediate access, making them a low-barrier resource. High viewership of such content suggests that viewers find them helpful, especially since they can be accessed flexibly when making financial decisions, without the need for formal course registration (Rongstock & Zureck, 2023).

Further, recent research on financial education delivery methods shows that younger audiences prefer media-based content over traditional sources, with print media declining in significance (Jonas et al., 2022). Comments on these influencer videos frequently include words like "thanks" and "good," implying a generally positive reception. This trend aligns with findings by Jonas et al., which suggest that financial literacy content in video form outperforms flyers and other visual aids.

Social media's influence on financial literacy is also evidenced by the research of Yanto et al. (2021) on Indonesian Millennials, where peer interactions on social media led to positive

behavioral shifts in financial habits. Comment sections in these videos enable users to interact with both peers and influencers and indicate that even online research alone can yield learning benefits for older adults. It was also found, that internet resources generally enhance financial literacy despite occasional misinformation. It concluded that, nevertheless, the positive effects outweigh the negative ones and suggests that users can generally gain learning benefits from informational research through videos by financial influencers (Rongstock & Zureck, 2023).

Finally, while much current research on social media influencers focuses on beauty, fashion, and lifestyle, studies by Ki & Kim (2019) reveal that influencers often act as trendsetters whose expertise is more valued for opinion leadership than imitation, suggesting a growing relevance for financial influencers in shaping public knowledge and behavior in financial planning. By breaking down complex subjects into practical advice, Finfluencers fill a gap left by traditional financial education channels.

The analysis of participants' behavior regarding social media use and their engagement with financial information revealed notable trends. Exploratory data analysis shows that most participants use social media multiple times daily (266 participants) or daily (68 participants), primarily for social interactions. These include relationship maintenance, entertainment, following public figures (including finance influencers or celebrities), and self-expression.

Social media is also used significantly for acquiring educational content and knowledge, including financial information and current event updates. Notably, Instagram is preferred for personal connections, while platforms like YouTube and TikTok are popular for financial information.

In terms of financial topics, participants mainly consumed information on wealth-building, general finance topics (e.g., inflation), capital market news, investment and product recommendations, and retirement planning.

The first regression analysis examined the relationship between social media use for financial information (dependent variable, SM) and financial literacy (independent variable, FL), along with several control variables. Results indicate both significant and non-significant effects, offering insights into the dynamics between these variables and social media use for financial information. The independent variable FL shows a positive coefficient, suggesting that higher financial literacy correlates with greater social media use for financial information. A one-unit increase in FL increases the odds ratio by about 2.22, meaning that financially literate individuals are more likely to use social media for financial information. This suggests that enhancing financial literacy could promote the use of social media as an educational tool for finance.

The variables SM_FLimprov and SM_ressourcen demonstrate highly significant positive effects (p-values < 0.0001) on the use of social media for financial information. The odds ratios for SM_ressourcen and SM_FLimprov are 1.24 and 3.49, respectively, indicating that increased financial resource utilization and the perception that financial literacy is improved through social media correlate with higher likelihoods of using social media for financial information.

Regarding employment type, a significant yet negative effect was found for the category "student." Self-employed individuals have a notably higher probability of using social media

for financial information compared to government employees or students. Employment type thus significantly influences social media use for financial information, with self-employed individuals having an odds ratio approximately 6.04 times higher, while students have a reduced likelihood of about 85.8%.

The variable SM_VERTRAUEN, reflecting trustworthiness of information on social media, has a positive coefficient of 0.34, suggesting that individuals who view social media as a trustworthy source are more likely to use it for financial purposes. An increase in trustworthiness by one unit raises the odds by about 40.4%. This finding is critical for financial service providers and regulators seeking to encourage social media use for financial education and information; labeling accurate information could help mitigate the risks associated with misinformation.

Variables such as education, age, and gender show no significant impact on social media use for financial purposes. The coefficients for age and education are negative but insignificant, indicating minimal effects compared to other factors like information trustworthiness.

The regression analysis of income (EINKOMMEN) and wealth (VERMOEGEN) revealed additional associations. Lower income categories generally correlate with reduced likelihoods of using social media for financial information. Specifically, the odds of individuals with middle incomes using social media for financial information are roughly half those of individuals with high incomes, based on a p-value of 0.27 and an odds ratio of 0.48. Similar trends are observed for low-income individuals.

Regarding wealth, middle-wealth participants are slightly more likely to use social media for financial information than those with no wealth, with an odds ratio of 1.1. However, those with high wealth (over €250,000) are less likely to use social media for this purpose (odds ratio of 0.41).

The variables INTENS and OC provide insights into social network usage intensity and self-assessment in financial matters. Higher social media usage intensity shows a slight but not significant increase in likelihood for financial information use. Meanwhile, individuals with overconfidence in financial knowledge tend to use social media for financial information less frequently, though this result lacks statistical significance.

The second regression analysis explored the influence of social media on financial decision-making. The financial decision-making variable (FE) showed a mildly significant effect (p-value=0.1) with an odds ratio of 1.25, indicating that each unit increase in financial decision-making is associated with a 24.8% increased likelihood of using social media.

The variable SM_ressourcen, indicating social media's influence on resource consumption, is strongly significant, with an odds ratio of 5.21, suggesting that individuals who use social media as a resource influence are 5.21 times more likely to engage in such resources. Similarly, SM_FLimprov is highly significant with an odds ratio of 2.23, showing that social media may play a critical role in promoting financial literacy.

The variable OC (overconfidence) serves as a measure of self-assessment in finance, with a negative coefficient (-0.47) and a significant p-value (0.02). The odds ratio of 0.62 suggests that overconfidence reduces the likelihood of accurate or appropriate financial knowledge application.

In sum, these findings suggest that social media significantly influences financial information consumption and decision-making, especially among financially literate and self-employed individuals. Overconfidence has a negative association with appropriate financial knowledge use, while high trust in social media positively correlates with financial information use. These results highlight the potential of social media as an educational platform for finance and support developing strategies that enhance financial literacy and informed financial decisions through social media.

Limitations

Despite high model fit and statistically significant outcomes based on a sample size of 362, it is acknowledged that limitations exist regarding generalizability, as a larger sample would likely yield more representative results.

Several specific limitations have been identified: First, a selection bias may arise from only considering specific generational cohorts. Second, unobserved variables could potentially influence the dependent variable, introducing endogeneity issues. Third, the simplified coding of financial knowledge responses hinders differentiation and may inaccurately capture overconfidence effects. Additionally, efforts to reduce overfitting led to model simplifications, consequently limiting analytical complexity and potentially excluding relevant factors.

Overall, this work identifies methodological and conceptual limitations that are crucial for transparent and precise interpretation of the findings and provide potential directions for future research.

Furthermore, the supporting research utilized in this study also faces its own limitations. The dataset, comprising YouTube user comments, offers only limited insights, particularly as other platforms such as Instagram—also influential in financial content—were not included. While the cluster analysis identified thematic focus areas in video content, the quality of these contributions and users' underlying attitudes were not comprehensively analyzed. Determining the optimal number of clusters also posed a methodological challenge. Future research can leverage these insights to refine methodology and gain deeper understanding of the impact of financial influencers on financial literacy (Rongstock & Zureck, 2023).

Conclusion

The analysis reveals significant patterns in social media usage and financial engagement, highlighting the increasing role of platforms like YouTube and TikTok in providing educational content, particularly related to finance. Most participants utilize social media not only for social interactions but also for acquiring knowledge on financial topics such as wealth-building, capital markets, and retirement planning.

The regression analysis indicates a positive correlation between financial literacy and the use of social media for financial education. Those with higher financial literacy are more likely to engage with financial resources on social media, with employment type influencing this engagement; self-employed individuals show the highest likelihood, whereas students are less likely to seek financial information online. Trust in the reliability of social media also significantly affects its use for financial purposes, suggesting that labeling verified content could enhance engagement while minimizing misinformation risks.

Income and wealth levels further impact social media engagement, with individuals from higher income brackets more inclined to utilize these platforms for financial information. Interestingly, overconfidence in one's financial knowledge appears to hinder social media use for financial education. Despite these challenges, social media is seen as a valuable tool that positively influences financial decision-making, particularly for those who perceive it as a resource.

In summary, financial literacy is crucial for preparing individuals for retirement, especially as they assume greater responsibility for their financial futures. Studies confirm that financially literate individuals are better equipped to navigate the complexities of wealth-building, emphasizing the importance of financial education. Financial influencers (Finfluencers) are emerging as accessible educators, offering immediate, cost-free access to diverse financial topics, which resonates particularly well with younger audiences who prefer digital formats over traditional media. The interactive nature of social media fosters peer-to-peer exchange and reinforces financial knowledge, making Finfluencers instrumental in bridging educational gaps and enhancing financial literacy. While there are risks associated with misinformation, the overall benefits of learning from Finfluencers outweigh these concerns, establishing them as valuable contributors to improving financial knowledge and behaviors.

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Appendices

Appendix A: Operationalization of Variables

Control variable	Operationalization		Scale level
Gender (GESCHLECHTweiblich)	male		Nominal (binary)
	female		
Age (ALTER)	in years		Metric
Education (BILDUNG)	No school qualification	0	Ordinal
	ISCED 2 (Secondary education)	2	
	ISCED 3 (High school diploma / vocational qualification)	3	
	ISCED 6 (Bachelor or equivalent / master craftsman / technician)	6	
	ISCED 7 (Master's degree or equivalent)	7	
	ISCED 8 (Doctorate)	8	
Employment Status (BESCHAEFTIGUNG)	Student / apprentice: student	student	Nominal
	Employee	angestellt	
	Civil servant	beamt	
	Self-employed	selbstst	
	Retired / pensioner	rente	
	Other (unemployed / looking for work)	sonstig	
Income (EINKOMMEN)	Low (less than €2,000)	niedrig	Ordinal
	Medium (less than €3,000)	mittel	
	High (more than €3,000)	hoch	
	No information:	k.A.	
Wealth (VERMOEGEN)	None (yet)	garnicht	Ordinal
	Low (less than €25,000)	niedrig	
	Medium (less than €250,000)	mittel	
	High (more than €250,000)	hoch	
	No information	k.A.	
Active Social Media Account (SM_ACC)	Yes = 1, No = 0		Nominal (binary)
Intensity of Social Media Use (INTENS)	Rarely	1	Ordinal
	Once a week	2	

	Several times a week	3	
	Daily	4	
	Multiple times a day	5	
Trustworthiness of Social Media (SM_vertrauen)	Scale from 1 (Strongly disagree) to 6 (Strongly agree)		Ordinal
Influence of Social Media on Financial Competence (SM_FLimprov)	Scale from 1 (Strongly disagree) to 6 (Strongly agree)		Ordinal
Influence of Public Figures on Financial Decisions (VIP_findec)	Scale from 1 (Not at all) to 6 (Very strongly)		Ordinal
Use of Financial Resources (SM_ressourcen)	Yes = 1, No = 0		Nominal (binary)

Appendix B: Detailed Results of the Logistic Regression I

This summarizes the results of the first logistic regression, sorted by descending significance level, highlighting the importance of the variables.

The table consists of six columns divided into the rank of the variables, their names, the estimated coefficients (Estimate), standard errors (Std. Error), as well as the z-values and p-values (Pr(>|z|). The statistical significance of the estimated regression coefficients is indicated by asterisks (***, **, *, .) and the p-value. If the p-value is less than 0.05 (*), 0.01 (**), or 0.001 (***), this suggests that there is a statistically (highly/very) significant relationship between the independent and the dependent variable. The intercept parameter represents the estimated log-odds when all independent variables have a value of zero (Kalisch & Meier, 2021). Each row indicates how the dependent variable changes with a one-unit increase in the independent variable.

Table 1: Results of the logistic Regression I

Pos.	Variable	Estimate	Std. Error	z value	Pr(>|z|)
	Intercept	-4.08677	2.01526	-2.028	0.04257 *
1.	SM_FLimprov	1.24914	0.20090	6.218	5.05e-10 ***
2.	SM_ressourcen	2.05626	0.48073	4.277	1.89e-05 ***
3.	BESCHAEFTIGUNGstudent	-1.95382	0.74988	-2.605	0.00917 **
4.	FL	0.79663	0.31136	2.559	0.01051 *
5.	BILDUNG	-0.22143	0.13586	-1.630	0.10313
6.	SM_vertrauen	0.33954	0.20928	1.622	0.10471
7.	OC	-0.29374	0.19815	-1.482	0.13823
8.	VERMOEGENk.A.	1.13647	1.00263	1.133	0.25701
9.	EINKOMMENmittel	-0.72779	0.66407	-1.096	0.27310
10.	BESCHAEFTIGUNGselbstst	1.79766	1.68050	1.070	0.28475
11.	INTENS	0.21763	0.26014	0.837	0.40284
12.	VERMOEGENhoch	-0.90160	1.25358	-0.719	0.47201
13.	BESCHAEFTIGUNGsonstig	1.13352	1.64638	0.688	0.49114
14.	BESCHAEFTIGUNGbeamt	-0.60157	0.98488	-0.611	0.54133
15.	ALTER	-0.01183	0.02325	-0.509	0.61099
16.	EINKOMMENniedrig	-0.26620	0.84187	-0.316	0.75185
17.	VERMOEGENniedrig	0.16381	0.60140	0.272	0.78533
18.	EINKOMMENk.A.	0.31246	1.45850	0.214	0.83036
19.	GESCHLECHTweiblich	-0.07241	0.50019	-0.145	0.88490
20.	VERMOEGENmittel	0.09065	0.72606	0.125	0.90064
	BESCHAEFTIGUNGrente	0.01445	1.55067	0.009	0.99256
Significance level: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1					

Subsequently, the odds ratios for the independent variable FL as well as the other control variables of the model are presented in the following Table 2.

Table 2: Odds Ratios of the logistic Regression I

	Odds Ratio		Odds Ratio
Intercept	0.01679346	FL	2.21806279
GESCHLECHTweiblich	0.93015410	ALTER	0.98824456
BILDUNG	0.80137381	BESCHAEFTIGUNGbeamt	0.54794876
BESCHAEFTIGUNGrente	1.01455489	BESCHAEFTIGUNGselbstst	6.03549546
BESCHAEFTIGUNGsonstig	3.10657356	BESCHAEFTIGUNGstudent	0.14173197
EINKOMMENk.A.	1.36678357	EINKOMMENmittel	0.48297601
EINKOMMENniedrig	0.76628384	VERMOEGENhoch	0.40591972
VERMOEGENk.A.	3.11574946	VERMOEGENmittel	1.09488515
VERMOEGENniedrig	1.17798593	INTENS	1.24312096
SM_vertrauen	1.40430310	SM_FLimprov	3.48732664
SM_ressourcen	1.24312096	OC	0.74547241

Odds ratios are a statistical measure that indicates the factor by which the probability of using social media as a financial information tool changes when an independent variable or control variable increases by one unit, while keeping all other variables constant (Nemes et al., 2009). An odds ratio greater than 1 suggests that a higher level of the independent or control variable is associated with a higher probability of using social media as a financial information tool (SM). Conversely, an odds ratio less than 1 means that the probability of using SM decreases.

Appendix C: Detailed Results of the Logistic Regression II

The significance level is defined as follows: '***' $p < 0.001$, '**' $p < 0.01$, '*' $p < 0.05$, '.' $p < 0.1$, and ' ' $p \geq 0.1$.

Table 3: Results of the logistic Regression II

Pos.	Variable	Estimate	Std. Error	z value	Pr(>|z|)
	Intercept	-2.32086	1.96109	-1.183	0.236630
1.	SM_ressourcen	1.65054	0.49500	3.334	0.000855 ***
2.	SM_FLimprov	0.80134	0.25045	3.200	0.001376 **
3.	OC	-0.47330	0.20745	-2.282	0.022518 *
4.	BESCHAEFTIGUNGstudent	-1.71937	0.74616	-2.304	0.021206 *
5.	FE	0.22161	0.13439	1.649	0.099136 .
6.	VIP_findec	0.50963	0.26174	1.947	0.051528 .
7.	VERMOEGENk.A.	1.50148	0.99223	1.513	0.130219
8.	EINKOMMENmittel	-0.94064	0.67260	-1.399	0.161956
9.	BESCHAEFTIGUNGselbstst	2.26702	1.81572	1.249	0.211829
10.	BILDUNG	-0.13143	0.13214	-0.995	0.319913
11.	SM_vertrauen	0.20601	0.21688	0.950	0.342164
12.	VERMOEGENniedrig	0.47188	0.60537	0.779	0.435693
13.	VERMOEGENhoch	-0.91259	1.32497	-0.689	0.490972

14.	BESCHAEFTIGUNGsonstig	1.14880	1.75336	0.655	0.512340
15.	ALTER	-0.01499	0.02316	-0.647	0.517599
16.	INTENS	0.15586	0.26645	0.585	0.558577
17.	VERMOEGENmittel	0.40839	0.74378	0.549	0.582955
18.	EINKOMMENniedrig	-0.45451	0.86093	-0.528	0.597552
19.	GESCHLECHTweiblich	-0.23587	0.50490	-0.467	0.640377
20.	BESCHAEFTIGUNGrente	0.4611	1.49866	0.308	0.758318
21.	EINKOMMENk.A.	-0.40223	1.53098	-0.263	0.792763
22.	BESCHAEFTIGUNGbeamt	-0.14718	0.96607	-0.152	0.878912
Signifikanzniveau: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1					

The odds ratios for the independent variable (FE) and the other control variables are presented in Table 4. These indicate how the likelihood of using social media for financial information changes when the independent variable or a control variable changes by one unit, while all other variables are held constant. According to the explanations in Chapter 4.5.1, odds ratios with a value greater than 1 suggest that a higher level of the independent (control) variable is associated with a higher probability, while odds ratios less than 1 correspondingly indicate a lower probability.

Table 4: Odds Ratios of the logistisc Regression II

	Odds Ratio		Odds Ratio
Intercept	0.09818924	FE	1.24809047
GESCHLECHTweiblich	0.78987945	ALTER	0.98512492
BILDUNG	0.87683699	BESCHAEFTIGUNGbeamt	0.86313996
BESCHAEFTIGUNGrente	1.58585423	BESCHAEFTIGUNGselbstst	9.65062072
BESCHAEFTIGUNGsonstig	3.15440747	BESCHAEFTIGUNGstudent	0.17917913
EINKOMMENk.A.	0.66883022	EINKOMMENmittel	0.39037810
EINKOMMENniedrig	0.63476109	VERMOEGENhoch	0.40148152
VERMOEGENk.A.	4.48830698	VERMOEGENmittel	1.50439687
VERMOEGENniedrig	1.60300486	INTENS	1.16866607
SM_vertrauen	1.22876545	SM_FLimprov	2.22853468
SM_ressourcen	5.20979380	VIP_findec	1.66467249
OC	0.62294026		

Assessing and Enhancing the Educational Environment for Hybrid Building Construction Lectures at Korean Universities

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Abstract
Online education at Korean universities is expanding and developing through COVID-19. One of the continued development directions of online education is the use of hybrid lectures. In hybrid lectures, learners can choose how they attend class. Learners can attend offline or online. This study aims to apply hybrid lectures to building construction education at Korean universities. That is, the purpose of this study is to analyze the current state of the educational environment at Korean universities and suggest ways to improve the educational environment. In order to apply hybrid lectures, a supportive educational environment is essential for successful hybrid lectures. In this study, the scope of the educational environment included educational infrastructure (facilities and equipment), teaching and learning support systems, and academic operation regulations. In order to analyze the educational environment of Korean universities, data on the educational environment of 30 Korean universities were collected. The universities being investigated were selected from among Korean universities in a balanced manner in terms of region, size, and founding entity. The data collection method included document analysis, on-site investigation, and interviews. The survey results showed that many universities are expanding their infrastructure year after year. Among the universities surveyed, only four universities were found to have added specific regulations related to hybrid lectures. It was analyzed that in order to apply hybrid lectures, Korean universities need to continuously improve their educational environment. This will allow Korean universities to more actively introduce hybrid lectures and improve the learning environment for students.

Keywords: Building Construction, Hybrid Curriculum, Educational Environment, Online Education

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Introduction

Online education is continuously expanding and developing with the advancement of ICT technology. Online education is evolving to increase learning effectiveness by improving learners' learning choices. Hybrid lectures allow learners to choose how they attend. Learners can attend offline or online. This study is a basic study for applying hybrid lectures to building construction education at Korean universities. That is, the purpose of this study is to analyze the current state of the educational environment at Korean universities and suggest ways to improve the educational environment. In order to apply hybrid lectures, an educational environment that can apply hybrid lectures must be established. We analyzed domestic and international research trends on the topic of hybrid lectures. It was revealed that various studies are being conducted to improve the learning effectiveness of hybrid lectures and develop hybrid curriculum (Table 1). Representative existing studies are as follows. Lim (2023) developed and presented a hybrid curriculum for university education (Lim, 2023). We are providing reference materials for instructors in the field of education by applying instructional design strategies to hybrid learning. Kim (2022) analyzed the learning effect of hybrid lectures (Kim, 2022). It analyzed the needs of university professors to derive the optimal plan for operating hybrid classes. Existing studies have mainly focused on designing teaching and learning methods for hybrid lectures and analyzing learning effects. This study is considered to be different from previous studies because it analyzed the educational environment of Korean universities and suggested improvement measures.

Table 1: Literature Review

Authors (year)	Research contents
Lim (2023)	Development of conceptual models and instructional design strategies for hybrid in higher education
Han, Jeong, Ahn (2022)	Study on Hybrid Class Operation in Korean Language Education
Kim (2022)	Needs Analysis for the Effective Operation of University Hybrid Classes in the Post-COVID Era
Cho (2023)	Investigating Academic Motivation and Achievement of College Freshmen in Hybrid, Online, and In-class Learning

Current Status of Online Education Environment at Korean Universities

Data Collection Overview

In order to analyze the educational environment of Korean universities, data on the educational environment of 45 universities were collected. The data collection methods included document research, on-site investigation, and interviews. The universities being investigated were selected from Korean universities in a balanced manner in terms of region, size, and founding entity (Table 2). In this study, the scope of the educational environment included educational infrastructure (facilities and equipment), learning management systems(LMS), and academic operation regulations.

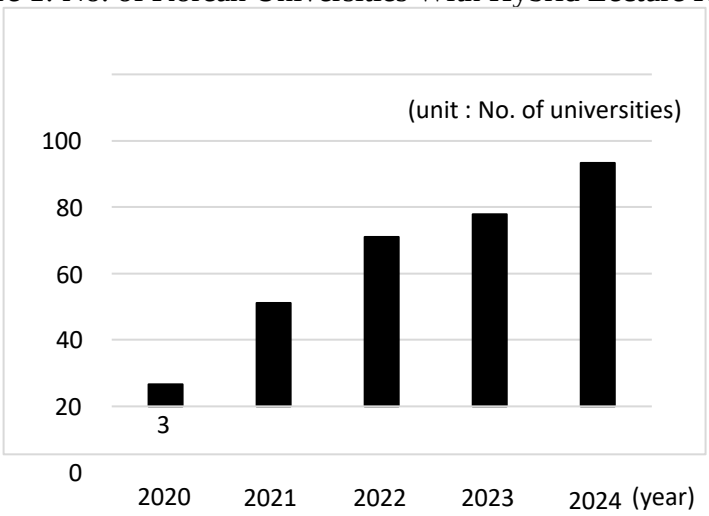
Table 2: Regional Distribution of Surveyed Universities

Region					National · Private	
Seoul· Metropolitan	Chungcheong	Honam	Yeongnam	Gangwon·Jeju	National	Private
9	10	10	10	6	20	25

Hybrid Lecture Room

We investigated whether Korean universities have hybrid classrooms. The number of universities with hybrid classrooms is expected to increase significantly from three in 2020 to 33 in 2024 (Figure 1). These results are believed to be due to Korean universities actively introducing innovative teaching methods such as hybrid lectures.

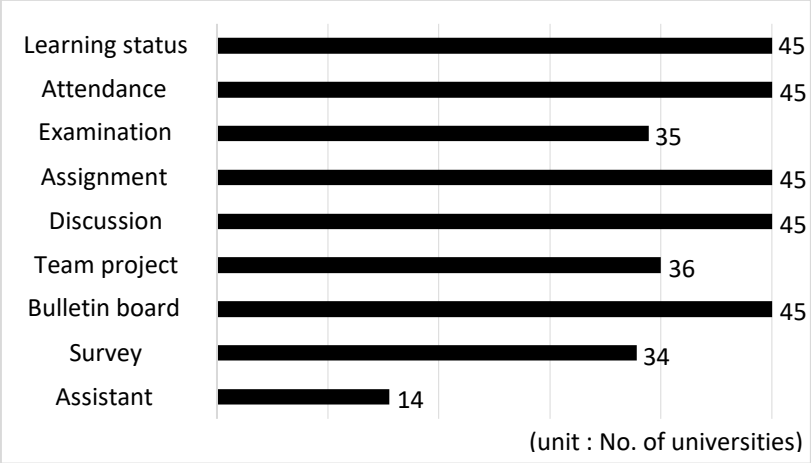
Figure 1: No. of Korean Universities With Hybrid Lecture Rooms



Learning Management System

Figure 2 shows the results of analyzing the functions of LMS used in Korean universities. Nine core functions were analyzed. It was found that five functions, including ‘learning status’ and ‘attendance’, are being utilized in all universities. On the other hand, there were many universities that did not have ‘exam’, ‘team project’, or ‘survey’ functions. It was analyzed that the LMS currently in use is structured around learning management. In order for LMS to support hybrid lectures, it is believed that functions supporting real-time interaction should be added.

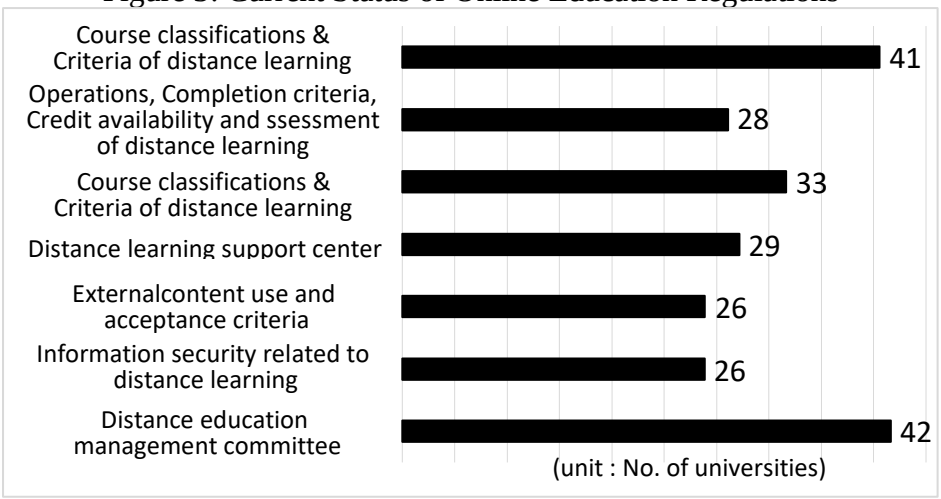
Figure 2: Current Status of LMS Functions



Regulations Related to Online Education

The results of analyzing the regulations related to online education at Korean universities are shown in Figure 3. We analyzed whether the regulations of Korean universities comply with Korean laws related to online education. The laws used as the basis for analysis were the 'Distance Education Act' and the 'Ordinance on the Operation of Distance Learning in Universities, etc.' The analysis results showed that most universities were complying with the ordinance regarding the 'Classification and Opening Standards for Distance Learning Subjects' and 'Distance Education Management Committee.' However, it was found that many universities do not have regulations for other items. In particular, the provisions of the 'Matters related to information protection related to remote classes' section were found to lack specificity. These results are believed to be due to the fact that the law was recently implemented (December 2023), and some universities have not yet completed the revision of the regulations.

Figure 3: Current Status of Online Education Regulations



Improvement of Educational Environment for Introduction of Hybrid Lectures

Educational Facilities and LMS

Table 3 presents a plan to improve educational facilities and learning support systems. Educational facilities were divided into three groups by user: instructors, learners, and instructors and learners. Auxiliary monitors are needed to check the status of online learners and respond quickly to questions and answers. Tracking cameras can automatically track the instructor's movements to increase online learner engagement in lecture activities. Microphones and speakers for learners can support smooth communication between offline and online learners. Cameras and monitors for learners can support smooth communication and learning activities. VR/AR devices can explain learning content in an immersive way. The discussion and team project functions of LMS need to be improved from the existing bulletin board format to enable real-time video conferencing and chatting.

Table 3: Improvements of Educational Facility and LMS

User	Classification	Improvement measures
Instructor	Secondary monitor	• Check the status of online learners and manage Q&A sessions effectively.
	Tracking camera	• Record instructor movements and lecture activities for enhanced learner engagement.
Learner	Microphone and speaker	• Facilitate auditory interaction between face-to-face and online learners
	Camera and monitor	• Enable visual interaction between face-to-face and online learners
Instructor · learner	VR/AR equipment	• Provide immersive learning experiences akin to real-world environments
LMS	Discussion	• Improve real-time communication functionalities
	Team projects	• Enhance collaborative capabilities for team-based activities

Regulations

Table 4 presents a plan to improve regulations for Korean universities to introduce hybrid lectures. It is necessary to define ‘hybrid lectures’ in regulations related to online education. It is necessary to supplement the regulations to allow real-time remote classes. Attendance management for real-time remote classes requires establishing clear attendance regulations according to the circumstances of each university. Teaching assistants need to be supported to the extent possible depending on the circumstances of each university.

Table 4: Improvement of Regulations for Hybrid Lecture Introduction

Classification	Improvement measures
Hybrid lecture	• Add hybrid lectures to distance learning definitions
Real timedistance learning	• Allow real-time distance learning
Real time distance learning attendance management	• Requires attendance regulations for real time distance learning
Teaching assistant	• Assign to the extent possible

Conclusion

Hybrid lectures are gaining attention as a teaching method that can contribute to the realization of student-centered education by expanding learners' learning choices. This study analyzed the problems of the educational environment for introducing hybrid lectures to architectural construction education at Korean universities and suggested improvement measures. The results of the analysis of the educational environment of Korean universities are as follows. It was found that hybrid lecture facilities at Korean universities are gradually increasing. It was analyzed that some functions of the learning support system need to be supplemented and added in order to support hybrid lectures. It was also found that many improvements, such as ‘personal information protection’, are needed in academic regulations in order to apply hybrid lectures. The following are ways to improve the educational environment of Korean universities. Educational facilities and equipment need to be continuously expanded. This should minimize inconveniences in teaching and learning activities for professors and students. LMS should also be supplemented to enable smooth communication between online and offline learners. Academic regulations should be continuously supplemented to protect and support professors and students participating in hybrid lectures. This study is a basic study for introducing hybrid lectures to Korean universities. It is believed that the contents presented in this study can be used as reference material for introducing hybrid lectures to Korean universities.

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Enhancing Digital Competencies in Civil Engineering Education Through Building Information Modeling (BIM) Integration: A Case Study at University of Maribor

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Abstract
Integrating Building Information Modeling (BIM) into civil engineering education offers a comprehensive digital approach, enabling students to create detailed models that encompass all project phases, from design to maintenance. It fosters collaboration among various professionals, improves practical experience with cutting-edge tools, and enhances visualization and analysis skills. Through interdisciplinary learning, students understand the interconnected aspects of architecture, engineering, and management. Our research was focused on reviewing the curriculum for the civil engineering study program and analyzing which professional courses could effectively integrate BIM during the next curriculum revision at the University of Maribor. This study aims to identify specific courses where BIM integration would be most beneficial to improve students' digital competencies. A preliminary analysis of the civil engineering curriculum indicates that integrating BIM into courses such as Structural Engineering, Construction Management, and Urban Planning can significantly enhance the digital competencies of our graduates. As part of the study, we will conduct interviews with selected lecturers. We expect that students will gain hands-on experience with cutting-edge technology, fostering their ability to manage complex projects and collaborate effectively in multidisciplinary teams. Furthermore, BIM integration can enhance students' understanding of real-world construction processes by providing a more interactive and immersive learning experience. This will bridge the gap between theoretical knowledge and practical application, allowing students to visualize and manipulate digital models of their projects. As a result, they will develop stronger problem-solving skills and a deeper understanding of construction dynamics.

Keywords: Building Information Modeling (BIM), Civil Engineering Education, Curriculum Integration, Digital Competencies, Interdisciplinary Collaboration

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Introduction

Building Information Modeling (BIM) has emerged as a transformative force within the Architecture, Engineering, and Construction (AEC) industry, offering a comprehensive digital framework that enhances project visualization, coordination, and execution. The integration of BIM into civil engineering education is increasingly recognized as essential for equipping future professionals with digital competencies required in a modernized construction environment. Recent studies emphasize the importance of digitalization and BIM-based education in higher learning institutions, highlighting its role in improving design, collaboration, and sustainability in construction projects.

Xu (2024) discusses the necessity of integrating information technology into civil engineering education, highlighting the role of BIM in enhancing design optimization and interdisciplinary collaboration. Similarly, Zahin (2024) outlines a digital innovation roadmap for the construction industry, emphasizing the increasing role of digital tools and smart technologies in modernizing construction education. Another study from Besiktepe et al. (2024), systematically analyzes how digital pedagogy, including BIM, enhances students' technical skills and interdisciplinary collaboration. Kong (2024) explores the integration of BIM into civil engineering curricula, focusing on innovative teaching models and university-enterprise collaboration to enhance students' technical skills and interdisciplinary cooperation. Lozano-Galant et al. (2024) present the development of an affordable augmented reality tool for visualizing BIM models, demonstrating its application in civil engineering courses to improve students' understanding of complex projects. Purwanto et al. (2024) conduct a comprehensive literature review on the integration of BIM in civil engineering projects, discussing its benefits, challenges, and implementation strategies to optimize project outcomes.

Furthermore, Flogie and Repnik (2008) highlight the broader impact of digitalization in education, particularly in knowledge-sharing and the transformation of traditional learning methodologies through digital technologies. They argue that digital literacy and access to digital tools are fundamental in bridging the gap between academic learning and practical applications, a perspective that aligns with the integration of BIM into civil engineering education at the University of Maribor.

The University of Maribor is currently reviewing its curriculum to identify opportunities for incorporating BIM into its civil engineering program. Preliminary analyses suggest that courses such as Structural Engineering, Construction Management, and Urban Planning are prime candidates for BIM integration. The objective is to enhance students' digital competencies and prepare them for the complexities of modern construction projects. This initiative aligns with global educational trends, which emphasize the importance of digitalization and BIM in engineering curricula.

By integrating BIM into these courses, the University aims to provide students with hands-on experience using advanced digital tools, thereby bridging the gap between theoretical knowledge and practical application. This approach is expected to improve students' problem-solving abilities, enhance their understanding of construction dynamics, and prepare them for effective collaboration in multidisciplinary teams. Such educational strategies have been successfully implemented in other institutions, demonstrating the value of BIM in fostering a more interactive and immersive learning experience.

This paper presents the findings of the curriculum review, detailing the proposed integration of BIM into specific courses and discussing the anticipated benefits for students' educational outcomes and future professional practice. Through this initiative, the University of Maribor seeks to align its civil engineering undergraduate study program with industry standards and technological advancements, ensuring that graduates are well-equipped to meet the demands of the evolving AEC sector.

Research Methodology

To assess the feasibility of BIM integration into the civil engineering curriculum, this study employed a qualitative and quantitative approach. The methodology consisted of several key steps: curriculum review, a structured faculty survey, data collection and analysis, and benchmarking against other institutions.

Curriculum Review

A detailed review of the undergraduate civil engineering curriculum was conducted to identify courses that could benefit from BIM integration. The analysis focused on existing course syllabi, learning objectives, and teaching methods to determine the relevance of BIM-based instruction. Courses that already included digital tools were examined to evaluate their potential for expanding BIM functionalities, while subjects lacking digital integration were identified as prime candidates for inclusion.

Survey of Course Instructors

A structured questionnaire was developed and distributed to faculty members responsible for teaching core civil engineering courses. The survey aimed to gather insights into the perceived relevance of BIM in their courses, the potential benefits and challenges of BIM adoption, and resource requirements such as software access and faculty training.

Survey Design and Distribution

The questionnaire included 14 structured questions, categorized into four sections: (1) General course information, such as course title and semester placement; (2) Current use of digital tools, assessing which technologies and software were already in use; (3) Potential BIM applications, exploring areas where BIM could improve visualization, structural analysis, and interdisciplinary learning; and (4) Challenges and resource limitations, focusing on issues like software accessibility, training, and curriculum adjustments.

Data Collection and Analysis

Responses were collected from five instructors across one core course. Qualitative responses were categorized thematically to highlight common concerns and recommendations. These findings were then mapped onto the curriculum structure to determine the most effective course placements for BIM integration.

Benchmarking Against Other Institutions

To strengthen the study’s recommendations, a comparative analysis was conducted against existing case studies of BIM integration in civil engineering programs at peer institutions.

This benchmarking process identified the best practices in BIM adoption, helping refine the implementation strategy and aligning it with global trends in engineering education.

Analysis of the Civil Engineering Undergraduate Study Program

Firstly, we analyze the possibility of introduction of a group project for individual study year civil engineering students, integrating the relevant courses from the provided syllabi of three-year civil engineering undergraduate study program. In all proposed group projects, the objectives, relevant courses, project description, deliverables, assessment criteria and skills developed were considered.

First-Year

The group project "Designing and Constructing a Sustainable Residential Building" is proposed. First-year civil engineering students will collaborate in groups of 4–6 to design a sustainable residential building, applying principles from courses such as Introduction to Civil Engineering, Geometric Modeling & Descriptive Geometry, Physics, Computer Programming, Architectural Constructions, Building Materials, and Geodesy. The project encompasses site analysis, structural design, material selection, and sustainability considerations. Deliverables include a comprehensive report with 2D and 3D plans, structural analysis, a materials list emphasizing sustainability, an energy efficiency simulation, and a site layout. Additionally, students will create a physical or digital model and present their work orally. Assessment focuses on technical accuracy, interdisciplinary integration, innovation in sustainability, teamwork, and presentation skills. This project aims to enhance practical application of theoretical knowledge, foster collaboration, and instill an understanding of sustainable construction practices.

Second-Year

The group project "Sustainable Foundation Design and Structural Stability" is proposed. Second-year civil engineering students will collaborate in groups of 4–6 to design sustainable foundations and ensure the structural stability of a residential building. This project integrates concepts from courses including Soil Mechanics, Mechanics of Deformable Bodies, Structural Design, Building Physics, Building Technology, Construction Management, and Construction Operations. Key tasks involve site and soil analysis, foundation and structural system design, application of building technology, and project management. Deliverables comprise a comprehensive report detailing analyses and designs, 2D and 3D digital models, and an oral presentation. Assessment criteria focus on technical accuracy, interdisciplinary integration, sustainability and innovation, teamwork, and communication skills. The project aims to enhance students' practical application of theoretical knowledge, foster collaboration, and promote sustainable construction practices.

Third-Year

The group project "Multi-Material Bridge Design with Sustainability Focus" is proposed. Third-year civil engineering students will collaborate in groups of 4–6 to design a multi-material bridge, incorporating concrete, steel, and timber, with a focus on sustainability, cost-effectiveness, and environmental impact. This project integrates principles from courses such as Concrete Structures, Steel Structures, Timber Structures, Hydrotechnics, Construction Economics, Precise Geodetic Measurement Methods, and Energy Principles and Variational

Methods. Key tasks include material selection and design, hydraulic analysis for flood resilience, economic cost estimation, and precise geodetic planning for accurate construction. Deliverables comprise a comprehensive report detailing design decisions, hydraulic and economic analyses, and geodetic plans; technical drawings and 2D/3D models; and an oral presentation. Assessment criteria emphasize technical accuracy, interdisciplinary integration, sustainability and innovation, teamwork, and communication skills. This project aims to provide a holistic learning experience by integrating technical, environmental, and economic considerations into a practical bridge design.

One Project Proposal - All Three-Year Group Project

We believe that implementing a project in each academic year may not be feasible. Therefore, instead of three projects, we have proposed a single project. This project is designed to emphasize Building Information Modeling (BIM) (digitalization), the green transition, and energy literacy. ECTS credits are also specified (the average course carries 5 ECTS), along with the courses from which these ECTS could be reallocated if a new course were to be created, or from which subjects' content could be drawn if the project remains within existing courses. The Courses to draw content from are: Concrete Structures, Building Physics, Construction Management, Construction Economics and Computer Modeling of Building Structures (all having 5 ECTS). Detailed proposal is in Appendix A.

The proposed project, "Digital Sustainability: Designing a Multi-Purpose Building Using BIM for Energy Efficiency and Green Transition" aims to immerse students in sustainable construction practices through the integration of Building Information Modeling (BIM) and digital tools. By leveraging BIM, students will develop a comprehensive digital model of a multi-purpose building, facilitating detailed analysis of energy consumption, material optimization, and life cycle assessment. This approach aligns with the industry's shift towards sustainability, as digital tools like BIM are instrumental in optimizing design and construction processes to reduce environmental impact.

The project emphasizes the green transition by encouraging the selection of sustainable materials and the incorporation of renewable energy sources, thereby reducing the building's carbon footprint. Through digital simulations, students will assess the environmental impact of their design choices, promoting energy literacy and an understanding of sustainable building practices. This educational initiative supports the European Commission's goals for a twin digital and green transition in the construction ecosystem.

By engaging in this project, students will enhance their digital competencies, particularly in BIM, and gain practical experience in sustainable design and construction. This hands-on approach prepares future civil engineers to contribute effectively to the industry's digital transformation and environmental sustainability efforts. The integration of BIM in sustainable construction not only improves efficiency but also supports eco-friendly practices in green building projects.

This project enables students to practically combine knowledge from multiple courses and apply it to the design of a sustainable building with an emphasis on digitalization and the green transition. Such an approach not only promotes digital competencies but also increases students' energy and environmental literacy, which is crucial for the future of construction.

Questionnaire for Course Instructors – BIM Integration

We have prepared a proposed questionnaire for course instructors (Appendix B) to achieve the following objective: to review the curriculum of the undergraduate civil engineering program and analyze in which (professional) courses BIM integration would be appropriate in the next revision and what improvements this would bring (for example, how much it would enhance students' digital competencies, etc.). We emphasized courses that were drawn content from to suggest One project proposal - All three-year group project named "Digital Sustainability: Designing a Multi-Purpose Building Using BIM for Energy Efficiency and Green Transition mentioned in previous section. All questionnaires were digitally answered by course instructors. The next subchapter consists of the summaries of individual course instructors' answers.

Appendix C contains the answers from the Questionnaire for Course Instructors.

Summary of BIM Integration Across Courses

The course "Concrete Structures," emphasizes the importance of BIM for improving modeling capabilities and structural analysis. The integration of BIM is seen as crucial for visualizing elements such as beams and slabs, automating calculations, and preparing reinforcement plans. By using BIM functionalities like 3D modeling and 4D construction phase simulations, students can gain practical insights into reinforcement design and load analysis. However, challenges such as limited software licenses and insufficient training resources need to be addressed. Suggestions include introducing practical BIM exercises and fostering collaborations with industry professionals to enrich the learning experience.

Course "Building Physics" highlights BIM's potential for simulating thermal, acoustic, and energy efficiency analyses. Technology is considered vital for understanding complex building physics phenomena, such as thermal losses, moisture analysis, and acoustic optimization. BIM functionalities like 3D modeling and 6D energy simulations could greatly enhance student learning. Although the course already uses digital tools for thermal calculations, expanding the scope with BIM requires access to more licenses and time for implementation. To bridge these gaps, interdisciplinary projects and hands-on simulations focused on energy and acoustic analyses are recommended.

In the "Construction Management" course, BIM is identified as a critical tool for managing construction documentation, real-time project tracking, and contract preparation. The integration of 4D and 5D BIM functionalities could streamline processes like scheduling and cost estimation while improving documentation visualization. Students can develop essential skills in managing project timelines and budgets with these tools. However, challenges such as hardware limitations and restricted software access must be resolved. Suggestions for improving the course include incorporating practical 5D BIM applications and working on real-world case studies through industry partnerships.

Course "Economics of Construction" views BIM as essential for automating cost estimation and conducting precise economic analyses. BIM tools can assist students in visualizing costs and analyzing direct and indirect project expenses. With 5D BIM functionalities, students can optimize construction budgets and understand the interplay between costs and timelines. However, limited resources for software and training pose significant challenges. To address

these issues, it is recommended to integrate 5D cost modeling into the curriculum and involve students in practical projects with real-world applications.

The course "Computer Modeling of Building Structures," already incorporates BIM, focusing on advanced parametric modeling and data analysis. BIM is used to help students understand the relationships between structural components and prepare analytical models. Key functionalities like 3D modeling, IFC interoperability, and 4D/5D analyses play a significant role in the course. However, the lack of advanced software licenses and computational resources limits the course's full potential. To overcome these challenges, the curriculum should include expanded BIM exercises and closer collaboration with the construction industry to provide students with practical, hands-on experience.

This comprehensive summary demonstrates the strong alignment of BIM with the goals of these courses, emphasizing its role in advancing student skills, improving interdisciplinary connections, and preparing graduates for modern industry challenges. Addressing resource constraints and expanding practical applications will further enhance the effectiveness of BIM integration in education.

Conclusion

The integration of Building Information Modeling (BIM) into civil engineering curricula equips students with essential digital and interdisciplinary skills, aligning with industry trends toward digitalization and sustainability. The key benefits of BIM in education include:

- Enhanced Digital Competencies: BIM provides hands-on experience with advanced tools for modeling, simulation, and analysis, preparing students for complex projects and modern construction challenges.
- Interdisciplinary Collaboration: BIM fosters seamless collaboration between architecture, engineering, and management disciplines, improving project outcomes.
- Focus on Sustainability: Projects integrating BIM emphasize green building practices, energy efficiency, and material optimization, reflecting global shifts toward eco-friendly construction.
- Practical Industry Alignment: BIM bridges theoretical learning and real-world application, strengthening problem-solving skills and students' readiness for professional environments.

To fully leverage these benefits, targeted curriculum enhancements and resource investments are necessary. Specifically, we recommend:

- Expanding access to BIM software, hardware, and training resources to ensure all students can develop proficiency with industry-standard tools.
- Implementing a unified project that emphasizes BIM, sustainability, and energy literacy across academic years, reinforcing these critical competencies.
- Integrating BIM into core courses such as Structural Engineering, Construction Management, and Building Physics to enhance practical learning and interdisciplinary collaboration.

By addressing these challenges and implementing these improvements, universities can ensure that graduates are well-prepared for leadership roles in the evolving AEC industry.

The integration of BIM across civil engineering curricula represents a transformative step in preparing future professionals for the challenges of modern construction. However, realizing

its full potential requires a commitment to faculty training, resource allocation, and pedagogical innovation. Universities that embrace these changes will not only enhance students' digital competencies but also contribute to a more sustainable, efficient, and technologically advanced construction industry.

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Appendices

Appendix A: All three-year group project

Project Proposal: Sustainable Design of a Multi-Purpose Building Using BIM and Digitalization

Project Title: "Digital Sustainability: Designing a Multi-Purpose Building with BIM for Energy Efficiency and the Green Transition"

Project Objectives:

- Utilize Building Information Modeling (BIM) as a central tool for comprehensive planning, analysis, and execution of sustainable multi-purpose building.
- Develop students' energy literacy with a focus on energy efficiency, reducing carbon dioxide emissions, and incorporating renewable energy sources.
- Emphasize the green transition as a fundamental direction of the project: reducing the environmental impact of construction, improving energy efficiency, and promoting a circular economy in construction.
- Apply digitalization and simulations to model energy consumption, optimize material usage, and analyze the building's life cycle.

Project Description: Students will work in groups of 4–6 to design a multi-purpose building (e.g., a commercial-residential complex) using BIM. The project focuses on digital design and simulations, ensuring that every aspect of the design considers sustainability, energy efficiency, and the green transition.

Project Steps:

1. **Basic Design with BIM:**
    - Students will use BIM to create a digital model of the building, including architectural, structural, and energy components. The model will incorporate multiple materials (concrete, steel, timber), emphasizing sustainability and the circular economy.
2. **Energy Analysis:**
    - Using BIM and other tools, students will perform simulations of the building's energy consumption. They will apply building physics to analyze thermal bridges, insulation, energy efficiency, and renewable energy sources (e.g., solar energy, heat pumps).
3. **Green Transition and CO□ Emission Reduction:**
    - Students will analyze the environmental impact of selected materials throughout the building's life cycle (from construction to deconstruction). They will design a waste management system, material recycling strategies, and calculate CO□ emissions generated during construction and operation.
4. **Designing an Energy-Efficient Building:**
    - Students will propose solutions to enhance energy efficiency (e.g., optimizing natural light, energy-efficient materials and systems) with the goal of obtaining an energy efficiency certification (e.g., LEED).
5. **Digital Presentation and Simulations:**
    - The project will culminate in a digital presentation of the BIM model, where students will showcase the building's sustainable features, energy consumption simulations, and proposed solutions for the green transition.

Courses to Draw Content From:

1. Concrete Structures (5 ECTS)
2. Building Physics (5 ECTS)
3. Construction Management (5 ECTS)
4. Construction Economics (5 ECTS)
5. Computer Modeling of Building Structures (5 ECTS)

ECTS Allocation: If the project becomes an independent course, it would be allocated 5

ECTS, which could be partially reallocated from the following courses:

- Building Physics (2 ECTS): Energy analysis and sustainability would be a significant part of the project.
- Computer Modeling of Building Structures (2 ECTS): BIM and digitalization would become a core part of the project.
- Construction Management (1 ECTS): The project would include financial analysis and cost estimation.
-

Proposed Learning Resources:

1. BIM software (e.g., Autodesk Revit, ArchiCAD) for modeling and simulations.
2. Simulation tools for energy analysis (e.g., DesignBuilder, EnergyPlus) to assess energy efficiency.
3. Life cycle analysis tools (e.g., Tally, One Click LCA) to evaluate material sustainability and CO_2 emissions.

Assessment and Presentation:

- **Group Report:** A detailed description of the building design, energy analysis, life cycle simulations, and the green transition plan.
- **Digital BIM Model:** A complete digital model of the building with energy simulations and calculations.
- **Oral Presentation:** Presentation of sustainable features, digital model, and energy literacy through the solutions proposed in the project.

Goals and Competencies:

- Students will develop digital competencies by using advanced digital tools like BIM.
- They will enhance energy literacy through the analysis of energy efficiency and sustainability.
- The project will encourage interdisciplinary learning by integrating various fields of civil engineering, economics, building physics, and digitalization.

Conclusions: This project enables students to practically combine knowledge from multiple courses and apply it to the design of a sustainable building with an emphasis on digitalization and the green transition. Such an approach not only promotes digital competencies but also increases students' energy and environmental literacy, which is crucial for the future of construction.

Appendix B: Questionnaire for Course Instructors in the Civil Engineering Program

Purpose: To review the curriculum of the civil engineering study program and analyze which professional courses could effectively integrate BIM, as well as the improvements this integration could bring to students' digital competencies.

1. Basic Information

- **Name and surname of the course instructor:**
- **Course title:**
- **Academic year in which the course is conducted:**

2. Connection Between the Course and BIM

1. Do you think integrating BIM into your course would be meaningful? Why or why not?
2. In which areas of your course could BIM contribute to a better understanding of the material (e.g., project visualization, analysis, simulations, etc.)?
3. Which BIM functionalities (e.g., 3D modeling, scheduling (4D), cost estimation (5D)) do you think would be most useful in your course?
4. Does your course already include any digital technologies? If yes, which ones, and how are they used?

3. Enhancing Students' Digital Competencies

5. How do you think integrating BIM could help improve students' digital competencies (e.g., using digital tools, collaboration, data analysis, project management)?
6. What specific digital skills could students develop by using BIM in your course?
7. Do you believe that including BIM would better prepare students for challenges in the modern construction industry? How?

4. Collaboration and Interdisciplinarity

8. How could BIM in your course encourage collaboration among students (e.g., group projects, simulations)?
9. Could BIM enable a better understanding of interdisciplinary connections (e.g., between architecture, engineering, and project management)? How would this benefit your students?

5. Assessment and Learning Outcomes

10. In your opinion, how could BIM improve assessment processes (e.g., through digital simulations, analyses, real-time feedback)?
11. What key learning outcomes do you think could be achieved using BIM in your course?

6. Opinions and Suggestions

12. What potential barriers or challenges do you see in integrating BIM into your course (e.g., lack of equipment, knowledge, time)?
13. Do you have any suggestions for improving the curriculum to facilitate BIM integration and enhance students' digital competencies?
14. What additional support (e.g., training, access to tools) would you need to successfully integrate BIM into your course?

Thank you for taking the time to complete this questionnaire. Your feedback is essential for improving the curriculum and ensuring better digital competencies for students in civil engineering.

This questionnaire is designed to allow course instructors to share their perspectives on the potential integration of BIM, while highlighting key aspects that will contribute to curriculum improvement and the enhancement of students' skills.

Appendix C: Answers to Questionnaire of Course Instructors

Answers to questionnaire are organized in six tables according to the question group of questionnaires:

1. Basic information
2. Connection Between the Course and BIM
3. Enhancing Students' Digital Competencies
4. Collaboration and Interdisciplinarity
5. Assessment and Learning Outcomes
6. Opinions and Suggestions

Table 1: Basic Information

Questions	Concrete Structures	Building Physics	Construction Management	Economics of Construction	Computer Modeling of Build. Struct.
Basic Information					
Course Title	Concrete Structures	Building Physics	Construction Management	Economics of Construction	Computer Modeling of Building Structures
Academic Year and Semester	3rd year, 5th semester	2nd year, 3rd semester	2nd year, 4th semester	3rd year, 5th semester	3rd year, 6th semester

Table 2: Connection Between the Course and BIM

Questions	Concrete Structures	Building Physics	Construction Management	Economics of Construction	Computer Modeling of Build. Struct.
Connection Between the Course and BIM					
Is BIM integration relevant? Why?	Yes, BIM facilitates accurate modeling of concrete structures, load analysis, and preparation of reinforcement drawings.	Yes, BIM enables simulation of thermal, acoustic, and energy efficiency analyses, crucial for building physics.	Yes, BIM supports better planning, monitoring, and documentation of construction processes.	Yes, BIM automates cost estimation and connects economic analyses with digital models.	Yes, the course already incorporates BIM, enhancing parametric modeling and data analysis.
Areas where BIM can improve understanding?	Visualization of structural elements (beams, slabs, columns), automatic calculations, and load simulations.	Simulating thermal losses, moisture analysis, acoustic planning, and light optimization.	Document management, real-time progress tracking, and preparation of contracts.	Preparing accurate cost estimates and visualizing cost structures.	Understanding parametric modeling, visualizing relationships between elements, preparing analytical models.
Most useful BIM functionalities?	3D modeling of reinforced concrete structures, 4D construction phase simulations, preparation of reinforcement drawings.	3D modeling for heat transfer analysis, 6D energy simulations, moisture and acoustic analysis.	4D scheduling, 5D cost estimation, documentation visualization.	5D BIM for cost estimation, linking BIM models with schedules, and visualizing economic impacts of design changes.	3D modeling, IFC interoperability, integration of 4D and 5D analyses.
Does your course already use digital tools?	Yes, software is used for analysis and dimensioning of concrete structures.	Yes, tools for thermal calculations and Moodle for task assignments are used.	Yes, modern IT tools are used for contract preparation and site monitoring.	Yes, software is used for calculations and standardized descriptions of work, materials, and equipment.	Yes, software like ArchiCAD, Revit, and SolidWorks is used for modeling and documentation.

Table 3: Enhancing Students' Digital Competencies

Questions	Concrete Structures	Building Physics	Construction Management	Economics of Construction	Computer Modeling of Build. Struct.
Enhancing Students' Digital Competencies					
How can BIM enhance students' digital skills?	Students gain skills to work with advanced digital tools and improve their ability to analyze and visualize structural systems.	Students gain skills to work with advanced digital tools and improve their ability to analyze and visualize structural systems.	Students develop skills in planning, managing documents, and overseeing projects using digital tools.	Students gain practical experience in cost analysis and connecting economic parameters with digital tools.	Students learn advanced modeling and analysis skills, preparing them for industry challenges.
Specific digital skills students can develop?	Parametric modeling, preparation and optimization of reinforcement drawings, interpreting load simulations.	Simulating thermal transitions, analyzing moisture in building elements, optimizing acoustic insulation, and light analysis.	Using BIM for document management, 4D progress tracking, and 5D cost analysis.	Using 5D BIM for cost calculations, understanding cost-schedule integration, optimizing costs through models.	Preparing parametric models, using interoperable formats, conducting collision analyses.
Can BIM better prepare students for industry challenges ?	Yes, as BIM represents an industry standard, it enhances planning, execution, and monitoring processes.	Yes, BIM prepares students for modern industry challenges by enabling them to use advanced tools to solve complex problems.	Yes, BIM equips students with advanced tools for optimizing construction processes and project management.	Yes, BIM prepares students for real-time economic analysis and competitiveness in the industry.	es, BIM aligns students with industry standards for advanced modeling and collaborative projects.

Table 4: Collaboration and Interdisciplinarity

Questions	Concrete Structures	Building Physics	Construction Management	Economics of Construction	Computer Modeling of Build. Struct.
Collaboration and Interdisciplinarity					
How can BIM encourage student collaboration?	Group projects where students model and analyze structural elements together.	Group projects modeling building elements, analyzing thermal losses, moisture, and acoustic properties.	Group projects involving simulations for scheduling and cost planning, fostering collaboration and leadership.	Group collaboration in preparing cost estimates and optimizing economic project parameters.	Group projects for modeling and analysis, optimizing designs collaboratively.
Can BIM improve understanding of interdisciplinary connections?	Yes, BIM connects architectural design, civil engineering, and structural engineering.	Yes, BIM integrates physical analyses with building design and construction, linking parameters like thermal transmittance and sound insulation with design solutions.	Yes, BIM connects technical planning, financial management, and execution, providing comprehensive project insights.	Yes, BIM links technical and economic project aspects, helping students understand the impact of decisions on costs and timelines.	Yes, BIM integrates multiple disciplines (architecture, engineering) and improves understanding of holistic project management.

Table 5: Assessment and Learning Outcomes

Questions	Concrete Structures	Building Physics	Construction Management	Economics of Construction	Computer Modeling of Build. Struct.
Assessment and Learning Outcomes					
How can BIM enhance evaluation processes?	BIM enables precise evaluation through digital simulations and automatic calculations.	Digital simulations allow quantitative evaluation of knowledge in thermal, moisture, and acoustic analysis with real-time feedback.	BIM ensures precise evaluation of scheduling, cost analysis, and project progress simulations.	BIM enables accurate cost estimation and impact visualization for design changes.	BIM facilitates objective evaluation by verifying parametric accuracy and analysis simulations.
Key learning outcomes with BIM integration ?	Modeling and dimensioning concrete structures, preparing reinforcement plans per Eurocode standards, using digital tools for structural analysis.	Understanding and analyzing thermal transitions and losses, using tools for acoustic simulation, developing solutions for energy optimization.	Mastering digital tools for project management, preparing simulations for time and cost, and monitoring project progress.	Preparing precise cost estimates, optimizing costs and schedules, understanding project documentation and economic analysis.	Understanding complete modeling processes, preparing interoperable models, visualizing and optimizing designs.

Table 6: Opinions and Suggestions

Questions	Concrete Structures	Building Physics	Construction Management	Economics of Construction	Computer Modeling of Build. Struct.
Opinions and Suggestions					
Challenges in implementing BIM?	Lack of software licenses, time constraints, need for additional training.	Lack of BIM software licenses, time constraints for curriculum updates, training needs for staff and students.	Limited software access, hardware constraints, time limitations for incorporating new content.	Limited access to software, time constraints for including additional content, need for training.	Lack of software licenses and advanced computational resources, training requirements.
Suggestions for improving the curriculum?	Introduce practical BIM exercises early in the curriculum, collaborate with industry for workshops.	Introduce BIM-based practical exercises and interdisciplinary projects focusing on physical properties and energy analysis.	Incorporate practical BIM-based exercises for time and cost management, collaborate with industry for case studies.	Introduce 5D BIM exercises for cost estimation and industry collaboration for real-world analysis examples.	Expand practical BIM exercises and collaborate with industry for hands-on modeling and analysis.
Additional support needed for BIM integration?	Access to software (e.g., Revit, Tekla), training sessions, and updated hardware.	Access to energy simulation software, training sessions, updated computer facilities.	Access to BIM software (e.g., Autodesk BIM 360, Revit), training sessions, curriculum adjustments.	Access to cost analysis software (e.g., Revit, CostX), training sessions, updated computer facilities.	Access to advanced software, training workshops, and upgraded computational hardware.

Parental Perceptions of the Competence-Based Secondary School Curriculum and Support for Schools in Uganda: Practical Strategies

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Abstract
Among the reforms introduced to enhance skills development in Uganda's secondary school graduates is the Competence Based Curriculum (CBC). Despite implementation with the first cohort of students sitting for ordinary level examinations in October 2024, concerns have been raised by stakeholders about the curriculum. This paper presents findings of a study that aimed to ascertain how parental perceptions and understanding of the revised curriculum impacts support towards enhancing academic performance of students. Conducted in three secondary schools, the study adopted the pragmatic learning theory (Dewey, 1948) and Bronfenbrenner's ecological systems theory (Bronfenbrenner, 1977) that focus on how children learn, are socialized at home, school and within the surrounding environments. Central is that children learn through experience, and that parents, teachers and the school are systems in which education functions. A qualitative study involved 24 participants: 9 parents, 6 students, 6 teachers, and 3 administrators. Findings show that majority of the parents were unfamiliar despite the government sensitization on different aspects of CBC. Concern was that media information on what children learn and the modes of assessment was distorted, conflicting and unreliable. The study recommends direct engagement through community symposia and intensifying radio programmes in local languages as appropriate for sensitization.

Keywords: Competence Based Curriculum, Pragmatic Learning, Skilling, Parents, Teachers, Uganda

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Introduction

In a bid to impart skills in school going youths that would respond to the challenges of youth unemployment, the government of Uganda through the Ministry of Education, Science, Technology and Sports embarked on the Competence Based Curriculum (CBC) in 2020, as a way of equipping learners with vast skills and knowledge in areas of their competencies (Government of Uganda [GOU], 2020), which the previous dominant knowledge-based curriculum could not help to achieve. According to National Curriculum Development Center [NCDC], (2019), the core competencies that the students acquire after undergoing a CBC aim at improving the quality of life as envisioned by the national policy framework (2020). Among these are: communication, critical thinking and problem-solving, collaboration, innovation and creativity, citizenship, learning to learn, self-efficacy, and digital literacy. It is also believed that the CBC impacts eight core values that include: love, responsibility, respect, unity, peace, patriotism, social justice, and integrity. (NCDC, 2019). Further, the CBC is perceived as a form of learning that accommodates a variety of learning styles by for instance, promoting individualized learning, where learners are stimulated and facilitated to construct their own knowledge.

Several countries globally, have implemented elements of the Competence-Based Curriculum in their education systems, even though with variations in design and focus (Sifuna & Obonyo, 2019). Ideologically, the CBS is applauded for being a more relevant and engaging teaching and learning pedagogy due to the widely guaranteed flexibility and responsiveness to the needs of the learner. As pointed out by Mabonga (2021), the competency-based curriculum has globally been perceived as more comprehensive and learner- centric approach to education at both primary and lower secondary schools. This is because, it prioritizes the mastery of skills over content retention (Kembabazi, 2023) because teaching is more pragmatic, that to say- based on the actual situation within the context (Singh 2007 as cited in Akinpelu, 2017). Thus, giving space and opportunity for each learner to learn at their own rhythm and focusing on student's areas of interest and ability. Of course, this approach to learning is actually not new to Uganda's education system. Reports on the history of education in Uganda indicate that missionary education set up demonstration and technical schools with the intention to discover and develop the children's talents (Sekamwa, 1997 as cited in Wabule, 2017. Subjects like handwork, domestic science, art and music, that emphasized practical work elements were taught.

Like elsewhere, the government of Uganda recognizes the importance of parental involvement for effective learning (Epstein, 2011; Jesse & Olela, 2022; Parast et al., 2023). Parental involvement is viewed as the outcome of attitudes, expectations, behaviors and actions that significantly impact performance of students especially in the CBC (Jesse & Olela, 2022). Research suggests complex relationship between parental involvement and academic performance as influenced by factors like parental expectations and pressure (Haller & Novita, 2021). Accordingly, parental perceptions and involvement styles differ across cultures worldwide and are influenced by their social and economic backgrounds, educational experiences, and cultural values. Yet, despite the key role of parents in the educational success of their children, only limited research has been done to explore this in most countries in Sub Sahara Africa (Affuso et al., 2023) and little in the context of Uganda. In several African countries such as Ethiopia, Nigeria, Ghana and South Africa that have embraced CBC as an education sector reform, parental concerns about limitations to understand the curriculum is highlighted among the major impediments to responding to the schooling needs of their children (Sifuna & Obonyo, 2019). In East African countries such as

Kenya, Tanzania and Rwanda that implemented the CBS earlier than Uganda, similar findings point to a lack of knowledge about the curriculum as a major factor leading to the high negative parental perceptions. Lack of parental involvement in education goes against UNESCO (2023)'s call for parental participation in the academic success of a student. For instance, the CBC requires that parents support their children on take-home activities, provide learning materials and of late, the provision of digitalized equipment and internet connection (Jesse & Olela, 2022; Kidega et al., 2024). In the context where the parents perceive the new curriculum as overly demanding in terms of resources requirements, it becomes challenging not only for the schools to teach effectively but also impacts negatively to the learner's academic achievement (Jesse & Olela, 2022; Kidega et al., 2024). Thus, exploring the perceptions and knowledge of the parents on the CBC is paramount for deriving strategies for enhancing their support and involvement in the children's education.

Literature Review

The role of education as a tool for increasing the totality of possibilities for national development is a known fact (UNESCO, 2023). Understood from two facets (Apple, 2012), education is in one part responsible for identifying and nurturing the potential ability of a learner for self-actualization, and on the other part, is responsible for ensuring societal progress and development through the supply of manpower. Intertwining the two as emphasized by the government of Uganda's White Paper on Education (1992), fulfills the sole objective of education which is, optimizing individual abilities as well as securing the needed human capital to enhance what Amartya Sen terms as functioning and capabilities (Hart, 2012; Jesse & Olela, 2022; Lozano et al., 2012). Thus, encouraging the students to work towards actualizing their optimal potentials and "utilizing the abilities in accordance to their talents" as advocated by the CBC is an ideal model for identifying and promoting the intellectual, emotional and physical abilities of the learners (Gervais, 2016; Jesse & Olela, 2022). Accordingly, CBC approaches education as a collection of activities that are designed optimally to stretch the individual student's abilities, by providing a myriad of alternative undertakings for the students to acquire a diverse range of experiences. A balanced education under the CBC ensures that foundational knowledge is given side by side with developmental activities that lead to discovery of talent and the diverse abilities that when well nurtured, can enhance their well-being (Kidega et al., 2024). Understood this way, Uganda has embraced the CBC with hopes of addressing the high youth unemployment rates because the graduates will possess the skills necessary for work (Gervais, 2016). This is based on the fact that the Competency-Based Curriculum adopts a learner-centered pedagogy, formative, authentic assessment approaches and emphasizes on the development of competencies and application of knowledge in real life context (Gervais, 2016; Sifuna & Obonyo, 2019).

The new competency-based learning approach that emphasize demonstration and other experiential hands on methods is credited for developing knowledge, skills and attitudes, and applying them to real life situations. Just as specified by the capability approach (Sen) and pragmatic learning theory, CBC focus on what people are effectively able to do and be (Hart, 2012; Lozano et al., 2012). The seven core competencies of CBC such as communication and collaboration, critical thinking and problem solving, creativity and innovation, citizenship, digital literacy, learning to learn and self-reliance are key to improving learner capabilities to thrive is society (Gervais, 2016). Although this study does not intend to take CBC to be an end in itself, the assumption is that it is more likely to facilitate processes that are instrumental for reaching the goal of wellbeing. Moreover, it is geared towards making learning enjoyable and productive. Taken from this perspective the CBC is perceived to be

critical for Uganda to empower its people with essential values, knowledge, attitudes and skills that transform individuals into empowered citizens with appropriate skills that are necessary for national development (UNESCO, 2023). Available literature underscore hands on teaching as developing student's personal skills as well providing the needed entrepreneurship skills that are crucial in responding to the changing needs of today's labor market (Bradford Jr. et al., 2019). This according Baker and Robinson, (2016), and Coleman et al., (2020), is achieved by structuring education in ways that integrate aspects that stimulate both the cognitive and social development of students.

Further, experiential learning that involves interaction with the real world of work as suggested under the CBC is advantageous in providing opportunities for students to take control of their own learning environments (Baker & Robinson, 2016). Subsequently, triggering valuable career skills of critical thinking, problem solving and creativity in the process of developing their craft (Bradford Jr. et al., 2019). Studies that underscore experiential learning such as the use of school, community or home farms and projects argue for student's interactions with the real life world while at school (Ochan, 2012). Similarly, a well implemented competence based curriculum facilitates quality teaching through collective learning, learner interaction, free communication, questioning, reflection and self-learning. This is specifically possible with the CBC that emphasizes teaching practices and techniques that require discovery learning, problem solving, inquiry teaching and peer assisted learning (Baldock & Murphrey, 2020). Aware that the students have prior experiences that they bring to the learning environment (McKim et al., 2020), students that are taught using interactive approaches develop high level order skills of emotional intelligence such as respectful behavior, conflict resolution, positive attitude, social skills, group cohesion and consultation skills that are highly valuable for one's future career and beyond (Baker & Robinson, 2016; Baldock & Murphrey, 2020).

Parental Involvement

Among the major features of the competence based curriculum is the emphasis on embedding learning in the communities so as to cultivate a sense of ownership and responsibility (Rubenstein, & Harris, 2014). Enlisting stakeholder support, including the support of the parents is significant for supervision, and in providing feedback to the teaching and learning processes (Parast et al., 2023; Robinson & Harris, 2014; Yulianti et al., 2018). Yulianti et al., (2018) understand parental involvement to be parental behaviors as related to the child's school or schooling that manifest through their commitment to the child's educational affairs. It includes dispositions such as 'the dedication of resources by the parent to the child within a given domain (Grolnick & Slowiaczek, 1994, as cited in Yulianti et al., 2018), or 'parents' active commitment to spending quality time on the academic and general development of their children. In the perspective of this study, parental involvement would mean direct involvement of parents in providing family support and conditions that favor learning, communicating with schools, paying visits to schools, volunteering at school events, helping children in making decisions and setting goals, and collaborating with the communities to be more responsive in contributing services to the schools. Of course, this requires creating expressive linkages between the schools and the wider communities (UNESCO, 2023), but also depends resource availability of resources, parental attitudes, knowledge of the pedagogical skills that are employed by the teachers in schools and what resources they require for effective delivery.

Creating programs that promote school-family-community participation is important for raising awareness on the importance of parental involvement in the education of their children. However, most studies conducted in sub- Saharan African countries point to the limited parental support. There is also lack of information on context specific ways in which parents can be engaged in the educational achievement of their children. In Uganda, reasonable effort has been undertaken to sensitive parents about the curriculum reforms so as to enable them understand the necessity of supporting schools. Whereas a special report by the Ministry of Education, Science and Technology (GOU, 2022), indicated information dissemination on the new curriculum through print and social media, and by conducting workshops for the teachers to act as ambassadors and change agents to the parents, on the contrary, inadequate parental involvement has been cited by various studies (Mabonga, 2021; UNESCO, 2023). These studies point to a lack of cooperation from parents, attributing it to inadequate orientation and engagement. Yet, parental and community involvement in the learning process is assumed to improve students' behavior, participation in classrooms and subsequently, the learning outcomes (Mwanji et al., 2021). Where their support is lacking like in Uganda, it becomes challenging for the CBC to succeed (Ojok et al., 2022). Pointing to inadequate sensitization Mabonga (2021) considers cultivating positive attitude towards the curriculum as enhancing the will of the parents to support their children. In their findings, children who had full parental support tended to perform better than the children whose parents did not understand the curriculum. In view of these findings, while schools are supposed to establish partnerships with parents so as to enlist their support, in Uganda, the school management committees which are supposed to facilitate linkages and social networks are either dysfunctional or lack a clear conceptualization of their roles (Wabule, 2017). A good parent teacher relationship indicates a significant indirect link with high academic achievement, which in turn influence parent's perceptions (Sifuna & Obonyo, 2019). This is specifically true when currently, schools are increasingly striving to fulfill the needs of their users or customers by producing good results (Haller & Novita, 2021).

Methodology

A qualitative approach was employed to explore parental perceptions (Hennink et al., 2020) of the CBC towards support, and the educational attainment of their children between February and March 2024. Three secondary school: Busiu secondary school, Busiu central college, and Musese secondary school, were selected for the study because of their rural set up. None the less, there was no intention to draw a comparison between rural and urban schools nor to generalize data but rather, to gain deeper understanding about the study sites (Creswell, 2023). It included 24 participants that comprised of 9 parents,6 teachers, 6 students and 3 head teachers.

All Participants were purposively (Creswell, 2023) selected for un-structured in-depth interviews because of their direct involvement with education. The students were selected from form four classes because they were deemed to be mature and as having adequate experience with the CBC. In-depth interviews were used to give each of them voice to share their own experiences in order to gain a deeper understanding (Hennink et al., 2020) on how they perceived the competence based curriculum and how this in turn impacted the support parents render to the schools. I sought informed consent of all the participants before their involvement (Creswell, 2023). The interviews that lasted between 60 to 90 minutes were audio and video recorded so as to capture all the nuances (Flick, 2018). The data generated was transcribed verbatim and analyzed thematically in line with the objectives of the study (Hennink et al., 2020). Themes were derived both deductively from literature before going to

the field, and inductively during data collection (Hennink et al., 2020) in order to make sense of what people say. With the help of a computer software for data analysis ATLASti, codes were developed from the transcribed data following an open coding procedure (Flick, 2018). Although the participant did not take the research as bearing any threat, they were assured of data confidentiality and anonymity. Thus, Pseudonyms are used to conceal their identities.

Findings

The findings are presented in line with the objectives and themes generated during data analysis namely; knowledge, perceptions and parental support of the competence based curriculum.

Knowledge About the Competence Based Curriculum

The majority of the parts reveled to be largely unfamiliar about the curriculum and its aspects. Although, both male and female parents with some basic education, those in formal employment and those who actively participated in school activities seemed to have a fairer understanding of the new curriculum than those without formal schooling. However, they were concerned that most of their knowledge was mainly limited to general information about the changes that have been effected in the lower secondary school curriculum but remained largely unaware of what the curriculum actually entailed. Failure to understand the curriculum was reported as causing immense confusion about the kind of support the schools required from the parents as pointed out by Musungu, a male parent:

> You people who interact with education and schools (sic), it may be easy when they explain these things on the radio… some of us, it is not easy to understand exactly what the children are learning and what me as a parent with little education is supposed to do. May be when they say, give the children some food, but other things, we do not know how…. So we have been told that the children are learning new things, which me a parent I cannot know… (Musungu, Personal communication, 2024)

Similar concerns were expressed on how assessment and reporting on individual learner progress and academic achievement was conducted. For instance, Wamanga another parent asserted that he could not ably interpret the report cards of their children. This is in part could be attributed to the educational levels of the parents in this rural setup, but in part due to lack of awareness on how the grading is done under the new curriculum. Unfamiliarity with the curriculum pauses a huge threat to its implementation as it limits parental feedback and support towards the learning of their children. The teachers and school administrators reported that they had to adjust to the new situation of teaching without sufficient preparation, while the parents reported uncertainty of what ways they can assist the children to learn especially while at home. Thus, it would be unrealistic to assume that parents can comprehensively offer support to the schooling system without adequate knowledge about the potential challenges that schools are facing in meeting the learning needs of students. This is made worse in the rural areas of Mbale where most parent are resource constrained. While a few parents expressed the willingness to learn, there was generally a communication gap between schools and parents. The school administrators were concerned that parents where not responsive when invited for school meetings where such issues were discussed.

Perceptions on the Curriculum

Findings from the three rural based secondary schools in Mbale district reveled a diversity of perceptions among the parents on the Competence Based Curriculum, depending on several factors such as sex, level of education, exposure to information through social media and social interactions. Of course, as pointed out above, since most parents in this rural setup had anecdotal information about the curriculum, their perceptions where limited to the amount of information they had. Some felt it was good, since it aims to teach practical skills to children, while others felt that teaching skills that could as well be gained informally would not grant their children jobs outside the home. This was echoed by Nabifo a female mother and housewife:

> I sometimes visit the school and we were told that the children are going to learn new things which they can do by hands. But I don't know exactly how they teach them. I see my girl here trying to make some baskets but I have not asked if that is what they teach them…. If that is what they teach them, it is good… but can that get one a jobs out there… (Nabifo, Personal communication, 2024)

Firstly, Nabifo being a house wife with low levels of education, her understanding of the what is offered by new curriculum was also limited even when she attempted to attend some school meetings. Secondly, she was concerned on whether knitting mats would get her daughter a job, an indication that she still held the perception that education should lead to securing white color jobs. It raises concern about the knowledge on what opportunities are presented by the new curriculum, thus, cements the fact that parents do not understand the curriculum. Low levels of parental education as also pointed out by literature studies impacts their perceptions and in turn, the support they render to the schools. As elsewhere (Yulianti et al., 2018), parents in formal employment and those engaged in income generating activities like trade and commerce attached more value to their children's education. While the more traditional ones, those mainly engaged in agricultural work like those in the study sites for this paper, still held the myth that the government provides free education under the Universal Secondary School's policy, thus, negatively impacting their support. While one may argue that majority of the people in the rural communities in Mbale district live in absolute poverty (NPHC 2024), a number of them may actually be putting their priorities elsewhere in the guise of free education.

Lamentation about a failure of learners to speak good English, reading and writing, could be rooted in history where education was formerly perceived by the Uganda communities as enhancing opportunities for exposure to a white man's culture that could earn one a job. Emphasis on speaking good English shows continued perception of education as preparing learners for white collar jobs as mentioned earlier. Thus, parents seem uncomfortable seeing the children they send to schools engaging is same practices such as knitting mats which in the view is a reserve for those with no formal schooling. It is a pity that all the interviewed parents perceived education in terms of getting a job outside the home, which is not in line with the aims of the CBC, thus necessitating extensive parental sensitization as initiated by this research project.

Support to the Schools

All the participants in the categories above declared limited support for the schools. The parents declared confusion on what responsibilities the schools required of them in order to

fully support their children's learning. Others decried the alarming poverty as the cause of their failures, while others were convinced by the proclamation of free government education. A female participant Nandutu, blamed the lack of support to the schools on poverty in the homes, but also on the men abandoning the responsibility of caring for their children's education.

> When you tell the father that the child wants a book or uniform he responds angrily… you know there is no money... what do you want me to do… to go and steal or what… (Nandutu, Personal communication, 2024)

This submission by Nandutu is collaborated by a narrative by Matayo a student who rides a boda boda (motorcycle) to meet his own school requirements:

> I support my own education and in my entire family, I am the only one who has seen a black board (gone to school) … We are seven but it is only me who has gone to school… My mother used to tell us that the little she gets can only provide a meal for us to grow… I just followed those going to school in primary and when they asked for money, I told the teacher that I do not have. Now this teacher was good to me. She made me do some work at her house and that is how I finished primary… …. So when I joined secondary, I got this job of riding boda boda… (Matayo, Personal communication, 2024)

The head teachers on the other hand, while, concerned about inadequate family resources, felt that the parents in these rural communities were simply reluctant to provide support to the schools. Manana, another head teacher represents such voices:

> I think the problem is more than lack of resources or free education… the whole issue is the parents here…in these community… why is it that parents elsewhere… you go to schools in the west… schools in Buganda… but also a school like Mbale S S which is posting very good results in eastern region… parents contribute… they can buy teaching materials… teachers are motivated… they get some extra pay… Does free education only apply to rural ones? Cant these parents here learn from others?... even very small schools in Kampala do well… why? I think the parents have to understand the value of education… (Manana, Personal communication, 2024)

Whereas parental laxity was in part attributed to the contradictions that have been created between Universal and free education as provided for under the USE policy in comparison with the CBC that require parental support to schools, Manana points to the value that parents attach to the education of the children. As mentioned earlier, parents in rural communities that engaged in agriculture for their livelihood provide less support to schools as compared to more affluent parents in urban areas. None the less one cannot ignore the fact that distorted information about support to schools continues to plague Uganda's Education sector reforms, thus failure to create genuine transformations that can enhance quality teaching and learning (Wabule, 2017). Wabule's study on teacher professional integrity (2017) found that majority of the parents that enrolled children in rural public schools shunned the responsibility of aiding their children and schools because information about universal education was distorted by political opportunists to mean free education. Distorting information on government programs by some significant stakeholders who caution schools administrators not to levy any charges on parents on grounds that the government was providing all the schooling costs of students create confusion. Thus, it becomes necessary to sensitize parents, reaffirming

their need to support their children so as to facilitate practical teaching and learning under the new curriculum.

Conclusion

This study has shown that parental perceptions of the education and schooling system are critical in influencing their choice to support schools towards effective implementation of the Competence Based Curriculum (CBC). As also pointed out by other studies, parents' direct involvement in school activities by communicating with schools, paying visits to schools, volunteering at school events, helping children in making decisions and setting goals, and collaborating with the communities to be more responsive in contributing services to the schools' favor teaching and learning for their children (Mabonga, 2021; Yulianti et al., 2018). In the perspective of this study on CBS Curriculum, parental involvement would mean parent at this study sites being concerned about the schooling needs of their children, by for instance, making some financial contribution to the school that may enable the purchase of simple scholastic materials or even monitoring the practical work assigned to children at school. While this is a common practice in urban schools where parents are more educated and also engaged in formal employment and other income generating activities (Yulianti et al., 2018), this is not the case in rural based schools in Mbale where the majority of parental are engaged in small scale farming. Although some participants argued that parents under similar circumstances in other contexts ably cared for the schooling needs of their children, blaming the negativity at the study sites to laxity to prioritize education.

The findings reveal that most parents in these rural schools do not have sufficient knowledge about the new curriculum, thus, where not sure of what support to provide to the schools. These finding are similar to that of Affuso et al., (2023) who blamed lack of parental support to inadequate sensitization, thus, cultivating negative perceptions. Whereas parents in this study, just like previous ones were largely blamed for failing to corporate with schools (Mabonga, 2021; UNESCO, 2023; Wabule, 2017), it is unlikely for parents to respond positively to something they do not comprehensively comprehend. As literature suggests, a call to parental involvement requires cultivating in them positive attitudes towards the learning and the schooling system (Haller & Novita, 2021; Kembabazi, 2023; Sifuna & Obonyo, 2019). Although these assertions do not give a leeway to the parents to remain ignorant of school needs. Taking initiatives to establish closer links with the schools could break the communication barriers and enhance knowledge sharing on pertinent education issues. In Uganda where parents perceive education as avenue for opening up opportunities for formal employment, a CBC curriculum that aims at life skills enhancement through teaching pedagogies that are based on the actual situation within the local context (Singh, 2007 as cited in Akinpelu, 2017), may be difficult for them to comprehend without sufficient sensitization. For instance, one female parent expressed fear that knitting mats could not earn her daughter a job. While hands on learning has a strong skilling element in line with the objectives of the CBC, a job to this parent probably meant a white collar job in the formal sector as opposed to the skills of craftsmanship that the CBC intends to promote.

These findings of this study like literature (Uwezo, 2013 as cited in Wabule, 2017) also cites lack of adequate preparation and sensitization on education sector reforms and politicization as being central for failure of parents to support most government programmes in Uganda. Parents are perceived to have been more supportive to schools before information about universal secondary was distorted to mean free education by those seeking political favors. Disrupting the mis conceived narrative calls for innovative approaches and programs by both

government and school administrators through which parents can be sensitized on CBC. For instance, directing engagement parents through community symposia and intensified radio programmes in local languages where suggested as appropriate channels for building a strong sense of synergy among parents that can enhance positive insights necessary for engaging more with the schools. And to restore confidence in the CBC, as Haller and Novita (2021) point out, the parents need to be educated by the schools and other education stakeholders to understand what the new curriculum entails and what actual benefits accrue from a skills based curriculum as compared to the rote learning. In line with the pragmatic learning theory (Dewey, 1948), the main focus should be on how children learn through experience, how they are socialized both at home, school and within the surrounding environments. Most importantly, to help them understand that effective coordination between the parents, teachers and the school are a requisite system in which education functions. By and large, the success of any sensitization would largely depend on the willingness of each stakeholder accepting and acting upon the information that is shared, but also by each realizing their roles and obligations.

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Emerging Hispanic Serving Institutions: Preparing to Serve Latine' Students Authentically

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Abstract
In this paper, we present our analysis of the Integrated Postsecondary Education Data System (IPEDS) to explore emerging Hispanic Serving Institutions (eHSIs) and their potential to increase doctoral degree attainment in computing fields. There are 401 institutions across 42 states (including Hawaii) identified as eHSIs, with Latino enrollment ranging from 15% to 24.9%. Although Latino enrollment is strong, degree attainment remains concentrated at the associate and bachelor's levels, with minimal progress at the master's and doctoral levels in computing, information science, and engineering. This stagnation highlights the need for higher education institutions to adopt strategies that foster a supportive environment and promote advanced degree attainment for Latino students. This knowledge is crucial for institutions transitioning from eHSI to HSI status while advancing STEM education, and for U.S. institutions to understand the Latino community's breadth and unique needs to provide effective support. We conclude by outlining the next steps for research in this emerging area.

Keywords: Emerging Hispanic Serving Institution, Computing, Doctoral Studies, Authenticity

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Introduction

The institutional designation of emerging Hispanic Serving Institution (eHSI) was created by the Hispanic Association of College and Universities (HACU, 2024) to identify the growing number of Primarily White Institutions (PWI) with a full time Latino enrollment between 15-24.9% and poised to become Hispanic Serving Institutions (HSI). The Latino population is the largest minority population in the United States, and one of the most racially diverse and blended. The growth of the Latino population has expanded beyond the U.S. Southwestern states that border neighboring Mexico (California, New Mexico, Arizona, and Texas), but also Florida (only 90 miles from Cuba and 828 from the Dominican Republic), the Northeastern states (New York, New Jersey, and Connecticut), and the U.S. Commonwealth of Puerto Rico. The growth in the population of Latinos is evident even in the rural areas and unexpected locations such as the Island State of Hawaii, the home of six eHSI (HACU, 2024). In appreciation for the 10th IAFOR Conference on Education, in Honolulu, this paper honors Hawaii, voted The Most Diverse State in America for 2024 (Kolmar, 2024).

Hawaii's population is 11% Hispanic/Latino, with the Big Island having 13% Latinos, and Napili-Honokowai with a 24.8% Hispanic/Latino population. Of the six eHSI community colleges and private universities, four are on Oahu and two on the Big Island with Pacific Rim Christian University having the highest Hispanic/Latino student enrollment (20.7%) (HACU, 2024). Hawaii is rich in Latino history starting with Francisco de Paula Marin who is credited with planting pineapple (and many other crops) in 1813 and who served as business advisor to King Kamehameha. This history continues with the King's request for cowboys (i.e., "paniolo") from Mexico to tend cattle gifted by the British. Laborers from Puerto Rico also came to Hawaii after two hurricanes damaged their island's agriculture industry in 1899 (Livingston, 2023).

With the number of Latino faculty in computing so small that it "cannot be reported without compromising their privacy," (U.S. House of Representatives Committee on Science, 2023, p.1), we aimed to understand to present the current state of Latino degree completion at eHSI with descriptive statistics based on IPEDS data. These data inform decision-making and have policy implications for Hispanics/Latinos. This study aims to address the following question:

> RQ: What impact do emerging Hispanic Serving Institutions (eHSI) have on doctoral degree attainment of Latinos in computing?

Latino Population Profile

Latinos are the largest minority population in the U.S., although this should not be confused with the fastest growing minority (i.e., Asians; Lim, 2022). In this section, we share demographics of U.S. states with highest population and percentage of Latinos. Our assumption is that policymakers who serve large Hispanic/Latino communities have an onus to understand and meet the needs of their constituents with applicable policies that improve their lives. This section provides data to support the need for evidenced-based practices and educational imperatives that serve Hispanics/Latinos.

Increase in Latino Population

Hispanics are the largest racial or ethnic minority in the United States and are currently 19.5% of the U.S. population (U.S. Census Bureau, 2021). By 2060, the U.S. Census Bureau

projects that 1 in 4 Americans will likely be Latino. Figure 1 depicts states with higher percentages of Latinos in dark blue.

Figure 1: Percentage of Latinos by State

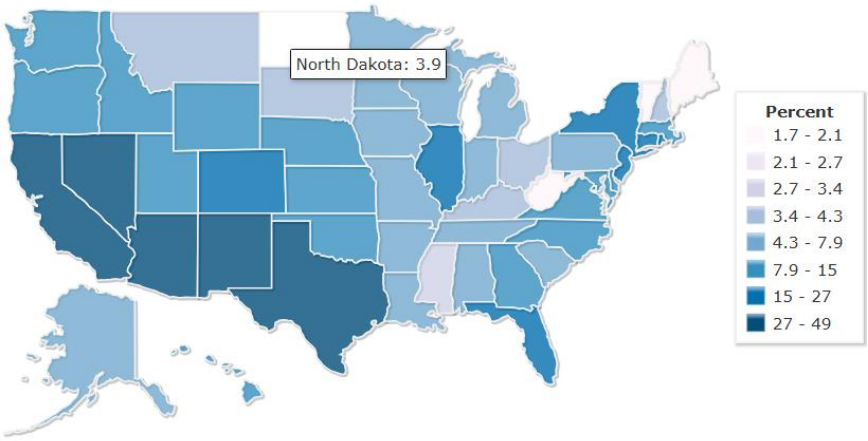


Table 1 shows that Puerto Rico ranks #1 among states with the highest percentage of Latinos (98%), followed by New Mexico (47.7%), California (39.4%), Texas 39.3%, Arizona (30,7%) and so forth.

Table 1: Hispanic and Latino Population by Percentage in Each State or Territory in 2000–2020 (Sorted by Percentage in 2020)

State/Territory	Numbers			Percent		
	2000	2010	2020	2000	2010	2020
Puerto Rico	3,762,746	3,688,455	3,249,043	98.8%	99.0%	98.9%
New Mexico	765,386	953,403	1,010,811	42.1%	46.3%	47.7%
California	10,966,556	14,013,719	15,579,652	32.4%	37.6%	39.4%
Texas	6,669,666	9,460,921	11,441,717	32.0%	37.6%	39.3%
Arizona	1,295,617	1,895,149	2,192,253	25.3%	29.6%	30.7%
Nevada	393,970	716,501	890,257	19.7%	26.5%	28.7%
Florida	2,682,715	4,223,806	5,697,240	16.8%	22.5%	26.5%
Colorado	735,801	1,038,687	1,263,390	17.1%	20.7%	21.9%
New Jersey	1,117,191	1,555,144	2,002,575	13.3%	17.7%	21.6%
New York	2,867,583	3,402,997	3,948,032	15.1%	17.6%	19.5%

However, a review of states by population of Latinos in Table 2 reveals that California, Texas, and Florida have up to five times, four times, and double the number of Latinos than Puerto Rico, respectively. These comparisons provide one of many explanations as to why some states with a high population, but lower percentage of Latinos, might not feel as obligated to pursue Latino-friendly policies, while states or territories with a high percentage of Latinos might feel more urgency to pursue policy and other educational opportunities for their constituents.

Table 2: Hispanic and Latino Population by State or Territory 2000–2020
(Sorted by 2020 Population)

State/Territory	Numbers			Percent		
	2000	2010	2020	2000	2010	2020
California	10,966,556	14,013,719	15,579,652	32.4%	37.6%	39.4%
Texas	6,669,666	9,460,921	11,441,717	32.0%	37.6%	39.3%
Florida	2,682,715	4,223,806	5,697,240	16.8%	22.5%	26.5%
New York	2,867,583	3,402,997	3,948,032	15.1%	17.6%	19.5%
Puerto Rico	3,762,746	3,688,455	3,249,043	98.8%	99.0%	98.9%

Profile of Hispanic Serving Institutions

Hispanic Serving Institutions

As of 2022-23, there are 600 Hispanic Serving Institutions, with Hispanic/Latino enrollment greater than 25%, of which 252 (42%) have a graduate program (gHSI) and 162 (or 27% of all HSI) offer doctoral degrees (Excelencia in Education, 2024). HSI represent 20% of colleges and universities and enroll 63% of Latino undergraduate students. The five states with the most HSI include California (n=172), Texas (n=111), Puerto Rico (n=56), New York (n=39), and Illinois (n=34). At the graduate level, 67% or two-thirds of all gHSI are in four states: California (n=56); Texas (n=550; Puerto Rico (n=35); and New York (n=23).

Emerging Hispanic Serving Institutions

There are 412 eHSI that represent 13% of all institutions and are in 43 states and the District of Colombia. Emerging HSI (eHSI) are also found in more rural states such as Iowa, Missouri, Nebraska, North Carolina, Tennessee, Utah, Wisconsin, and Wyoming. Most eHSI are 4-Year institutions (72%) and private (45%), although 29% of eHSI are 2-year colleges (Excelencia, 2024).

Method

Data Collection

We used IPEDS for AY 2022-2023 to collect doctoral degree completion information by Classification of Instructional Programs (CIP) codes, or CIP code 11 (Computer and Information Sciences and Support Services). We used HSI and eHSI lists from the Hispanic Association of Colleges and Universities (HACU) to identify emerging (eHSI) and Hispanic Serving Institutions (HSI) to distinguish between: 1) HSIs, institutions meeting the HSI criteria for 2022-23; 2) eHSIs, institutions nearing the HSI designation; and 3) all other institutions. No institutions were excluded from the IPEDS data collection, meaning that our lists include public, private 2-year, and 4-year institutions. We include programs delivering doctoral degrees in all modalities (i.e., online, in-person, or hybrid), to understand the entirety of institutions that contribute to Hispanic/Latino doctoral degree completions in computing.

Data Analysis

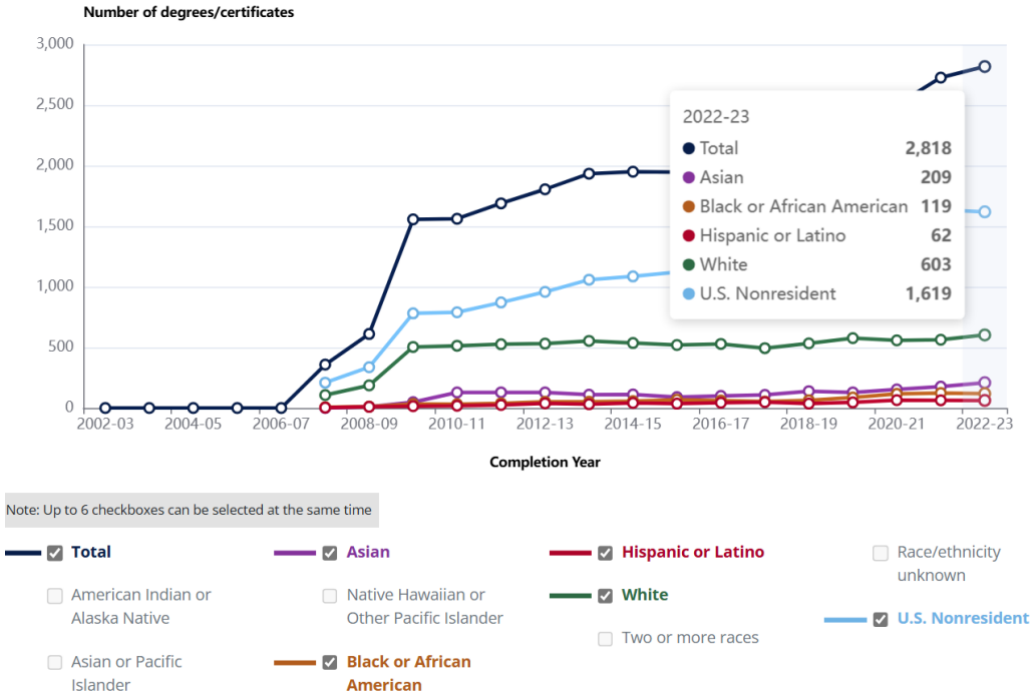
A list sorting program was created to sort the institutions into HSIs, eHSIs, and non-HSIs based on the HACU lists and IPEDS data. Additionally, a ranking scheme was developed to rank universities by Hispanic degree completion and degree level.

Results

Doctoral Degrees in Computing

We used the IPEDS Trends Generator (and shows only provisional data for 22-23) to create Figure 2, which reveals that doctoral degrees in computing for Latinos have remained unchanged over 20 years.

Figure 2: Number of Computing Doctoral Degrees 2002-2023 by Selected Race/Ethnicity



Note: Results limited by Award level (Doctor's degree - research/scholarship (new degree classification), CIP Code (Computer and Information Sciences and Support Services).

As Figure 2 shows, though the largest U.S. minority group, Hispanics/Latinos, have one of the lowest doctoral degree attainments in computing (2%). Black and Asian students almost double and triple doctoral degrees awarded in computing compared to Latinos, and nonresident degree attainment almost doubles all the other racial groups (i.e., White, Black, Hispanic, and Asian) combined.

Table 3: Latino Doctoral Degrees in Computing (CIP 11) by University Type - 2023

Institution	State	University Type	Sector	Rank	Degrees (#)
Capella University	Minnesota	nonHSI	Private for-profit, 4-year or above	1	4
University of Illinois Urbana-Champaign	Illinois	nonHSI	Public, 4-year or above	1	4
Marymount University	Virginia	HSI	Private not-for-profit, 4-year or above	3	3
Nova Southeastern University	Florida	HSI	Private not-for-profit, 4-year or above	3	3
The University of Texas at El Paso	Texas	HSI	Public, 4-year or above	3	3
University of Colorado Boulder	Colorado	nonHSI	Public, 4-year or above	3	3
Columbia University in the City of New York	New York	eHSI	Private not-for-profit, 4-year or above	7	2
Florida International University	Florida	HSI	Public, 4-year or above	7	2
Naval Postgraduate School	California	nonHSI	Public, 4-year or above	7	2
Princeton University	New Jersey	nonHSI	Private not-for-profit, 4-year or above	7	2
Texas A & M University-College Station	Texas	nonHSI	Public, 4-year or above	7	2
University of California-Santa Cruz	California	HSI	Public, 4-year or above	7	2
University of Florida	Florida	eHSI	Public, 4-year or above	7	2
Air Force Institute of Technology-Graduate School of Engineering & Management	Ohio	nonHSI	Public, 4-year or above	14	1
Duke University	North Carolina	nonHSI	Private not-for-profit, 4-year or above	14	1
Florida State University	Florida	eHSI	Public, 4-year or above	14	1
George Mason University	Virginia	eHSI	Public, 4-year or above	14	1
Georgia Institute of Technology-Main Campus	Georgia	nonHSI	Public, 4-year or above	14	1
Georgia State University	Georgia	nonHSI	Public, 4-year or above	14	1
Indiana University-Bloomington	Indiana	nonHSI	Public, 4-year or above	14	1
Michigan State University	Michigan	nonHSI	Public, 4-year or above	14	1
Northcentral University	California	nonHSI	Private not-for-profit, 4-year or above	14	1
Northeastern University	Massachusetts	nonHSI	Private not-for-profit, 4-year or above	14	1
Northern Arizona University	Arizona	HSI	Public, 4-year or above	14	1
Old Dominion University	Virginia	nonHSI	Public, 4-year or above	14	1
St. Thomas University	Florida	HSI	Private not-for-profit, 4-year or above	14	1
Stanford University	California	eHSI	Private not-for-profit, 4-year or above	14	1
Stony Brook University	New York	nonHSI	Public, 4-year or above	14	1
Syracuse University	New York	nonHSI	Private not-for-profit, 4-year or above	14	1
The University of Alabama	Alabama	nonHSI	Public, 4-year or above	14	1
University of Alabama in Huntsville	Alabama	nonHSI	Public, 4-year or above	14	1
University of California-Berkeley	California	eHSI	Public, 4-year or above	14	1
University of California-Irvine	California	HSI	Public, 4-year or above	14	1
University of California-Los Angeles	California	eHSI	Public, 4-year or above	14	1
University of California-San Francisco	California	nonHSI	Public, 4-year or above	14	1
University of California-Santa Barbara	California	HSI	Public, 4-year or above	14	1
University of Chicago	Illinois	eHSI	Private not-for-profit, 4-year or above	14	1

University of Maryland-College Park	Maryland	nonHSI	Public, 4-year or above	14	1
University of Miami	Florida	eHSI	Private not-for-profit, 4-year or above	14	1
University of Michigan-Ann Arbor	Michigan	nonHSI	Public, 4-year or above	14	1
University of Pennsylvania	Pennsylvania	nonHSI	Private not-for-profit, 4-year or above	14	1
University of the Cumberlands	Kentucky	nonHSI	Private not-for-profit, 4-year or above	14	1
University of Wisconsin-Madison	Wisconsin	nonHSI	Public, 4-year or above	14	1
Virginia Commonwealth University	Virginia	nonHSI	Public, 4-year or above	14	1
Total					65

Table 3 shows that 44 institutions awarded doctoral degrees (n=65) in computing to Hispanics in AY 22-23, with a mix of online and traditional face-to-face programs. A review of IPEDS data showed 212 institutions awarding computing degrees, although only 44 showed degrees completed beyond 0. Among the institutions awarding doctoral degrees (n) in computing are 26 nonHSI (57%, n=37), 9 HSI (26%, n=17), and 9 eHSI (17%, n=11). Institutions awarding these degrees include 29 public 4-yr and above (n=41 degrees, 63%), 15 private non-for-profit (n=20 degrees, 31%), and 1 private for-profit (n=4 degrees, 6%). Our program automatically assigned a rank according to the number of degrees awarded by institution with equal ranks showing for programs awarding the same number of degrees, and then sorting institutions alphabetically after degree ranking, with no specific ordering for program quality (as this was not assessed).

Our analysis also revealed the top eHSI that award computing degrees to Latino, again sorted by number of degrees and then listed alphabetically included Columbia University in the City of New York and the University of Florida, both awarding 2 doctoral degrees each to Hispanics/Latinos in AY 2022-23.

Discussion

In this study, we use IPEDS data to understand how PWI with a Hispanic/Latino enrollment between 15 to 24.9% are contributing to doctoral degree completion in computing:

- *What is the contribution of emerging Hispanic Serving Institutions (eHSI) to doctoral degree attainment by Latinos in computing degrees? How does this differ from HSI and non-HSI?*

Together, PWI (nonHSI and eHSI) award 74% of all Latino doctoral degrees in computing, of which 17% are by eHSI. With only 162 (27%) of all HSI (600) offering doctoral degrees, the 9 contributing HSI (26%, n=17) were able to award their proportion of doctoral degrees in computing. With an initial IPEDS list showing 212 institutions with doctoral programs in computing and only 65 institutions having awarded the degree, this finding suggests that more can be done to strengthen graduate programs and increase doctoral degree attainment among Hispanics/Latinos overall. Implications and the next steps for research are as follows:

Accountability: Why did 147 institutions that offer doctoral degrees in computing not award any degrees? What factors (e.g., facilitators and barriers) mediate degree completion and employment outcomes at eHSI?

Program Quality: It is noted that one of the limitations of the study is that the quality of the doctoral programs was not assessed, making it difficult to support an argument based on quantity of doctoral degrees alone. Are these programs adequately developing faculty and/or computing professionals? What evaluative measures could

be used to assess program quality for serving Hispanics/Latinos in computing degrees at the doctoral level?

Intentionality: Are the doctorate degrees awarded based on an intentional effort by institutions to improve Hispanic/Latino outcomes? Intentionality suggests that institutions go beyond "enrolling" Hispanics/Latinos, and "serve" them, the latter assuming that goals and measures are in place to support academic achievement. For eHSI, intentionality may require that the institutions transition from "ghosting" Hispanic/Latino efforts to genuinely supporting students through adequate programs, processes, and practices.

Belongingness: Students benefit from feeling that they belong and can be their authentic selves.

Funding: Many HSI (and other institutional types) are underfunded and do not have the resources to implement quality doctoral computing programs; however, R1 institutions may be especially equipped to support students who seek to become researchers as this is already a part of their mission. Research on the number of eHSI that are also R1 is warranted.

Modality: Without assessing employment outcomes for students who attend online, face-to-face, or hybrid doctoral programs, it is difficult to assert which models work best. Additionally, findings indicated that the majority of the degrees (63%) are awarded by public institutions of higher education. More research is needed to understand these models, and how various modalities and program choices impact Hispanic/Latino doctoral degree completion outcomes.

Conclusion

An important finding of this study is that nonHSI, eHSI, and HSI all play a role to increase the number of Hispanics/Latinos who receive advanced graduate degrees, although the number of degrees has not increased substantially in 20 years. States with a high population of Latinos have an imperative to serve their communities, although Latinos are now the largest minority group in rural populations as evidenced by the number of eHSI in these locations. An intentional approach is needed to support Latino achievement in computing, with economic, social, and political implications for our cities, states, and nation.

Acknowledgements

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Educational Research on the Application of Multiple Linear Regression Analysis to the Relationship Between Electric Vehicle Exterior Design and Affective Vocabulary

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Abstract
This study applies multiple linear regression analysis to investigate the correlation between electric vehicle exterior design and emotional vocabulary, with an emphasis on its educational application. We selected six primary automotive features as independent variables (X) and compiled consumer emotional response data toward various design features as dependent variables (Y). Multiple linear regression analysis was performed, with the F-test results showing an F-value of 5.198 and a p-value less than 0.05, indicating significant predictive ability. Some independent variables exhibited significant effects on the dependent variables based on t-test results ($p<0.05$), demonstrating that these variables significantly impact the dependent variables. The model passed normality (Shapiro-Wilk test, $p=0.976$) and independence tests (Durbin-Watson value=1.838) without issues of multicollinearity, ensuring its robustness and explanatory power. Subsequent validation of the model confirmed its significance and stability. These results indicate that the model is effective in examining the influence of design features on emotional vocabulary, offering practical insights for designers and educational applications. Additionally, it serves as a tool to enhance students' design analysis capabilities.

Keywords: Electric Vehicle Design, Emotional Vocabulary, Multiple Linear Regression Analysis, Design Education, Emotional Analysis

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Introduction

With the advancement of modern technology, product design must address not only consumers' functional needs but also their emotional expectations (McDonagh, Bruseberg, & Haslam, 2002). In the evolving electric vehicle (EV) market, the exterior design of a vehicle plays a pivotal role, representing not only aesthetic expression but also consumers' emotional engagement with the product. Designers must meet both functional and technical requirements while evoking positive emotional responses through design, thereby influencing purchasing decisions.

This research, based on multiple linear regression analysis, investigates the correlation between six primary electric vehicle exterior design features and consumer emotional responses. Furthermore, the study explores the potential application of these findings in design education. As design education increasingly emphasizes the integration of theory and practice, students must learn to utilize data to inform design decisions. This can help them better understand consumer needs and enhance their data analysis skills during the design process.

Correlation Between Design Features and Emotional Vocabulary

This study selected six primary exterior design features of electric vehicles—headlights, front grille, lower grille, windshield, fog lights, and side mirrors—as independent variables (X). Consumer emotional response data regarding these design features were collected as dependent variables (Y), specifically focusing on two emotional vocabularies: "modern and sleek" and "robust and comfortable." These design features directly influence consumers' visual perception and may shape their emotional response to the overall vehicle image. By understanding these responses, designers can optimize the design process to elicit positive reactions from target audiences.

According to the results of the multiple linear regression analysis, the model's F-test showed significant predictive power ($F\text{-value}=5.198$, $p<0.05$), indicating that these design features play a statistically significant role in shaping emotional responses. The t-test results revealed that some independent variables had a significant impact on the dependent variables ($p< 0.05$). Furthermore, the model passed the Shapiro-Wilk normality test ($p=0.976$), confirming that the data distribution met the normality assumption, while the Durbin-Watson value of 1.838 indicated no autocorrelation issues. Additionally, no multicollinearity problems were detected, further supporting the model's robustness.

These results demonstrate that our regression model has strong explanatory and predictive power, enabling designers to make more informed design decisions during the design process. At the same time, this model highlights the value of data-driven design, providing a foundation for future research.

Application in Design Education

In the field of design education, data-driven design thinking is becoming increasingly important. With the widespread adoption of data analysis techniques, design is no longer solely reliant on designers' intuition or creativity; data analysis provides a scientific basis for design. This study’s multiple linear regression model offers empirical support for design education, allowing students to understand the data underlying design decisions.

Through this model, students can learn how to translate design features into measurable variables and apply data analysis techniques to quantify the impact of design features on consumer emotional responses. This not only enhances students' data analysis skills but also promotes their understanding of the scientific basis of decision-making in the design process.

Additionally, the model serves as a practical case study for evaluating and optimizing design solutions. By incorporating data-driven design into education, students can improve their design capabilities and enhance their ability to solve real-world design problems, which is crucial for their future professional development.

Cultivating Data-Driven Design Thinking

Data-driven design thinking is an integrated approach that combines creative design with data analysis. As the design industry evolves, data analysis has become an essential skill for designers. The multiple linear regression model serves as a tool for quantifying design decisions, helping students gain insights into the subtle correlations between design features and consumer emotional responses through data.

Data-driven design thinking requires students to adopt critical thinking during the design process, using data to validate design assumptions and adjust designs based on analysis results. This skill is particularly important in today's fast-changing market environment, where consumer needs often shift, and designers must quickly adapt their design strategies based on the latest market feedback and data. Data-driven design thinking is not just about using numbers to support design decisions but also about developing a mindset that actively seeks out and integrates data throughout the design process. This approach empowers designers to make informed decisions, rather than relying solely on intuition or aesthetic preferences. As designers begin to prioritize data in their decision-making, they are able to identify patterns and correlations that may not be immediately obvious. For example, designers can analyze consumer feedback data to better understand how specific design features resonate emotionally with their target audience, enabling them to fine-tune their work for greater impact. Furthermore, this approach encourages continuous improvement by allowing designers to assess the effectiveness of their designs through the collection and analysis of real-world data. The ability to iterate quickly based on data-driven insights not only enhances the design's relevance and appeal but also improves the efficiency of the design process, reducing the time and resources spent on designs that do not meet consumer expectations. As the design industry moves forward, integrating data analysis into creative thinking is becoming an essential skill, enabling designers to stay competitive and respond to emerging trends more effectively. By integrating data-driven design thinking into their workflow, designers can foster a culture of innovation that is both creative and analytical. This mindset encourages designers to explore new possibilities while grounding their decisions in real-world insights. As a result, they can create products that not only meet functional needs but also resonate emotionally with consumers. Moreover, data-driven approaches enable designers to predict future design trends by analyzing consumer preferences and market behaviors. This predictive capability allows them to stay ahead of competitors and develop products that align with evolving consumer expectations. Additionally, the incorporation of data analytics tools and artificial intelligence can further enhance the design process by automating repetitive tasks and providing deeper insights into consumer behavior. With these advancements, designers can focus more on the creative aspects of their work while leveraging data to optimize their designs. Ultimately, embracing data-driven design thinking helps bridge the gap between creativity and science,

ensuring that design decisions are not only aesthetically pleasing but also strategically sound and aligned with user expectations.

Conclusion

This study explored the correlation between electric vehicle exterior design features and emotional vocabulary through multiple linear regression analysis, highlighting its potential application in design education. The results demonstrate that the model effectively explains the relationship between design features and consumer emotional responses, providing concrete data support for both designers and design education.

Future research could build upon this framework to further explore the impact of other design features on various emotional responses. For example, whether different interior design elements, such as seats and dashboards, have similar effects on consumer emotions is a question worth investigating. Additionally, with the advancement of artificial intelligence, future studies could integrate these technologies into design decision-making, making the design process more intelligent and efficient.

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This study would not have been possible without the support and assistance of many people. First, I would like to thank all the respondents who participated in the survey, providing valuable insights and time. Their data formed the foundation of this research, allowing us to better understand the correlation between electric vehicle exterior design features and consumer emotional responses. I also extend my gratitude to the experts and my academic advisor, whose guidance and suggestions were invaluable throughout the data collection and analysis process. The completion of this study is the result of collective efforts, and for that, I am deeply grateful. In the future, I hope to apply the findings of this research to broader design practices and continue exploring the interaction between design and emotional responses.

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Self-Reflection and the Interplay of Agency in ESL Learning

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Abstract
Self-reflection in language education has opened the path to a deeper understanding of cultural nuances and personal growth, enriching teaching practices and learning experiences. More recently, authors (Thanh, 2019; Upton & Hirano, 2022) have noted how the inclusion of self-reflection practices in language learning can promote awareness, critical thinking, and autonomy, to name a few. Therefore, the evident intersection between agency and language learning is becoming more significant as this intersection allows learners to take a more enduring responsibility for their language learning processes; to illustrate, language learners can take ownership of their own language learning by setting specific learning goals, highlighting their own strengths and weaknesses, and engaging more deeply in the decisions needed to continue advancing their language skills. For this reason, the present study situates self-reflection as it intersects with the agency and autonomy learners develop as they incur in self-reflection practices. About 90 college students enrolled in English as a Second Language (ESL) courses in an American institution participated in the study. Results demonstrated that, despite many participants expressing confidence in their oral presentation skills, self-reflection practices revealed areas for improvement that they had previously overlooked. Furthermore, the results underscored that integrating self-reflection practices among students can enhance their language acquisition by refining their oral proficiency. These results emphasized that agency and self-reflection are interconnected in language learning; thus, agency provides learners with the freedom and responsibility to direct their learning, while self-reflection allows them to evaluate and refine their learning strategies to improve their linguistic skills.

Keywords: Self-Reflection, Emergent Bilinguals, Agency

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Introduction

Self-reflection in language education has opened the path to a deeper understanding of cultural nuances and personal growth, enriching both teaching practices and learning experiences. More recently, authors (Thanh, 2019; Upton & Hirano, 2022) have noted how the inclusion of self-reflection practices in language learning can promote awareness, critical thinking, and autonomy, to name a few. Therefore, the evident intersection between agency and language learning is becoming more significant as this intersection allows learners to take a more enduring responsibility for their language learning processes; to illustrate, language learners can take ownership of their own language learning by setting specific learning goals, highlighting their own strengths and weaknesses, and engaging more deeply in the decisions needed to continue advancing their language skills. For this reason, the present study situates self-reflection as it intersects with the agency and autonomy learners develop as they incur in self-reflection practices.

Conceptual Framework

A conceptual framework section has been developed to help the reader gain a deeper sense of the terminology widely used in the present paper. This brief section provides definitions for the terms 'self-reflection' and 'agency.'

Self-Reflection

Based on Nattress (2007), self-reflection is:

> Think carefully about a given experience and then use the resultant insights to learn more about what one has done and implement necessary changes for future performance. In a practical sense, the goal of reflection in education is to get students to think about what they are doing in class, and not just perform an activity, leave class when the bell rings, and then forget what they have experienced in that class. (p. 168)

In this respect, the goal of self-reflection in education is to claim assurance that students are leaving the classrooms with the opportunity to fully engage with the materials provided by their instructors; students have been given the opportunity to listen, practice, apply, and re-think what has been covered for a given lesson.

Agency

Additionally, the term agency is defined according to Duff's (2013) perspectives. The author states:

> Agency refers to people's ability to make choices, take control, self-regulate, and thereby pursue their goals as individuals, leading, potentially, to personal or social transformation. A sense of agency enables people to imagine, take up, and perform new roles or identities (including those of proficient L2 speaker or multilingual) and to take concrete actions in pursuit of their goals. Agency can also enable people to actively resist certain behaviors, practices, or positionings, sometimes leading to oppositional stances and behaviors leading to other identities, such as rebellious, diffident student. (p. 417)

This said, agency, primarily among emergent bilinguals, is a pivotal factor in promoting students' academic success. It is through agency that students find themselves exploring circumstances, languages, and opportunities that they would not otherwise.

Research Question

This study focused on the intersection of self-reflection and agency, explicitly concerning the participants' oral proficiency. The research question leading this study can then be found below:

- *How does integrating self-reflection practices in ESL courses impact students' language learning agency and oral proficiency?*

Methodology

This section outlines the research design employed in this study. It further details the procedures followed for data collection and the subsequent analytical methods utilized to analyze the collected data.

Research Design

The research design utilized for this study was a mixed-method design. This research design was preferred over others as it provides an enhanced understanding of the data. Furthermore, with the implementation of more innovative practices, many have made repeated calls for using mixed-method approaches (Suri, 2011; Palinkas et al., 2015).

Data Collection

The sampling procedure used during the study was purposeful sampling, considering that, given the context of the study, these participants would likely provide rich and relevant information about their circumstances as college students who were concurrently emergent bilinguals. Approximately 90 college students who were enrolled in ESL (English as a Second Language) courses during the time of the study participated. Participants were enrolled in an HIS (Hispanic Serving Institution), an American institution; all these first-year students were Hispanic descendants whose primary language was Spanish.

The data collection methods included surveys, observations, and the collection of various artifacts. To begin with, the participants who took part in this study completed a ten-question-long survey, which included a combination of self-reported metrics (e.g., rating questions) and open-ended questions; all questions included in the survey were required to submit the survey. All surveys were answered electronically using a Microsoft Form. Observations were performed by PI during two different semesters (one academic year); these observations were conducted in different ESL courses (reading and writing courses). In addition, different participants' artifacts were collected for analysis; these artifacts were assignments directly related to their courses.

Data Analysis

As previously noted, this study employed a mixed-methods design. Consequently, the data analysis encompassed both quantitative and qualitative components. The quantitative analyses, for the most part, included descriptive statistics, charts, and graphs, whereas the

qualitative analyses included content analysis, which was performed by Microsoft Forms and the mixed-method software Dedoose.

Results

The findings presented below underscore the significance of self-reflection in the language classroom, particularly for emergent bilingual students. These results highlight the crucial role of agency in their learning journey. This section provides descriptive statistics to illustrate participants' responses across various aspects of their oral presentation experiences, including their overall performance, reactions to their delivery, adherence to instructions, and presentation organization.

Figure 1 represents participants' overall feelings about their oral presentations. As can be seen in Figure 1, the majority of participants rated themselves on a 5/5 or a 4/5 scale, with the average rating being 4.33 on a scale of 5. This means that approximately 80 participants rated themselves in these categories.

Figure 1: Overall Satisfaction (Self-Reported)

Figure 2 shows how participants felt about the way they delivered their oral presentations. The delivery of their oral presentations highlighted specific features such as confidence, posture, movements, eye contact, and energy level. Figure 2 demonstrates that 70 participants rated themselves with either a 5/5 or a 4/5 regarding how they delivered their oral presentation, where a 5 represented ‘excellent.’ The average rating for this question was 4.20 on a scale of 5.

Figure 2: Delivery (Self-Reported)

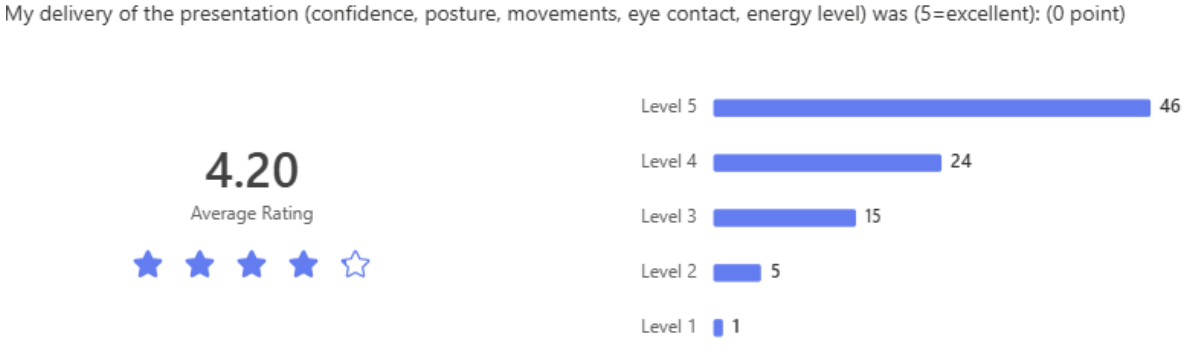
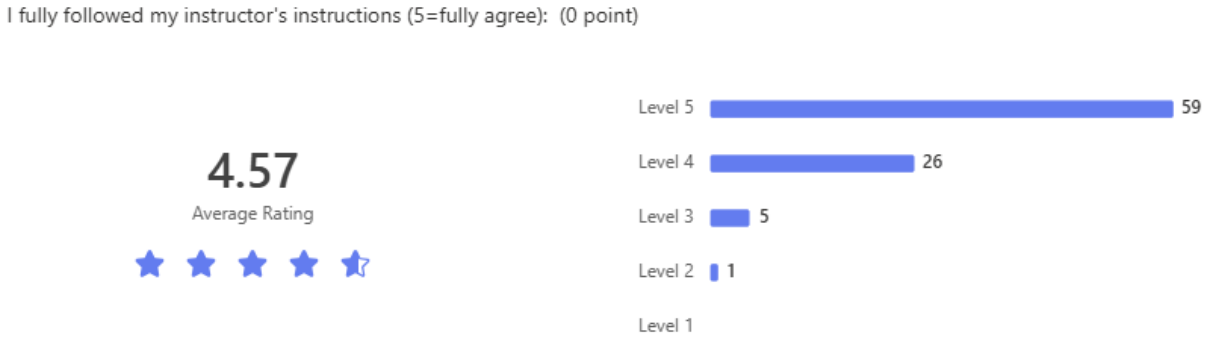


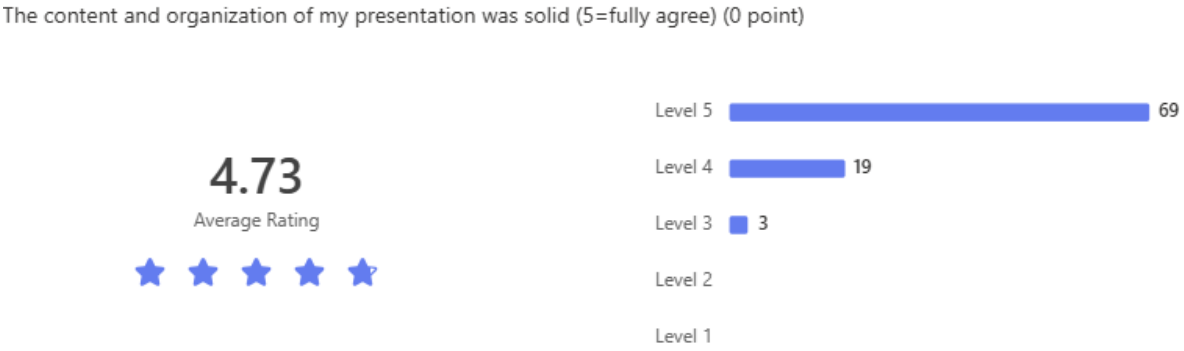
Figure 3 represents how participants perceived their eagerness to follow instructions to succeed in their oral presentations. Eighty-five participants self-reported following instructions to conduct their oral presentations successfully, with an average rating of 4.57 on a scale of 5.

Figure 3: Following Instructions (Self-Reported)



Last but not least, Figure 4 represents the perspective participants had regarding the content of their oral presentations. Here, Figure 4 represents how participants perceived how they presented their content and organized their oral presentations; more than 80 participants self-reported being satisfied with how they presented and organized their content as part of their oral presentations. This represents a 4.73 average rating on a scale of 5.

Figure 4: Content (Self-Reported)



After the descriptive statistics provided above, the primary focus shifted to content analysis. This analysis revealed three recurring themes in the participants' responses: nervousness, pronunciation, and confidence.

The following sample responses from participants were gathered regarding nervousness:

> Not being nervous, speaking and my nerves, trying not to follow my notes word by word, and being less nervous. I was nervous during the presentation, but I plan to improve it by practicing and trying different words. Participants' responses were highlighted for pronunciation: Improve my vocabulary and pronunciation, my pronunciation of difficult words. I'll improve it by repeating the same words several times until it comes out fluently and with good pronunciation; my pronunciation in certain words like “similarities”; I have to practice the pronunciation of some words

> and phrases. Finally, for confidence, participants revealed that: Maybe for the next time i wanna try have more confidence when I talk; I could provide more fun fact of thing to tell the class about the topic for not have silence during the presentation; I should try to stutter less while talking. When speaking in English, I tend to repeat words multiple times; more being confident with my answers, and not to be so scared and shy.

Based on the provided responses, it was evident that self-reflection significantly impacts language learners' agency. Here is a breakdown of how self-reflection influenced their language learning agency: First, it increased their self-awareness. Second, it enhanced their goal-setting. Third, it improved their self-efficacy. Lastly, it enhanced their autonomy.

Discussion

Based on participants' responses, these self-reflection experiences after completing their oral presentation made evident the role that agency plays for emergent bilinguals. To begin with, these practices allowed participants to increase their self-awareness about how they were performing when conducting oral presentations in their ESL classrooms. On the one hand, they were able to recognize their weaknesses. They were able to pinpoint specific areas where they needed improvement, such as pronunciation, vocabulary, and fluency. By the same token, participants were additionally able to recognize their strengths. This was relevant because while acknowledging their failures, participants also recognized their strengths, which can boost their confidence.

Moreover, after these self-reflection practices, participants strengthened their goal settings. It was demonstrated that participants could set specific goals for improvement, and more importantly, they were taking a personalized approach. First of all, participants set clear and actionable goals for improvement, such as practicing pronunciation, expanding vocabulary, and improving fluency. Similarly, participants' goals were tailored to individual needs and strengths, empowering learners to take ownership of their language learning journey. Miller (2012) highlights how agency in language learning settings, such as language classrooms, is mediated and relational; consequently, opening spaces in language classrooms where students can efficiently and effectively reflect upon their learning practices opens their opportunities to incorporate actionable plans into their learning.

Furthermore, incorporating instances where emergent bilinguals can self-reflect about their performance can improve self-efficacy. Presenting students with opportunities in the language classroom to self-reflect upon their language performance can help them overcome nervousness and simultaneously build their confidence. In this particular study, participants recognized the impact of nervousness on their performance and developed strategies to manage it, such as practicing and preparing thoroughly. More importantly, these emergent bilinguals gained confidence in their abilities, leading to more assertive and confident language use by setting achievable goals for their own. In the words of Duff (2013), "students fulfilling language requirements may have relatively little apparent choice or control over their L2 learning, reaching advanced levels of L2 proficiency arguably requires concerted effort, sustained and strategic practice, and opportunity—all manifestations of personal and social agency" (p. 417). Consequently, creating proficient language learners requires a communal effort where educators and students together build their own strategies for success, constantly looking for students' advancement in language.

Equally important, guiding emergent bilinguals to self-reflect about their oral presentations can help them enhance their learning autonomy. In this sense, they can take more initiative to positively impact their linguistic improvement and think critically about their own learning and organization styles. In the present study, participants took the initiative to practice independently, seek additional resources, and experiment with different language learning strategies. As Xiao (2014) explains it: "Agency is the process in which students intentionally and somewhat proactively try to personalize and otherwise enrich both what is to be learned and the conditions and circumstances under which it is to be learned" (p. 4). In this study, participants decided to practice outside class periods while looking for external resources to perform at their best during the oral presentations. They critically reflected on their learning processes, allowing them to make informed decisions about their language learning goals and strategies.

Conclusions

Self-reflection empowers language learners by increasing their self-awareness, fostering goal setting, boosting self-efficacy, and enhancing their autonomy. By regularly reflecting on their strengths, weaknesses, and learning processes, learners can take control of their language learning journey and progress significantly. Therefore, including spaces and pedagogical practices in the language learning classroom where self-reflection is encouraged can build supportive learning environments, support learner autonomy, and agency, and promote social mobility through an agency (Flowerdew & Miller, 2008). Nevertheless, more professional development opportunities are needed where language instructors can be better equipped to include constant self-reflection practices in their classrooms; in addition, curriculum developers should also be aware of the great need that self-reflection practices have in language classrooms. Today's curricula are so full that practices promoting agency amongst emergent bilinguals tend to be overseen, if not wholly disregarded, given unfortunate time constraints. A clear limitation and further consideration for the present study was that neither reflection journals nor focus groups were included; adding reflection journals and focus groups can potentially enlighten future similar studies.

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Cluster Analysis of Electric Vehicle Exterior Features: An Educational Study Using Miro for Online Collaboration and Data Analysis

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Abstract
This study utilized cluster analysis and the online collaboration whiteboard platform Miro to help students identify and classify the exterior features of electric vehicles, thereby enhancing their online collaboration skills in design classification and complex data analysis, leading to increased efficiency and accuracy. The study was conducted in four main stages: first, students collected 120 representative front-view images of electric vehicles; next, they categorized six key car parts (headlights, front grille, lower grille, windshield, fog lights, and side mirrors) on Miro using an expert-driven method, with each part classified into five design feature styles. Then, hierarchical cluster analysis using SPSS, where the dendrogram generated from the data, identified five optimal clusters; finally, the clusters were divided into five groups using the K-Means clustering method. The ANOVA (Analysis of Variance) results showed significant differences in the selected features between different clusters, validating the effectiveness of the classification method and the clustering results. The results of this study demonstrated that, through expert classification and SPSS hierarchical cluster analysis, five clusters with significant differences were ultimately formed. Therefore, this study successfully conducted online collaborative classification through Miro and applied cluster analysis to perform detailed classification and analysis of the design features of 120 electric vehicle front-view images. This approach not only enhanced students' abilities in identifying and classifying design features but also cultivated their skills in online collaboration and data analysis. Additionally, it provided valuable insights for automotive designers in understanding and applying design feature differences to meet market demands.

Keywords: Cluster Analysis, Electric Vehicle Design, Online Collaboration, Feature Classification, Design Education

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Introduction

With the rise of global environmental awareness and technological advancements, the sales of pure electric vehicles (EVs) have steadily increased from 2012 to 2024, and the market continues to expand. Sales have grown exponentially in recent years, doubling yearly (IEA, 2024). According to the Global EV Outlook 2024 report by the International Energy Agency (IEA), global EV sales reached a record-breaking 14 million units in 2023, marking a 35% increase compared to 2022. Nearly one in five cars sold in 2023 was electric, demonstrating the EV market's strong momentum and continuous growth potential. In Taiwan, EVs are also gaining popularity among consumers due to their environmentally friendly characteristics and supportive government policies (Pai et al., 2023).

Motivation

Moreover, with the EV market expanding, consumer demand is growing fast, too. The car's appearance is the most noticeable and the one people care about the most. However, balancing aesthetics with consumer demands has become a significant challenge for automotive designers as the market expands. Many studies have proven that a product's design greatly influences consumer purchasing decisions (Sun & Park, 2024). Therefore, with the continuous expansion of the market and the increasing consumer demand, designers need to invest more effort in understanding consumers' aesthetic preferences. For product designers, understanding consumer preferences in exterior design needs to be faster and more accurate—otherwise, they risk getting left behind in the market. This growing need highlights the importance of finding ways to enable designers to conduct product appearance design research more efficiently, which is the primary motivation for this study.

In traditional design education, studying product appearance features often involves printing many product photos for analysis. Researchers commonly use cluster analysis to classify product morphology and perceptual images, aiming to identify the design features most preferred by consumers (Liu & Zhu, 2023). While this process is tedious and time-consuming, it has long been considered a crucial foundational training for designers, helping them develop a keen eye for aesthetic details and user preferences. However, as technological advancements reshape the way designers work, more efficient and innovative approaches are worth exploring. Digital tools and online collaborative platforms present new opportunities to streamline design research, improve accessibility, and foster teamwork across geographical boundaries. For example, as an intuitive and versatile platform, Miro enables efficient online collaboration, enhancing student engagement and interactive learning experiences (Tucker et al., 2021). This study explores using Miro, an online collaboration platform, to conduct product appearance research in a digital environment.

Purpose

This study focuses on electric vehicles (EVs)—a rapidly evolving and highly relevant product category to provide a practical application of this approach. By integrating Miro into the research process, this study aims to experiment with different research methodologies and generate valuable insights for product designers. This study seeks to contribute to the growing discourse on digital transformation in design education, offering a new perspective on how online tools can be leveraged to enhance efficiency, accuracy, and collaboration in product appearance analysis. Here are the three main objectives of this study:

1. Explore using online collaboration tools (Miro) for categorizing product features.

2. Determine the best method for classifying electric vehicle exterior designs while ensuring the reliability of the results.
3. Provide reference data for the electric vehicle design field, enabling designers to understand market trends better.

Literature Review

Miro was selected for this study due to its robust online collaboration capabilities, which make it particularly suitable for data analysis and research. It allows users to tag and categorize images, manipulate their arrangement freely, and export data directly to Excel, enhancing efficiency and usability (Miro, n.d.).

Table 1 summarizes Miro's key functionalities and advantages based on information from its official website. The platform supports real-time multi-user collaboration, facilitating effective team-based classification and discussion. Its visualization capabilities enable intuitive manipulation of images and classification tags through a drag-and-drop interface, improving readability. Miro's seamless data integration also allows for direct Excel exports, streamlining subsequent analysis. These features collectively enhance classification efficiency by optimizing the organization and reorganization of data.

Table 1: Miro's Functions and Advantages

Functions	Advantages
Online Collaboration	Supports real-time multi-user editing, suitable for team classification and discussions.
Visualization	Allows direct drag-and-drop of images and classification tags, improving readability.
Data Integration	The data can be exported to Excel for convenient subsequent data analysis.
Improved Classification Efficiency	Speeds up the classification process through drag-and-drop operations and tagging.

Previous research has recognized Miro as an effective tool for online collaboration, particularly in educational settings where teamwork and ideation play a critical role. Tucker et al. (2021) found that Miro's real-time interaction capabilities help simulate face-to-face brainstorming sessions, making it a valuable resource for design-focused courses. The study also highlighted that Miro supports structured design processes, such as empathy mapping and journey mapping, enabling teams to analyze user needs and behaviors systematically. Additionally, Miro accommodates step-by-step and continuous brainstorming approaches, allowing for more significant idea generation and refinement flexibility. These findings underscore Miro's potential as a practical and interactive tool for collaborative design research and education (Tucker et al., 2021).

Cluster analysis is widely utilized in product design research as a systematic approach to classifying product attributes and identifying key design elements. Sutono (2016) applied cluster analysis in automotive design research to categorize descriptive adjectives, demonstrating its effectiveness in identifying meaningful patterns within large datasets. This method has proven particularly valuable for large-scale product design data analysis due to its efficiency in detecting trends and organizing complex information (Sutono, 2016).

Building on this foundation, this study employs cluster analysis to classify the exterior design features of electric vehicles systematically. By creating structured and meaningful groupings, this approach provides valuable insights into emerging design trends, making it an effective tool for analyzing large-scale product design data and supporting informed decision-making in design research.

Methodology

This study employed a structured cluster analysis approach to categorize the exterior design features of electric vehicles (EVs). The research process was conducted in four key phases: (1) data collection, (2) feature classification using Miro, (3) hierarchical cluster analysis using SPSS, and (4) validation of clusters through K-Means clustering and ANOVA (Analysis of Variance). Integrating Miro as an online collaboration tool was crucial in efficiently organizing and analyzing design features.

Data Collection

According to the Global Electric Vehicle Outlook 2024 report, China dominates the electric vehicle (EV) market (IEA, 2024). Given this significant influence, ensuring a representative dataset was a key priority for this study. To achieve this, data was sourced from China's XCAR website, a well-regarded platform for automotive information. One hundred twenty front-view images of electric vehicles were selected from the platform's internal rankings, as shown in Figure 1, ensuring that the study was based on valuable and relevant comparisons. The selection criteria prioritized diversity in design while maintaining consistency in image angles and resolution to facilitate accurate feature analysis.

Figure 1: 120 Front-View Images of Electric Vehicles

Feature Classification Using Miro

After selecting the images, we applied the Quasi-Expert Method to categorize them. According to relevant studies, even if participants are not highly specialized experts, experienced scholars can still employ the Expert Method—an approach referred to as the Quasi-Expert Method. This method allows for a structured and informed classification process without direct industry expertise. This study's classification was conducted by graduate students specializing in industrial design. The quasi-expert classification approach is widely utilized in design research, particularly when access to industry professionals is limited. This ensures that categorization is based on informed judgment rather than general perception. Tsai (2016) demonstrated that design students could reliably assess creative products using structured evaluation criteria, further supporting the validity of this approach.

To enhance classification accuracy, we invited three graduate students with extensive design experience to participate in the Quasi-Expert Method. Their role was to systematically classify the exterior design features of electric vehicles using Miro's interactive tagging and categorization tools. This method facilitated real-time collaboration, ensuring structured classification and consistency in feature categorization across all selected vehicle images. In the second phase, six key exterior components of EVs were selected for classification, as shown in Figure 2.

Figure 2: Key Exterior Components of Electric Vehicles for Classification

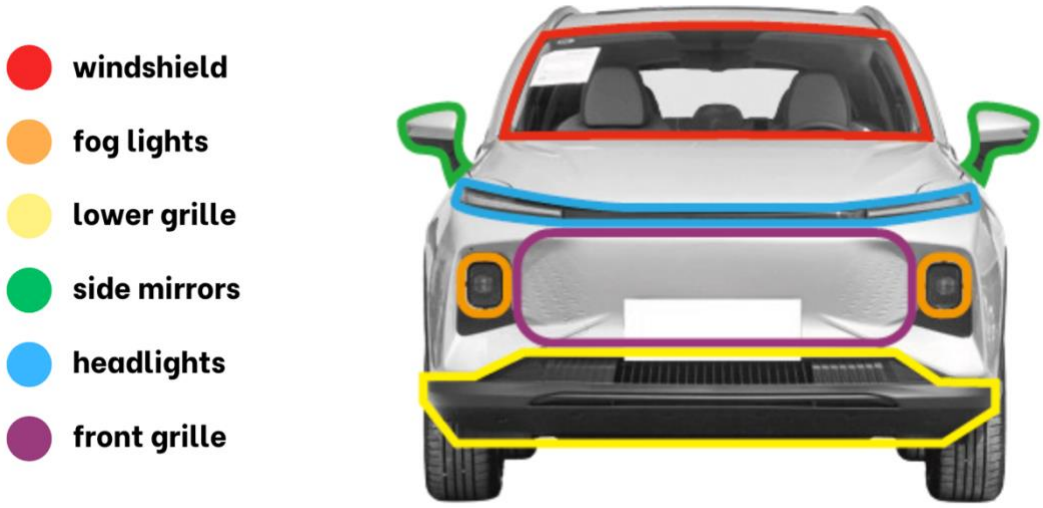

Figure 2 illustrates the six key exterior components of electric vehicles (EVs) that were selected for classification in this study. Each component is highlighted in a distinct color for clarity: Windshield (Red), Fog Lights (Orange), Lower Grille (Yellow), Side Mirrors (Green), Headlights (Blue) and Front Grille (Purple). Each feature was categorized into five distinct design styles using an expert-driven classification method. Miro’s interactive features enabled real-time tagging, sorting, and collaborative refinement of these classifications, ensuring a systematic and organized approach.

Each feature was classified into five distinct design styles through an expert-driven methodology. Miro’s interactive functionalities facilitated real-time tagging, sorting, and collaborative refinement, ensuring a systematic and well-structured classification process.

Table 2 presents the classification of six key exterior features of electric vehicles: headlights, front grille, lower grille, windshield, fog lights, and side mirrors. Each feature has been systematically categorized into five distinct design styles, labeled using an expert-driven classification method. These classifications reflect the most common design variations observed in the dataset of 120 electric vehicle images.

Table 2: Classification of Electric Vehicle Exterior Design Features

Headlights X1	**Front grille X2**	**Lower grille X3**	**Windshield X4**	**Fog lights X5**	**Side mirrors X6**
Rectangle X11	Panel X21	Connected to the Bottom of the Car X31	Flat Trapezoid X41	Slender Type X51	Triangle X61
Arc Shape X12	Grille X22	Framed Structure X32	Tall Trapezoid X42	Block Type X52	P-Shape X62
Polygon X13	Pattern X23	Connected to Fog Lights X33	Arc Shape X43	Connected Type X53	D-Shape X63
Slender Shape X14	Curved Line X24	Frame Connected to the Bottom X34	Rectangle X44	Extended Type X54	Rectangle X64
Irregular Shape X15	Horizontal Line X25	None X35	Curved Shape X45	None X55	Circle X65

For example, headlights (X1) are classified into five primary shapes, including Rectangle (X11), Arc Shape (X12), Polygon (X13), Slender Shape (X14), and Irregular Shape (X15). Similarly, the front grille (X2) includes design variations such as Panel (X21), Grille (X22), Pattern (X23), Curved Line (X24), and Horizontal Line (X25). Each category represents a fundamental stylistic choice in automotive design, helping to identify distinct trends and aesthetic preferences across different electric vehicle models.

Hierarchical Cluster Analysis (HCA) Using SPSS

The classified data were analyzed using hierarchical cluster analysis (HCA) in SPSS software. A dendrogram was generated to identify the optimal number of clusters by examining similarity patterns among the classified features. This process facilitated the formation of five primary clusters, ensuring a data-driven categorization of electric vehicle (EV) design elements. To prepare the data for statistical analysis in SPSS, One-Hot Encoding was applied to categorize different feature groups (X11–X15). The data were then converted into binary (0/1) markers to ensure that each image classification remained mutually exclusive, meaning each image could belong to only one category within a given feature set.

K-Means Clustering for Refinement and ANOVA for Statistical Validation

Following HCA, the K-Means clustering algorithm was applied to refine the clusters, ensuring consistency and reducing intra-cluster variability. The algorithm reassigned feature categories iteratively to optimize classification accuracy. An Analysis of Variance (ANOVA) test was conducted to validate the clustering results' effectiveness. The statistical comparison of feature variations across different clusters confirmed significant differences ($p<0.05$), ensuring that the classifications were meaningful and reliable.

Results

The cluster analysis and K-Means clustering successfully categorized the 120 electric vehicle (EV) front-view images into five clusters based on their exterior design features. The clustering process focused on six key components: headlights, front grille, lower grille, windshield, fog lights, and side mirrors. The classification allowed for a systematic evaluation of common design trends in EV aesthetics.

The initial cluster centers were established through cluster analysis, followed by iterative refinements using the K-Means clustering algorithm to achieve optimal intra-cluster similarity and differentiation. The clustering process converged after nine iterations, with minimal variation between the final cluster centers, ensuring stability in the results.

Cluster Centers Analysis

As shown in Table 3, the final cluster centers reveal how different exterior features correspond to each cluster.

Table 3: Cluster Center Interpretation

	Cluster				
	1	2	3	4	5
Headlights	4	1	3	4	3
Front grille	4	2	4	4	2
Lower grille	3	3	2	2	3
Windshield	2	3	2	4	1
Fog lights	2	3	2	2	4
Side mirrors	2	3	4	4	3

From Table 3, this study hypothesizes and observes the following:

- Cluster 1 features traditional designs, with rectangular headlights, panel-based grilles, and a standard windshield shape.
- Cluster 2 leans toward modern, sporty aesthetics, with arc-shaped headlights and structured grilles.
- Cluster 3 incorporates more dynamic, angular elements, likely in performance or futuristic models.
- Cluster 4 emphasizes streamlined, elongated shapes, indicating a trend towards sleek, aerodynamic designs.
- Cluster 5 showcases unconventional, concept-like features, making it the most unique and futuristic design category.

Cluster Distance and Differentiation

The distance between cluster centers determines how distinct each group is. As shown in Table 4, the larger the distance, the more significant the design differentiation.

Table 4: Cluster Distance Matrix

Group	1	2	3	4	5
1		4.306	3.132	3.199	3.851
2	4.036		3.374	3.341	3.343
3	3.132	3.374		2.872	3.305
4	3.199	3.341	2.872		4.125
5	3.851	3.343	3.305	4.125	

From Table 4, this study hypothesizes and observes the following:

- Clusters 1 and 2 are the most distinct, with a distance of 4.036, suggesting they represent entirely different design trends.
- Clusters 3 and 4 are closely related (distance=2.872), indicating similarities in lower grille and windshield features.
- Cluster 5 has moderate distances from all other clusters, implying a blend of different features.

ANOVA Significance of Feature Differences

To validate whether these cluster differences are statistically significant, ANOVA (Analysis of Variance) was conducted. The F-values and significance levels are shown in Table 5:

Table 5: ANOVA Results

	Group		Error			
	Mean Square	Degrees of Freedom	Mean Square	Degrees of Freedom	F-test	Significance
Headlights	34.787	4	1.133	115	30.698	.000
Front grille	30.167	4	.959	115	31.466	.000
Lower grille	9.418	4	1.529	115	6.161	.000
Windshield	29.919	4	1.151	115	26.003	.000
Fog lights	11.905	4	1.284	115	9.269	.000
Side mirrors	24.781	4	1.216	115	20.385	.000

Components with the highest F-values, which contribute most to classification, include:

- Headlights ($F=30.698$, $p<0.001$) → Headlamp design is a major distinguishing factor.
- Side Mirrors ($F=31.466$, $p<0.001$) → Side mirror styling significantly affects overall vehicle aesthetics.
- Headlights, windshields, and side mirrors have the highest F-values, indicating that these elements contribute the most to distinguishing the clusters.
- Lower grille and fog lights have lower F-values, meaning their role in defining vehicle clusters is less pronounced.
- All features have p-values<0.001, confirming a statistically significant difference among clusters for each feature.

These results validate the reliability of the K-Means clustering, ensuring that the identified groups accurately reflect real-world design variations.

Conclusion

This study utilized Miro to classify electric vehicle exterior features and evaluated its feasibility in online collaboration and design education.

- Advantages: Miro provides real-time collaboration, drag-and-drop functionality, and structured data labeling, making the classification process more intuitive and efficient.
- Challenges: Some participants reported that handling many images simultaneously could lead to system crashes, disrupting discussions. Additionally, screen size limitations affected image clarity, making classification more challenging.

Despite these limitations, Miro proved an effective platform for collaborative classification, demonstrating its potential for digital design education and remote teamwork. These findings highlight the role of digital tools in design research, with future studies exploring ways to enhance user experience and system performance.

For the data analysis component, this study utilized a one-way analysis of variance (ANOVA) to examine the statistical significance of design differences across the five clusters. The results indicate that headlights ($F=30.698$, $p<.001$), front grille ($F=20.385$, $p<.001$), lower grille ($F=9.269$, $p<.001$), windshield ($F=26.003$, $p<.001$), fog lights ($F=6.161$, $p<.001$), and side mirrors ($F=31.466$, $p<.001$) all exhibited significant differences among clusters.

The findings confirm that K-Means clustering effectively differentiates distinct design categories, offering a structured electric vehicle design classification framework. The following conclusions have been drawn based on the analyzed data:

1. Cluster analysis successfully categorized electric vehicle designs into five groups based on key exterior features.
2. High ANOVA F-values indicate that Headlights, windshields, and side mirrors are the most influential design elements.
3. Clusters 1 and 2 exhibit the most differentiation, while Clusters 3 and 4 share overlapping characteristics.
4. Cluster 5 represents a hybrid or emerging design trend, potentially blending futuristic elements with mainstream styles.

These findings provide valuable insights for automotive designers, allowing them to align their future designs with distinct market trends and consumer preferences. However, since K-

Means clustering is inherently designed to maximize inter-group variance, the ANOVA results should be interpreted primarily for descriptive analysis rather than hypothesis testing. Future research could integrate market demand analysis to further validate the applicability of this classification system in understanding consumer design preferences.

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Exploring the Lived Experiences of Wellness of Immigrant Community College Learners

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Abstract
Immigrant community college learners experience increased stress and adversity due to their demographic statuses, adversely impacting their wellness (Barker, 2015). Despite the increasing wellness-related problems among community college learners Nguyen & Benet-Martínez, 2013), the lived experiences of wellness of immigrant community college learners have not been fully explored. The purpose of this biographical narrative study was to explore the lived experiences of wellness of immigrant-origin community college learners and give a voice to this marginalized population. Convenience sampling was used to recruit ten participants for semistructured interviews. The data were analyzed using Braun and Clarke's thematic analysis and the theoretical framework of acculturation theory. The answers to the two research questions revealed ten themes. These findings included (a) resiliency and self-efficacy positively impacting wellness, (b) social networks' role in wellness, (c) wellness benefits of functioning in two cultural streams, (d) adverse effects of discrimination, (e) ethnic identity's role in wellness, (f) cultural perceptions and wellness-related stigma around help-seeking, (f) and experiences of discrimination and microaggressions in student wellness services. The study's findings contribute insight for application in counseling, supervision, and counselor education settings. Counselor educators and supervisors can use this information with applied skills to incorporate when working with immigrant-origin learners in their settings and through pedagogical strategies for counselor training. Finally, this study contributes to the growing knowledge of the broader cultural issues at work toward the specific cohort of immigrant-origin community college learners.

Keywords: Culturally Competent Counseling, Community College, Immigrants, Psychological Distress

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Introduction

Immigrant college learners experience high levels of social exclusion (Borjian, 2018), psycho-social stressors, and microaggressions associated (Barker, 2015) with their immigration status, and these encounters ensue at the beginning of their academic journey and continue throughout their time in higher educational settings (Verbeek et al., 2015). Learners at community colleges are more likely to be from lower socioeconomic backgrounds (Jakub et al., 2018), learners of color, or be working or older than their counterparts at traditional universities (Borjian, 2018). Community college learners experience more stress and adversity (Borjian, 2018), impacting their mental and emotional health (Nguyen & Benet-Martínez, 2013, p. 150). There is a need to better understand the experiences of immigrant community college learners due to increasing mental health problems among college learners (Pascal et al., 2011, p. 180).

Community college learners are vastly underrepresented in nearly all the literature on college learner mental health (Razum & Spallek, 2014). The limited literature affirms stark differences between community college and four-year college populations concerning demographics, culture, and mental health issues (Verbeek et al., 2015). Despite differences between traditional universities and community colleges, very few studies have focused on the well-being of community college learners and even fewer on immigrant learners (Nguyen & Benet-Martínez, 2013). Most community college learners are more diverse in terms of their ethnicity (Borjian, 2018), age, and SES than traditional universities (Verbeek et al., 2015). Many of these cultural and demographic traits are associated with increased stress and adversity indicated in the literature (Razum & Spallek, 2014). A body of research has shown a link between psychopathology, SES, and ethnic/racial status (Barker, 2015). The literature strongly links stress and adversity experienced by ethnic minorities to a decline in mental health (Razum & Spallek, 2014). Community college learners may be more susceptible to stress and have higher rates of psychopathology due to their demographic (Verbeek et al., 2015). In addition, there is a significant research gap in investigating the intersection of immigrant status and the community college campus experience (Barker, 2015), institutional policies on the acculturation and integration of immigrant learners, and immigrant learners' utilization of mental health resources (Nguyen & Benet-Martínez, 2013).

For most immigrant learners, overall emotional and psychological well-being is a significant barrier to academic functioning (Nguyen & Benet-Martínez, 2013). Immigrant learners frequently experience high levels of shame and powerlessness (Nguyen & Benet-Martínez, 2013). Anxiety and depression (Verbeek et al., 2015) occur among immigrant learners at greater rates than samples of non-immigrant learners (Pascal et al., 2011). Pascal et al. (2011) discovered that experiencing discrimination due to immigrant status has been strongly associated with developing higher and more severe cases of depression in immigrant learners. Immigrant learners with high levels of depression (Nguyen & Benet-Martínez, 2013) had lower grade point averages than their natural-born learner counterparts afflicted by depression (Barker, 2015). There is a significant research gap in investigating the intersection of immigrant status and the campus experience (Nguyen & Benet-Martínez, 2013), including utilization of mental health resources (Verbeek et al., 2015).

In addition to the vast underrepresentation in research of community college learners (Razum & Spallek, 2014), there is minimal research on the integration of immigrants in the United States' higher education environments (Barker, 2015). Immigrants face questions about their ethnic identity in a new environment (Verbeek et al., 2015), apart from the need to adapt

psychologically and socio-culturally (Razum & Spallek, 2014). Therefore, I ask the following pertinent questions: What are the mental health needs of immigrant community college learners? What are the common presenting issues of the immigrant community college learners? What are the barriers to accessing mental health-related resources for immigrant community college learners? What are immigrant community college learners' perceived methods of outreach activities at the community college setting? How is the utilization of mental health resources of community college learners? What are immigrant learners' perceived experiences in counseling in the community college setting? What cultural areas are unique to the immigrant community college learner population regarding their mental health? These questions are not answered in the literature.

This qualitative study aimed to understand the mental health needs of immigrant community college learners from the New York metropolitan area. There is a need to better understand the experiences of immigrant community college learners due to increasing mental health problems among college learners (Razum & Spallek, 2014). This study helps identify the mental health needs of immigrant community college learners and potential factors that may affect their overall well-being. Discovering the mental health needs of immigrant community college learners is paramount as a welcoming and understanding campus climate is essential for immigrant learners to succeed in higher education (Verbeek et al., 2015).

Method

The purpose of this biographical narrative study was to explore the lived experiences of wellness of immigrant-origin community college learners and give a voice to this marginalized population. Convenience sampling was used to recruit ten participants for semistructured interviews (Verbeek et al., 2015). The data were analyzed using Braun and Clarke's thematic analysis and the theoretical framework of acculturation theory (Nguyen & Benet-Martínez, 2013). The main research question of this study was: How do immigrant community college learners in a position of immigrant students from the New York metropolitan area describe their lived experiences in the higher education context? The research goal was to rely on the participants' views of the situation. I used "social constructivism" (Razum & Spallek, 2014, p. 150) as the interpretive framework to guide the process of inquiry. Through the views of social constructivism, people seek to acknowledge the world and develop a subjective sense of their experiences. Research is based on subjects' perspectives of the situation (Barker, 2015). The facilitative questions were broad and general to allow the learners to make sense of a situation and create subjective meanings. A narrative approach to social constructivism was a good fit (Nguyen & Benet-Martínez, 2013). The narrative approach seeks to understand and explore how participants' personal experiences are expressed via storytelling.

Conclusion

These findings included (a) resiliency and self-efficacy positively impacting wellness, (b) social networks' role in wellness, (c) wellness benefits of functioning in two cultural streams, (d) adverse effects of discrimination, (e) ethnic identity's role in wellness, (f) cultural perceptions and wellness-related stigma around help-seeking, (f) and experiences of discrimination and microaggressions in student wellness services. The study's findings contribute insight for application in counseling, supervision, and counselor education settings. Counselor educators and supervisors can use this information with applied skills to incorporate when working with immigrant-origin learners in their settings and through

pedagogical strategies for counselor training. Finally, this study contributes to the growing knowledge of the broader cultural issues at work toward the specific cohort of immigrant-origin community college learners.

Counselors and policymakers need to be aware of the importance of college learners' mental well-being from immigrant backgrounds due to the significant increase in college learner populations and the massive immigration in the United States (Verbeek et al., 2015). Discovering the needs of immigrant community college learners is paramount as a welcoming and understanding campus climate is essential for immigrant learners to succeed in higher education.

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Teacher's Emotional Scaffolding in Constructing a Translanguaging Space as Inclusive Pedagogical Practices

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Abstract
Emotional scaffolding is an effective technique for changing feelings in the classroom. Teachers' emotional scaffolding as inclusive pedagogical practices increasingly supports the process of constructing a translanguaging space in multilingual classroom. The process of enacting inclusive pedagogical practices engages EFL learners' feelings in response to particular elements of English learning and mobilises various available multilingual and semiotic resources. This study is an attempt to investigate on the teacher's emotional scaffolding in EFL classroom on constructing a translanguaging space to mobilise the learners' various semiotic repertoires. To achieve the objectives of the current study, descriptive qualitative research design approach involving a classroom observation and video-stimulated-recall-interview were conducted in EFL classroom in Indonesia. This study applies Multimodal Conversation Analysis and then triangulated with the video-stimulated-recall-interview applying Interpretative Phenomenological Analysis to investigate how the teachers' emotional scaffolding constructs a translanguaging space to mobilises learners' semiotic repertoires in English learning. The findings show that teachers' emotional scaffolding provides opportunities for the EFL learner to thoroughly employ the semiotic and spatial repertoires for engaging in translanguaging practices. Such practices in turn allows the learners enriching their social-emotional learning (SEL) that plays a critical role in the development of emotional awareness in the classroom. The findings imply that teachers' emotional scaffolding entails bridging the gap between what the learners already know and the new knowledge they achieve. Pedagogically, these findings advocate the teachers' emotional scaffolding to establish learners' social-emotional skills performing more capable of controlling their emotions, performing better academically, and communicating effectively in a flexible and fluid translanguaging friendly space.

Keywords: Translanguaging, Translanguaging Space, Emotional Scaffolding, Semiotic Repertoires, EFL Learning

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Introduction

In multilingual classroom, teachers who provide emotional support is fundamentally weaving an invisible net of trust and comprehension with their learners. English teachers uniquely need to have empathy as the ability to put themselves in their learner's else's shoes and honestly feel what their learners are feeling. One type of pedagogical approach is scaffolding arranged to influence learners' emotional response to an idea or mental concept that I called this emotional scaffolding. Teacher's emotional scaffolding is teacher's support strategies that help students recognize their emotions and utilize them to actively participate in classroom activities and achieve their learning goals (Back et al., 2020). Considering English is already a compulsory subject in the secondary and university curriculum in Indonesia. Yet nearly 70 % students with limited proficiency in English navigate classroom content and social interactions in the language (EF English Proficiency Index (EF EPI 2023 Data). As a result, EFL learners have a very hard time adjusting to and studying in EFL classrooms (Zein, 2022) and learners in English-only classrooms are likely to experience a variety of emotions. Moreover, many of which may impede their learning experience and result in behavioural issues (Zhang, 2021).

To tackle this issue of weak English learning motivation and students' low participation in English-speaking classrooms, this requires EFL teachers to move away from the monolingual pedagogy (English-only classrooms) to an emotional scaffolding in constructing a translanguaging space where students' L1 are valued and deliberately empowered (Canagarajah, 2011; García, 2014). Considering translanguaging as the perspective, English Language Teaching (ELT) to EFL students is "a multimodal activity", encompassing modalities including images, facial expressions, gaze, emotion, speech, bodily movement, and proxemic for meaning making (Wei, 2011, p. 381). To mobilize learners' multilingual and multimodal resources, translanguaging views languages as distinct entities and employs a pedagogy that allows fluid, dynamic, and intense discursive resources (Canagarajah, 2011; Wei, 2018).

Further, translanguaging has rich potential for emotional scaffolding and creating desired classroom climate to promote students' emotional well-being by adopting a multilingual, "multimodal" and "multisemiotic" understanding (Wei, 2023). Therefore, this study is an attempt to investigate on the teacher's emotional scaffolding in EFL classroom on constructing a translanguaging space to mobilize the learners' various semiotic repertoires and engage English teachers with practical matters in creating a translanguaging space to provide the equality of languages in building educational practices. Accordingly, a more thorough coverage on how an EFL teacher empower the use of emotional scaffolding in constructing a translanguaging space to facilitate and support L2 English learning. Hence, this research attempts to fill in this gap and address this research question: *How does an EFL teacher empower the use of emotional scaffolding in constructing a translanguaging space to facilitate and support L2 English learning?*

Methodology

Data was gathered by observing 40 Indonesian university students in Medan, North Sumatera, Indonesia. English is the primary language that is enforced. In this university for most of its lectures, as the university's language policy places a high value on improving students' English language skills. The participating teacher involved in this research has a commendable ten years of experience teaching English at this university. The teacher who is

participating in this study, was born and raised in Indonesia. He is a native speaker of Indonesian, while Arabic and English are his foreign languages. For data collection and analysis, the study employed two primary instruments for data collection: classroom observations and video-stimulated recall interviews. The data aimed to investigate how an EFL teacher empower the use of emotional scaffolding in constructing a translanguaging space to facilitate and support L2 English learning, as well as the explanations and reflections regarding his understanding of emotional scaffolding through translanguaging practices that emerged during specific moments of classroom activities. This research integrates Multimodal Conversation Analysis (MCA) with Interpretive Phenomenological Analysis (IPA) (Tai, 2023) to investigate emotional scaffolding through translanguaging in EFL classrooms. MCA was utilized to examine the video recordings of interactions within the classroom. In the interim, Interpretative Phenomenological Analysis (IPA) was utilized to examine the video recordings of post-video-stimulated recall interviews. This approach was employed to understand the emotional scaffolding through translanguaging that emerged during specific instances of classroom activities.

Findings and Discussion

The analysis identified two primary themes that illustrate the role of emotional scaffolding through translanguaging within the EFL classroom as inclusive pedagogical practices. These practices aim to enhance meaning-making and support English language learning by actively involving learners varied multilingual and multimodal approaches: (1) Teacher's emotional scaffolding, dealing with students' affective and cognitive, response to the subject matter being taught and (2) Translanguaging practices in turn allows the learners enriching their social-emotional learning (SEL) that plays a critical role in the development of emotional awareness in the classroom. The following two key themes are presented below, along with representative excerpts that illustrate the interconnected features of emotional scaffolding through translanguaging observed within the classroom setting.

Teacher's Emotional Scaffolding, Dealing With Students' Affective and Cognitive, Response to the Subject Matter Being Taught

In line 11, The teacher (T) gave the instructions to the students to do the task properly. In line 12, T rephrased his statement in Indonesian "kategorikan dia yah" (Categorize the signs) based on the selected pictures that the students had collected before. The extract showed that T employed positive emotions by using his multilingual (Indonesian and English) and multimodal resources (i.e. extending left-hand index finger pointing at the screen and contingently kept moving his right-hand up and down at the screen). The effects of assistance and caring on his teaching gave more learning experience is enjoyable and the less it is anxiety-producing. Based on T's self-evaluation during the post-video-stimulated recall interviews led him to believe that emotional scaffolding in constructing a translanguaging space will significantly improve learners' satisfaction with the material covered in class. T also validated the important function that emotional state plays in students' affective and cognitive in responding to the subject matter being taught.

Figure 1: Teacher's Emotional Scaffolding: Giving the Instructions to the Students

11 T: [Well] listen (.) listen everybody (.) please you categorize.
+T pointed at the screen, extending his right-hand arm.

Figure #1

12 T: Kategorikan dia yah from those pictures. ((Categorize the signs))
+T Extending left-hand index finger pointing at the screen.
13 (0.1)
14 A store sign (.) if you have (.) if you have store sign, please you think okay↑ for the title sore sign and then put the picture.
+T Extending left-hand index finger contingently pointing at the screen.
15 (0.1)
16 T: A government warning and notice if you have please you make the title and pick the picture ( )
+T contingently kept moving his right-hand up and down at the screen.

Figure #2

T acknowledged that positive emotions would increase social, psychological, and physical resources, so expanding and strengthening the thought-action repertoire. It is noticeable in this extract that T significantly contributed to offering EFL learners the best possible learning experiences by utilizing psychological scaffolding techniques. That is, this led to responses from a student by raising their hands to ask questions. In lines 26, a student raised his hand and initiated a question by saying *gak papa yah kalo misalnya kita gak bikin* (it is ok if we don't make) in Indonesian. The extract analysis reveals that T has the potential to enhance students' learning experiences by fostering an inclusive and equal environment where students can openly and critically articulate their thoughts and emotions during discussions. T realized that he could cultivate a nurturing environment for students, fostering a sense of positivity. This positive sentiment can significantly enhance students' focus and eagerness to engage in classroom activities. The provision of supportive opportunities through translanguaging can significantly improve students' participation in non-competitive manners. In essence, T can maintain his students' enthusiasm, optimism, and resolve to pursue further learning by implementing psychologically scaffolding strategies.

Figure 2: Teacher's Emotional Scaffolding: Maintaining the Students' Enthusiasm

17 T: and then the art of mural you pick which one is the picture and then covid 19 (.) if you have don't forget

18 +T moved towards the students slowly.
T: >Okay< but sir I don't have for example I don't have billboard

19 T: Hello, I don't have billboard sir, it's ok
+T moved back to the screen and waved the hand.

20 (0.2)

21 T: ( ) You just pick the pictures you have based on the categories

22 (0.1)

23 Okay ↑ All right do it right now.
+T moved towards the students.

24 + S tilted his head and gazed at his friend to his right
+ S chatted to his friend
+ S raised a hand and self-initiated a question

Figure #3

25 (0.1)

26 T: Yes?
+T raised his head and looked at the student and walked over him

27 S: Sir it is *gak papa yah kalo misalnya kita gak bikin* (0.1) about covid 19 sign
((it is ok if we don't make))
+S looked at T and approached him

28 (0.1)

It is evident after a 4.2 -second pause, the student called T again, raised his hand while standing up, and again self-initiated a question by uttering "Sir, so do we group the picture *berdasarkan kategori*?" (based on categories?), he deployed the linguistic code from English to Indonesian after a 0.2-second pause. It is noticeable that when T demonstrated a strong enthusiasm for teaching, the student found himself equally motivated to learn. T's passion for the subject significantly inspires and invigorates students' commitment to the challenging process of acquiring a new language by deploying translanguaging practices.

Figure 3: Teacher's Emotional Scaffolding: Comprehending the Students' Emotions

29 T: That's ok yah (0.1)

+T nod his head and pointed at the PowerPoint slide

*--->

Figure #4

T: Yah, you speak the picture based on (what you got) if it's not about covid 19 is ok, forget it and skip, all right?

30 (.)

31 S: Thank you sir

32 T: Yes

+T turned his body, facing other student and checking the activity

33 (4.2)

34 S: Sir!

+S called T again, raised his hand while standing up, and again self-initiated a question

Figure #5

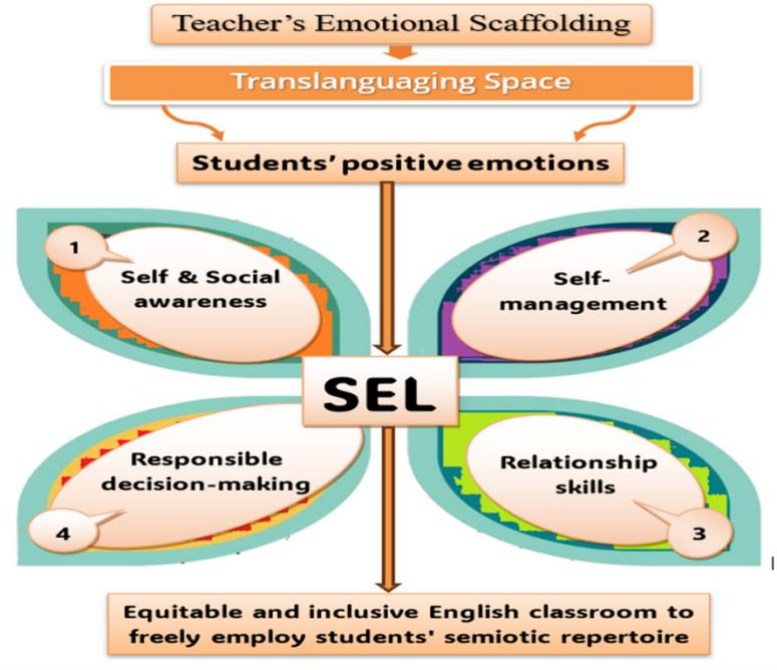
The extract revealed the extent to which T's beliefs, knowledge, and various contextual elements played a role in the development of emotional scaffolding strategies. Therefore, it is important to comprehend students' emotions and applying corresponding emotional strategies (Alavi & Esmaeilifard, 2021). Moreover, to establish and maintain trust, it is evident that T engages in practices such as clearly articulating their expectations through translanguaging employing multilingual and multimodal resources, such as maintaining eye contact with students, sharing personal anecdotes, demonstrating enthusiasm and enjoyment during interactions, employing humour, and acknowledging students' strengths through compliments.

Translanguaging Practices in Turn Allows the Learners Enriching Their Social-Emotional Learning (SEL)

Social-emotional learning (SEL) plays a critical role in the development of emotional awareness in the classroom. SEL encompasses the methods by which individuals, both young and adult, gain and utilize the knowledge, skills, and attitudes necessary for cultivating healthy identities, regulating emotions, and attaining both personal and communal objectives (DeJaeghere & Murphy-Graham, 2022). It is noticeable in the combining MCA and IPA

analysis of video-stimulated-recall-interview data that establishing a supportive classroom environment will foster students' motivation to engage in the classroom. This study demonstrated that emotional scaffolding through translanguaging serves as an essential educational tool, enabling teachers to engage in developmentally suitable activities that promote students' academic achievement. Viewed in this way, T mentioned that emotional scaffolding through translanguaging in turn allows the learners to enrich their social-emotional learning (SEL) that plays a critical role in the development of emotional awareness in the classroom.

Figure 4: Emotional Scaffolding, Translanguaging, and SEL



SEL can play a significant role in tackling different types of inequity, enabling EFL students to collaboratively develop flourishing educational environments and foster safe, healthy, and equitable communities (Gimbert et al., 2023). It is noticeable in this extract that T utilized emotional scaffolding through translanguaging as his supporting positive emotional experience to his students that leads to enhancing their learning participation and development. This study reveals that T's emotional scaffolding through translanguaging can assist students in cultivating their social and emotional competencies and it may aid them in managing or averting behavioural, emotional, and learning challenges. As seen in the extract line 26 and 34, the importance of the strategies in T's emotional scaffolding helps student move from those with shared responsibilities to independent ones, including better control of social and emotional skills during the discussion. Moreover, T's emotional scaffolding established and nurtured supportive relationships while making decisions between teacher and students. It gave a space for students in identifying their strengths and weaknesses while fostering an understanding of their thoughts and feelings during the lesson. That is, this strategy can enhance students' self-awareness that promotes self-confidence and equips them with the skills to tackle challenges in a constructive manner.

Conclusion

This study is an attempt to investigate on the teacher's emotional scaffolding in EFL classroom on constructing a translanguaging space to mobilize the learners' various semiotic repertoires and engage English teachers with practical matters in creating a translanguaging space to provide the equality of languages in building educational practices. Regarding the research question, T's beliefs, knowledge, and various contextual elements played a role in the development of emotional scaffolding strategies. T admitted that positive emotional scaffolding through translanguaging would increase students' social, psychological, and physical resources, so expanding and strengthening the thought-action repertoire. That is, this strategy developed students' affective and cognitive, response to the subject matter being taught. In terms of the teachers' views, emotional scaffolding through translanguaging might provide an inclusive and equal space for EFL students to take part in individual and group work activities in classroom that led to the development of SEL, which in turn help them develop social and emotional life skills, performance, and mental well-being

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AI-Eustress Implications in Healthcare and Mental Health Digitalization: A Scoping Review

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Abstract
The rapid advancement of technology, particularly artificial intelligence (AI), has introduced both challenges and opportunities in human-technology interactions. The literature differentiates between technostress, techno-distress, and techno-eustress, and the emerging concept of "AI-eustress" represents the positive stress arising from AI-related challenges and incentives that contribute to personal and professional growth. As AI becomes increasingly integrated into healthcare and mental health services, understanding AI-eustress is essential. This scoping review examines AI-eustress and its implications for the digitalization of mental health systems and healthcare, identifying research gaps, synthesizing current knowledge, and proposing strategies to enhance its relevance. A systematic search of academic databases, including Scopus, Web of Science (WOS), and PubMed, yielded 250 studies, which were analyzed following scoping review guidelines. Findings from this review may contribute to the development of AI-powered frameworks for customized, real-time assessment and intervention tools, particularly in mental health. Additionally, this review explores ethical considerations and highlights priority research areas to understand the role of AI-eustress in mental health digitalization. By addressing these challenges, this study aims to pave the way for innovative AI-powered solutions that harness the beneficial aspects of technology-induced stress, ultimately improving well-being in the digital era.

Keywords: Eustress, Techno-Eustress, AI-Eustress, AI-Induced Stress, Healthcare, Mental Health, Digitalization

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Introduction

Background

Technology makes system-human relations better but also complicates behavior. Technostress resulting from technological challenges consists of both happy eustress and negative unpleasantness. Technologically, techno-eustress refers to positive stress reactions to technological-based obstacles, enhancing performance and creativity. In the framework, artificial intelligence-eustress and techno-eustress characterize AI-related and technological-use stress consequences. Whereas techno-eustress provides stress benefits from digital tools, artificial intelligence-eustress refers to stress reactions to AI algorithms that boost job efficiency, creativity, and health.

AI-eustress increases relationships and support. AI-powered social dynamic filters help moderators remove bad comments from online groups, therefore promoting good relationships and mental wellness (Rosario et al., 2022). Artificial intelligence increases community involvement and social aid, thereby creating stress. Faster operations and improved decision-making with professional AI technology help reduce artificial intelligence-eustress. Several research studies show that artificial intelligence improves staff output and organizational performance, thereby raising confidence and motivating factors (Toll et al., 2020). Advanced technology generates artificial intelligence-eustress in companies.

AI changes medical residents' employment. Inaccurate application of AI tools meant to increase patient care and output could strain resources. Adoption of artificial intelligence technology calls for weighing benefits against drawbacks (Tavory, 2024). People's stress views influence results. One could experience discomfort or stress. Issa et al. (2024) claims that responses to professional stress define techno-eustress or techno-distress. Good opinions of technology and artificial intelligence help reduce stress and anxiety.

Human biological stress response systems show how appropriate challenges increase physiological flexibility, improving health (Lu et al., 2021; Ueda et al., 2021; Xia, 2023). AI-eustress works since technologies created by artificial intelligence force humans to grow. Unlike techno-eustress, AI-eustress increases efficiency and helps users selectively (Xia, 2023). Knowing these pressures helps one assess technology.

Tools grounded in machine learning inspire kids to learn. While artificial intelligence feedback systems can foster engaging, supportive, and adaptive learning environments (Dewey et al., 2022), traditional educational technologies cannot produce similarly stress-reducing learning contexts. AI-induced eustress improves mental well-being. Ueda et al. (2021) suggest that AI-based coping mechanisms help increase emotional control and well-being.

Attributes of AI-eustress differ from those of techno-eustress. Different impacts of good stress reactions are provided by artificial intelligence- and techno-eustress. When artificial intelligence is included in society, people experience AI-eustress; conversely, using technology causes techno-eustress. These two stress types must be separated if we are to use technology and artificial intelligence to raise productivity and well-being.

Medical professionals, including psychologists, must see stress holistically. Historians often examine stress as discomfort, according to Bienertova-Vasku et al. (2020), ignoring the

eustress's growth-promoting advantages (Aschbacher et al., 2013). Mild stress, according to Aschbacher et al. (2013), enhances physiology.

AI-induced stress and techno-eustress resulting from healthcare AI systems, AI diagnostics and therapies, as well as patient contact systems (D'Alfonso, 2020), generate new stresses and positive reactions. Healthcare workers experience techno-eustress—user involvement and motivation via technology—during system adaptation (Zielonka & Rothlauf, 2021).

Psychological issues raised by artificial intelligence incorporation into systems call for investigation into human adaptations to its dual purpose.

Significance of the Study

The research constructs AI-eustress by extending the base concepts of eustress with techno-eustress. The positive stress response from AI-related challenges, leading to enhanced performance and growth, defines AI-eustress as an essential inquiry field regarding health services technology implementations.

These sectors increasingly depend on AI technology, which creates both valuable prospects and demanding challenges for healthcare personnel and their patient users. AI-eustress research requires identifying both the positive stress generators from AI systems alongside the risk factors that could potentially cause distress (Rodriguez & Choudrie, 2021).

Research Objectives

This scoping review aims to:

1. *Delineate the Historical Evolution of Stress Concepts*: Establish a timeline for stress evolution, explore the historical growth of eustress coupled with techno-eustress and AI-induced stress, and provide major theoretical elements and experimental findings.
2. *Introduce and Define AI-Eustress*: Initiate a definition of AI-eustress by introducing a clear standards-based definition that separates it from surplus constructs while exploring its healthcare and psychological effects.
3. *Develop a Theoretical Framework*: The study should integrate established models, including the Job Demands-Resources (JD-R) model with the Technology Acceptance Model (TAM), to build a complete theoretical foundation for AI-eustress (Kupang et al., 2024).
    - The JD-R model structures the assessment of AI-driven work environments, balancing demands and resources to determine their impact on stress and well-being (Demerouti & Bakker, 2011, 2023; Li et al., 2023).
    - The TAM acts as a validated framework, according to Malatji et al. (2020), to demonstrate how users experience technology-based systems related to ease of use and usefulness, which controls stress reactions and acceptance (Shamsi et al., 2021).
    - The simultaneous use of these models enables detailed understanding of AI-eustress through identification of its professional and healthcare sector origins and operational processes and outcomes.
4. *Synthesize Empirical Evidence*: Using Structural Equation Modeling (SEM) and path analysis will allow us to synthesize empirical evidence toward developing an advanced theoretical framework for eustress, techno-eustress, and AI-eustress comprehension.

    - SEM allows researchers to analyze complex relationships between invisible and detectable variables in order to reveal AI stress factors, their sources, and results (Stoffels et al., 2023).
    - Path analysis helps construct eustress frameworks by creating a system to examine causal connections, which improves assessment precision regarding AI impacts on stress-related consequences (Grimm, 2023).
5. *Establish a Logical Classification System*: Create a systematic classification approach by utilizing antecedents and consequences of AI-eustress to establish research standards about measurement scales and practical interventions.
6. *Provide Recommendations for Future Research and Practice:* Introduce plans for developing AI systems that enhance productivity through the promotion of AI-eustress among healthcare professionals and patients.

This scoping review aims to enhance knowledge in stress research specifically focused on the digital-based healthcare sector through achieving its outlined objectives. The research outcomes would support the creation of procedures to turn AI's beneficial aspects into productive uses and minimize its adverse consequences, leading to enhanced AI technology usage.

Literature Review

Historical Perspective on Eustress

The definition of eustress evolved tremendously since its origination as "good stress." Selye (1976) established eustress as a term that would distinguish healthy stress from undesirable stress. The framework enabled scientists to progress their comprehension of stress by acknowledging that not all sources of stress endanger personal well-being. Research from the early phase of study examined eustress's physiological impacts and psychological benefits, demonstrating stress's positive role in better performance, increased motivation, and resilience. Aschbacher et al. (2013) presented definitive evidence showing how intermediate stress levels reduce oxidative stress damage, which is a biological indicator of aging (García-Giménez et al., 2024). Researchers confirmed that proper amounts of stress create positive effects that help lengthen the human lifespan. Vincze and Vincze-Tiszay (2020) provided a detailed assessment of the history of stress and stress adaptation, along with education on the distinction between eustress and distress.

Overview of Eustress in Stress Frameworks

Positive stress, known as eustress, operates as the pathway through which individuals build their motivation levels, boost their resilience, and enhance their performance outcomes. Stress consists of both distressing negative aspects alongside positive eustress elements in technological environments, according to Tarafdar et al. (2024) and other earlier researchers. Many current studies show that eustress functions as an essential aspect of technology-enabled spaces since technology represents both a motivating factor and a resource for development (Saini et al., 2024).

Eustress in Specific Contexts (Table 1):

- *Adolescents and Educational Settings*: Research conducted by Yazıcı-Kabadayı (2024) demonstrates that eustress serves as a mediator that connects mental toughness with mindfulness levels in teenagers throughout educational institutions.

- *Workplace and Job Performance*: Fleige (2017) analyzed how combined elements of job demands and resources with eustress generate positive results, including better workplace job performance and increased mental well-being.
- *Health and Aging*: Eustress facilitates older adults with chronic diseases to participate more actively in recreational activities, which leads to improved quality of life, according to An et al. (2022).

Table 1: Key Ideas From the Reviewed Literature

Study	Context	Key Findings
(Saini et al., 2024)	Adolescents in India	Positive correlation between eustress and mental health; cultural nuances.
(Fleige, 2017)	Workplace settings	Job resources linked to eustress and improved emotional well-being.
(Yazıcı-Kabadayı, 2024)	Adolescents and mindfulness	Eustress positively mediates mental toughness and mindfulness.
(An et al., 2022)	Aging populations	Leisure satisfaction facilitates eustress among older adults.
(D'Alfonso, 2020)	AI in mental health	AI enhances tailored interventions for mental health.

Techno-Eustress: Technology's Impact on Stress

Investigations by Zielonka and Rothlauf (2021) reveal that techno-eustress appeared during the late 20th and early 21st centuries as positive stress that arises when people interact with technology and view this technology as platforms for development while boosting engagement, motivation, and performance levels.

SEM analysis in the study by Zielonka and Rothlauf (2021) revealed that people who find technology easy to use and beneficial to their daily lives usually develop techno-eustress. Positive views about technology enable potential workplace stressors to shift into eustressors, which enhances work-related performance. Research into techno-eustress focused on educators confirms that structural and coping mechanisms from organizations assist teachers in transforming technology stress into constructive work experiences (Solís et al., 2023).

AI-Induced Stress: A New Frontier

Due to its high-speed development, AI technologies have brought about an interaction between people and devices that generates distinct stressors affecting psychological wellness and emotional state. Users experience AI-induced stress when engaging with AI systems because they react negatively due to system complexity, job conflicts, moral concerns, and diminished control over automated procedures. Digital tools, as established by the Job Demands-Resources (JD-R) paradigm, serve as instruments that create both work-related needs and favorable aspects (Scholze & Hecker, 2023).

Two primary workload categories are presented by artificial intelligence systems:

1. Data automation and processing capacity
2. Algorithm learning requirements and AI output interpretation needs

Organizations must handle their AI systems in ways that generate enough resources to balance workload requirements by establishing training sessions, encouraging supportive environments, and making AI system decisions open and clear (Scholze & Hecker, 2023).

Introducing AI-Eustress: A Novel Construct

AI-eustress emerges as a positive stress response that enhances cognitive flexibility, performance, and motivation. Users thrive under AI challenges when they perceive them as opportunities for skill-building.

Key Factors Influencing AI-Eustress:

1. *Perceived Usefulness and Ease of Use* – Users develop AI-eustress when they find AI useful and easy to integrate (Gado et al., 2022; Kashive et al., 2020; Kim et al., 2021).
2. *Self-Efficacy and Coping Strategies* – High self-confidence in AI interaction enhances eustress (Chen et al., 2024; Lorente et al., 2014; Venkatesh, 2000; Wang & Yen, 2015).
3. *Organizational Support and Culture* – AI-eustress flourishes in learning-oriented, supportive environments (Galanti et al., 2024; Na et al., 2023).
4. *Ethical Considerations* – Transparency, fairness, and privacy protections promote positive AI interactions, while bias and accountability issues contribute to distress (Issa et al., 2024; Saeidnia et al., 2024).
5. *AI-Eustress and Digital Mental Health* – AI-based interventions in mental healthcare facilitate resilience and cognitive growth (D'Alfonso, 2020; Kibibi, 2024; Tavory, 2024).

Theoretical Framework

Understanding AI-eustress requires a comprehensive theoretical foundation (Kupang et al., 2024). Existing models help explain how individuals perceive AI stress and adapt to it.

- Job Demands-Resources (JD-R) Model – Explains how job demands and resources shape employee well-being (Lesener et al., 2019).
- Technology Acceptance Model (TAM) – Establishes perceived usefulness and ease of use as key factors influencing AI adoption (Venkatesh & Davis, 2000).
- Social Cognitive Theory – Explores how individual behaviors and attitudes toward AI influence stress outcomes (Tsai, 2014).
- Person-Environment (P-E) Fit Theory – Describes how AI systems must align with users' cognitive abilities to maximize positive stress effects (Caplan & Van Harrison, 1993).

Methodologies for Theoretical Framework Consideration: SEM and Path Analysis

Structural Equation Modeling (SEM) and path analysis provide robust methodologies for examining AI-eustress. These techniques assess causal relationships between stressors and coping mechanisms.

- SEM enables researchers to model interactions between AI, stress, and well-being (Hartwell et al., 2019).

- Path Analysis refines eustress frameworks by tracing direct and indirect stress-response pathways (Khairi et al., 2021).
- Advanced SEM Tools (Lavaan, AMOS) facilitate large-scale AI stress research (Rosseel, 2012; South & Jarnecke, 2017).

These methodologies ensure rigorous classification of AI-eustress, contributing to future research and practical AI deployment strategies.

Methodology

Scoping Review Approach

A scoping review methodology served as the framework to map all available literature about eustress alongside techno-eustress, together with developing AI-eustress as its new subclass. The methodology follows Arksey and O'Malley's (2005) principles while applying PRISMA-ScR guidelines to suit the investigation of AI-eustress, which is an evolving segmental construct (Daudt et al., 2013; Tricco et al., 2018).

Systematic improvements through both stakeholder involvement and multiple data collection methods created a solid framework to merge results and recognize missing information. This methodology delivers complete insights concerning AI-eustress, creating a framework for future healthcare and digital health research (Peters et al., 2020; Westphaln et al., 2021).

Search Strategy

The research used three respected academic databases, namely Scopus, Web of Science (WOS), and PubMed, for an organized search strategy. The selection of these databases gave researchers access to the most comprehensive literature available in healthcare, psychology, and information technology research.

Three key concepts were linked through a combination of specific research keywords within the search procedure:

- ✓ Eustress and Stress Types: *"eustress," "distress," "stress," "chronic stress," "acute stress"*
- ✓ Technology-Related Stress: *"technostress," "techno-eustress," "digital stress"*
- ✓ AI-Related Stress: *"AI-induced stress," "AI-eustress," "artificial intelligence and stress"*
- ✓ Healthcare and Mental Health: *"healthcare," "mental health," "digital health," "health informatics"*
- ✓ Outcomes: *"well-being," "job satisfaction," "performance," "productivity," "innovation"*
- ✓ Methodological Terms: *"structural equation modeling," "SEM," "path analysis," "predictive models"*

Articles published in English formed the basis of this study because researchers applied restrictions according to date limitations to track the concepts' historical development.

Inclusion and Exclusion Criteria

The following inclusion and exclusion criteria were applied to select relevant studies:

Inclusion Criteria:

1. *Focus on Eustress, Techno-Eustress, or AI-Stress*: Studies that explicitly addressed eustress, techno-eustress, AI-induced stress, or AI-eustress were included.
2. *Empirical Studies*: Empirical studies that collected and analyzed quantitative or qualitative data were included.
3. *Theoretical Papers*: Theoretical papers that contributed to the conceptual understanding of eustress, techno-eustress, or AI-eustress were included.
4. *Healthcare or Mental Health Context*: Studies that focused on healthcare or mental health settings, or had implications for these settings, were included.

Exclusion Criteria:

1. *Non-Peer-Reviewed Literature*: *Gray literature*, such as conference abstracts, dissertations, and reports, were excluded.
2. *Studies Unrelated to Stress*: Studies that did not address stress or its related constructs were excluded.
3. *Studies Not Focused on Technology or AI*: Studies that did not focus on technology or AI were excluded, unless they provided relevant theoretical insights into eustress or stress in general.
4. *Articles Not in English*: Studies published in languages other than English were excluded.

Data Extraction and Analysis

A total of 250 articles were initially retrieved after applying the inclusion and exclusion criteria from the database search. 45 articles were selected for full-text review and data extraction.

A standardized data extraction form was developed to capture key information from each study, including:

1. Study Characteristics: *Author(s), year of publication, study design, sample characteristics, setting.*
2. Theoretical Framework: *Theoretical models or concepts used in the study.*
3. Key Constructs: *Definitions and operationalizations of eustress, techno-eustress, AI-induced stress, and AI-eustress.*
4. Antecedents: *Factors identified as antecedents of eustress, techno-eustress, or AI-eustress.*
5. Consequences: *Outcomes associated with eustress, techno-eustress, or AI-eustress.*
6. Methodological Approach: *Research methods used, including data collection and analysis techniques.*
7. Key Findings: *Main findings related to the relationships between antecedents, constructs, and consequences.*

Researchers combined quantitative with qualitative methods when they analyzed the extracted data. The study characteristics summaries served as a part of quantitative analysis, with frequency and percentage tables used to track antecedents and consequences versus psychosocial constructs and confirmed variables.

A thematic synthesis identified and described frequent themes emerging from various studies. The researchers merged the outcomes from quantitative and qualitative assessments to build a thorough view of modern eustress research, while considering techno-eustress and AI-eustress.

Categorization Framework from SEM and Path Analysis Models

The database analysis depended on collecting information from studies that adopted both Structural Equation Modeling (SEM) and path analysis methods.

The research investigations revealed relevant associations among fundamental factors that affect eustress and its digital-related manifestations, as well as their intervening/moderating factors.

Research studies provided data that led to developing a categorization system for organizing antecedents and consequences, through identification of common connections and theoretical foundations between elements.

Findings

Antecedents and Consequences of AI-Eustress and Techno-Eustress

Scientists derived the classification framework shown in Table 2 by performing systematic analysis on variables and relationships present in path analysis and SEM models within the 45 final studies listed. The model defines six different classifications for antecedents.

Table 2: Categorization Framework From SEM and Path Analysis Models

Category	Antecedents	Consequences	Supporting Studies
Individual Capacities	Resilience, IT mindfulness, self-efficacy, coping flexibility, personality traits (Curiosity, sensation seeking, and persistence), and age	Enhanced skills, increased job satisfaction, performance	(De Cordova et al., 2024; González-Hernández & Ato-Gil, 2019; Scherz et al., 2023; Zhao et al., 2023, 2024)
Motivational Drivers	Intrinsic motivation, career advancement goals	Innovation, adaptive behaviors	(Anjum et al., 2023)
Perceptual Factors	Positive appraisal, adaptability, techno-enrichment	Improved satisfaction, cognitive engagement	(Fu et al., 2023; Pluut et al., 2022; Tarafdar et al., 2024)

Category	Antecedents	Consequences	Supporting Studies
Socio-Cultural Enablers	Social support, inclusive organizational culture	Team collaboration, reduced stress	(Gabbiadini et al., 2023; Issa et al., 2024; Khedhaouria et al., 2024; Saini et al., 2024)
Technological Features	Usability, reliability, system adaptability, technological proficiency, accountability	Productivity, technological proficiency	(Asfahani, 2022; Awada et al., 2023; Tarafdar et al., 2019)
Organizational Context	Technical support, innovation, encouragement, synergic literacy	Job performance, employee retention	(Daneshmandi et al., 2023; Menon et al., 2022; Nascimento et al., 2024; Naz et al., 2020; Nelson & Simmons, 2005; Pham et al., 2024; Tarafdar et al., 2010; Wulansari et al., 2015)

Theoretical Framework for AI-Eustress

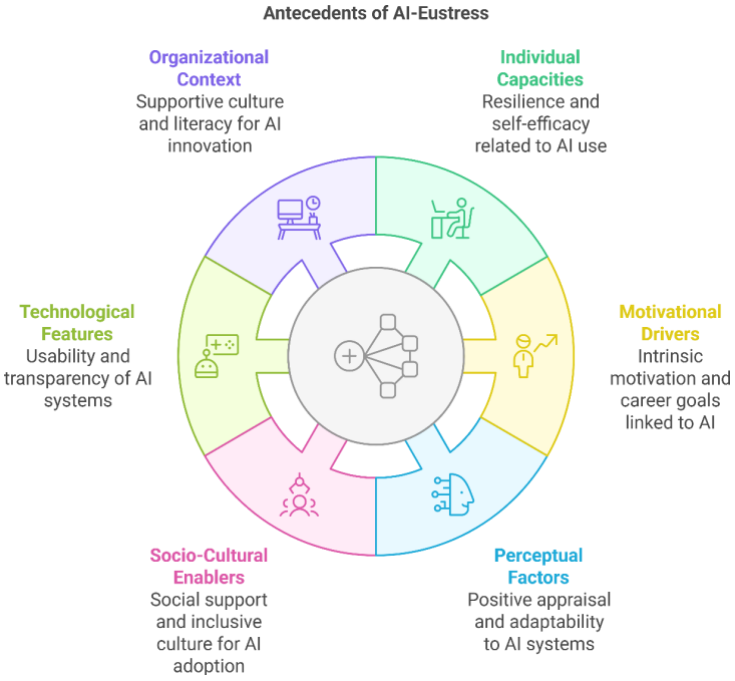
Research findings about techno-eustress led to the creation of a theoretical framework that combines the JD-R model, TAM, social cognitive theory, and person-environment fit. AI-eustress emerges from multiple interacting factors, which include individual capabilities, motivational elements, perceptual components, socio-cultural facilitators, technological aspects, and workplace factors.

Antecedents

The antecedents of AI-eustress (Figure 1) are similar to those of techno-eustress, but with a specific focus on AI-specific features. These include:

- ✓ *Individual Capacities*: Resilience, IT mindfulness, self-efficacy specifically related to AI use, coping flexibility, personality traits (Curiosity, sensation seeking, and persistence), and age.
- ✓ *Motivational Drivers*: Intrinsic motivation to use AI, career advancement goals related to AI proficiency.
- ✓ *Perceptual Factors*: Positive appraisal of AI-related challenges, adaptability to AI systems, perceived AI-enrichment.
- ✓ *Socio-Cultural Enablers*: Social support for AI use, inclusive organizational culture that values AI adoption.
- ✓ *Technological Features*: Usability, reliability, adaptability, transparency, and accountability of AI systems.
- ✓ *Organizational Context*: Technical support for AI tools, an organizational culture that promotes AI innovation, management encouragement for AI adoption, and organizational AI literacy.

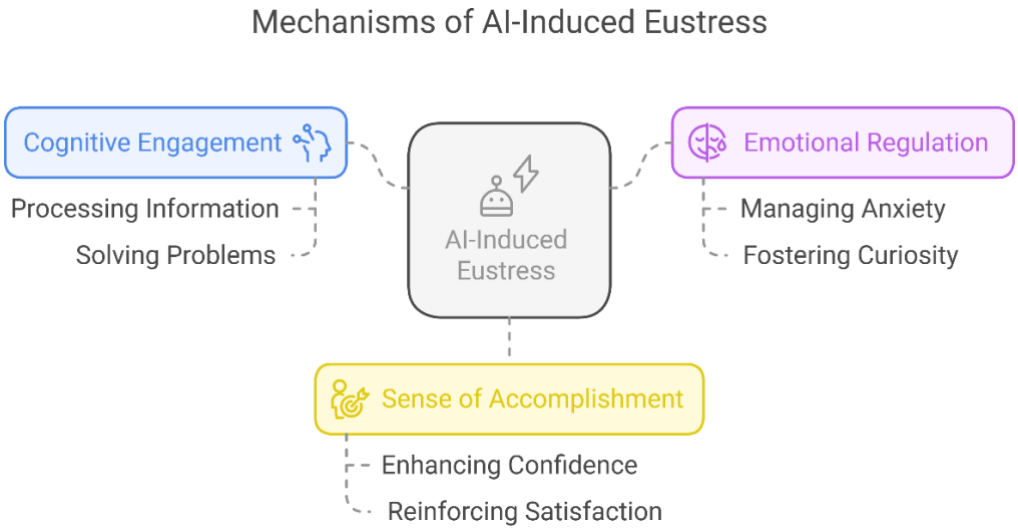
Figure 1: Antecedents of AI-Eustress



Mechanisms

The conceptual model demonstrates that AI systems create mental and emotional obstacles which people can transform into growth potential to build AI-eustress. The difficulties stem from mastering new AI systems and adapting workflow processes as well as comprehension of AI results and dealing ethically with AI systems' implications. (Figure 2) outlines the mechanism that explains how the challenges create AI-eustress.

Figure 2: Mechanisms of AI-Induced Eustress

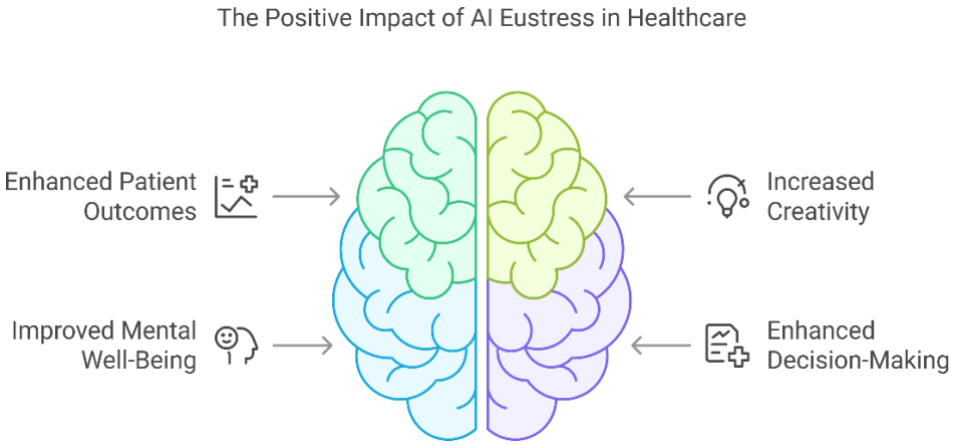


✓ **Cognitive Engagement**: The challenges from AI systems create cognitive difficulties, forcing people to engage in active mental processing, problem-solving, and constructing new ways of thinking. AI tools maximize user cognitive control, enabling users to find AI useful and applicable in their work (Henkel et al., 2020).

✓ **Emotional Regulation**: The experience of eustress requires people to control their emotions and develop curiosity and satisfaction to manage anxiety and frustration successfully. Research studies show how cognitive reappraisal methods and adaptive coping mechanisms work together to generate positive responses in demanding AI environments (Salih, 2023).

✓ **Sense of Accomplishment**: People who reach their AI-related objectives create eustress through feelings of accomplishment. Scientific evidence demonstrates that effective interaction with AI systems leads to increased self-confidence and contentment, strengthening positive emotional reactions (Kolomaznik et al., 2024).

Figure 3: The Positive Impact of AI Eustress in Healthcare



Consequences (Figure 3)

✓ **Enhanced Professional and Patient Outcomes**:
- AI-eustress improves diagnostic precision, personalized treatment, and better decision-making.
- AI assists radiologists in identifying early disease detection (e.g., cancer diagnoses).
- AI-powered clinical decision support systems improve care quality and consistency (Alandjani, 2023; Patil & Shankar, 2023).
- AI-eustress reduces burnout, improving healthcare workforce retention (Shinners et al., 2020).

✓ **Increased Creativity and Innovation**:
- Professionals experiencing AI-eustress develop new AI applications.
- AI-based mental healthcare solutions were developed due to AI-eustress (Okhiai & Loo, 2022).
- Cognitive advancements in healthcare were fostered (Anjum & Zhao, 2022).

✓ **Improved Mental Well-Being**:
- AI-eustress increases self-worth, fulfillment, enthusiasm, and contentment.
- Positive emotions from AI help healthcare professionals maintain resilience in digital healthcare environments (Adegboye, 2024; Tortorella et al., 2021).

✓ **Enhanced Decision-Making**:
- AI-eustress improves professionals' ability to combine AI-generated insights with clinical expertise.
- AI diagnostic tools assist medical staff in refining clinical reasoning (Dawoodbhoy et al., 2021).

Discussion

The review establishes a full framework that explains AI-eustress during healthcare and mental health processes. The combination of programmatic recommendations enables organizations to use transformative AI potential safely for professional wellness and increased patient care in digital healthcare. The support given by organizations serves as a key factor that helps reduce stress levels and improve workplace well-being among healthcare professionals (Ramaci et al., 2024).

The literature review compiles multiple quantitative and qualitative studies that connect eustress examination to techno-eustress dynamics and current research about AI-eustress in medical and mental healthcare digitalization development. Research shows that positive stress responses from AI technology result from three interacting factors, which include:

✓ Individual capabilities
✓ Organizational policies
✓ AI system development elements

The study uses the Job Demands-Resources (JD-R) model and the Technology Acceptance Model (TAM) to create a basic framework that explains methods to enhance healthcare worker creativity, productivity, and well-being through optimal AI-eustress implementation (Khan & Shamsi, 2021).

Integration With Theoretical Frameworks

The proposed AI-eustress framework presents AI systems as dual entities under the JD-R model, according to Demerouti and Bakker (2023). Accurate perceptions of AI management together with AI usefulness enable these systems to operate as resources that improve user engagement while boosting performance and motivation (Kaiser et al., 2020). AI systems that present design flaws or complexity evolve into overwhelming demands, which create distress for users.

✓ Perceived ease of use and utility affect user acceptance and stress-level enhancement through the TAM model, requiring AI developers to design intuitive interfaces (Baroni et al., 2022).

Practical Implications

The research outcomes establish several vital requirements for healthcare organizations to meet.

✓ **User-Centered AI Design**
- The design of AI systems should emphasize usability, transparency, and adaptability, as these aspects lower cognitive overload and boost user engagement.
- Users benefit from XAI features that explain AI outputs, improving understanding and trust in AI systems (Adeniran et al., 2024; Melikoğlu, 2024).

✓ **Comprehensive Training Programs**
- Organizations need complete training programs to develop employee skills in AI understanding, coping methods, and self-assurance abilities.
- The skills required to work with modern AI technologies require continuous development through professional support from healthcare professionals (Panigutti et al., 2023).

✓ **Supportive Organizational Culture**

- Leadership teams need to establish supportive workplace cultures that enable healthcare staff to investigate AI tool applications.
- Maximizing AI-eustress depends on the combination of open dialogue, collaborative teamwork, and appropriate budget allocation (Ramaci et al., 2024).

✓ **Ethical Considerations**

- The adoption of proactive solutions will tackle AI ethical concerns while constructing trust frameworks to combat AI-related stress.
- The establishment of transparent accountabilities and bias-detection techniques creates trust between stakeholders (Edith Ebele Agu et al., 2024; Sargiotis, 2024).
- Robust data protection, explainable AI systems, and clear accountability frameworks enable healthcare organizations to prevent disparities and ensure responsible AI deployment (Islam, 2024; Jeyaraman et al., 2023).
- The combined implementation of these strategies allows for both ethical governance and minimized risk in AI systems.

Limitations

Several limitations must be acknowledged:

✓ **Language and Publication Bias**

- The review was limited to English-language, peer-reviewed articles, potentially excluding relevant research in other languages or gray literature.

✓ **Lack of Empirical Validation**

- While this study proposes a theoretical framework, it lacks empirical testing to validate the identified relationships between antecedents, mechanisms, and consequences of AI-eustress.

✓ **Healthcare-Centric Focus**

- The focus on healthcare and mental health limits the generalizability of findings to other sectors where AI-eustress may operate differently.

Future Research Directions

To advance the understanding of AI-eustress, future research should:

1. Empirically validate the framework through quantitative studies such as Structural Equation Modeling (SEM).
2. Develop standardized measures to differentiate AI-eustress from techno-distress.
3. Explore cross-cultural perspectives to understand how cultural factors influence AI-eustress.
4. Conduct longitudinal studies to examine the long-term effects of AI on healthcare professionals' well-being.
5. Design interventions that enhance AI-eustress and reduce AI-induced distress.

Conclusion

The scoping review findings will help to understand the new concept of AI-eustress and the importance of healthcare and mental health digitalization. AI applications can elicit either eustress or distress, depending on the ability of people to cope with the technology, the characteristics of the AI itself, and their workplace settings. Identifying and cultivating AI-

eustress could be a roadmap to improving healthcare professionals' productivity, creativity, and mental health.

The theoretical framework combines established models (like the JD-R model and TAM) to show how challenges from AI can be managed to turn them into opportunities for growth and performance improvement. The key result shows the need to build user-centered transparent, and adaptable AI. Also, building comprehensive training programs along with a supportive organizational culture. We must also address issues like bias, privacy and accountability--for the sake of the user.

By dealing with these factors' healthcare organizations will be able to unlock the potential of AI Practical recommendations include.

- **Adopting User-Centered AI Design:** Prioritize usability and transparency to reduce cognitive strain.
- **Enhancing AI Literacy:** Implement training that boosts self-efficacy and coping mechanisms.
- **Fostering Supportive Work Environments:** Encourage open communication and collaboration.
- **Embedding Ethical Safeguards:** Ensure fairness, accountability, and data privacy in AI systems.

Going forward, research should empirically test the framework proposed for AI-eustress, develop reliable measurement tools to measure AI-eustress and assess the long-term impact of AI integration on various type of healthcare setting. An in-depth grasp of AI-eustress optimization necessitates longitudinal and cross-cultural studies and intervention-based research for improved healthcare delivery and professional well-being.

Embracing the salutary uses of AI in the medical arena is an equally important opportunity. By putting AI systems that promote eustress into operation in the health system, we can not just make the operations more efficient but also help develop a healthy and strong workforce for better patient care.

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Empowering Digital Education: Thai University Students' Views on Online Learning

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Abstract
Online learning has become an essential part of education worldwide, including in Thai universities. While it offers enhanced learning experiences, it also poses various challenges. This study examines the perspectives of 83 third-year Chinese education students at Mae Fah Luang University, who have been engaged in online learning for three years. Using a mixed methods approach, the research collected data through student reflections. Quantitative results, presented in tabular form, highlight both positive and negative opinions, while content analysis was used to explore students' views on the challenges and benefits of online learning. The findings reveal that most students perceive online learning as having more disadvantages than advantages. Key recommendations emphasize the need for both students and instructors to acquire digital technology skills and adopt strategies for online platforms. Promoting continuous engagement with technology-enhanced learning activities is vital for student development. Mastery of online learning today equips Thai learners to thrive in tomorrow's digital society. Moreover, online learning helps develop essential life skills critical for future success. This study supports the continued use of online methodologies by educators, supporting for persistence in online teaching approaches despite the challenges, as these methods foster an adaptable and effective learning environment.

Keywords: Student’s Views, Online Learning, Obstacles and Benefits of Online Learning, Language Education Students

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Introduction

The COVID-19 pandemic significantly impacted all aspects of daily life, especially education. In response, educational institutions worldwide accepted online systems to ensure the continuity of learning (Sa & Serpa, 2020). This shift from traditional classrooms to online platforms introduced a 'new normal' in teaching and learning. Educational technology has been essential in this change, enabling for the adoption of innovative methods (Lai & Bower, 2019). Rapid technology advancements further facilitated this transition. Organizations such as UNESCO have promoted distance and online learning to make education more flexible and accessible (UNESCO, 2015). As a result, online learning has become increasingly common. This shift not only reflects the advancement of educational institutions in the digital era (Casey et al., 2016) but also enhances interaction between teachers and students. Platforms like Zoom, Google Meet, and Microsoft Teams enable real-time communication, while tools such as YouTube, OBS Studio, and Loom help create engaging multimedia content. In today's tech-driven environment, the effective use of these tools can significantly enhance student engagement.

Many studies highlight the advantages of online learning, citing its flexibility and capacity to enhance student learning effectiveness. It boosts student interest and engagement (Deeley, 2018), reduces costs, and increases convenience. Most importantly, it addresses educational inequality by allowing students from different regions to access lessons simultaneously and at any time (Hill, 1997; Webster & Hackley, 1997). Additionally, online learning plays a key role in shaping learning behaviors, fostering self-discipline and responsibility (Wongyai et al., 2019). However, significant challenges remain (Conlon, 1997; Crawford et al., 2020), including internet instability and inadequate institutional support (Brandt, 1996; Velle et al., 2020). To overcome these challenges, educators and students must stay up to date with rapidly evolving technologies (Crawford et al., 2020). Effective online learning requires students to exhibit high levels of responsibility (Sumbawati et al., 2020), while educators need to continuously develop their skills to align with the 'new normal.' Utilizing technology effectively is essential to support learning and achieve educational goals (Ming et al., 2021). Selecting appropriate platforms and adapting to modern educational trends will enable students to reach their learning objectives (Sumbawati et al., 2020; Ming et al., 2021).

The Format of Online Teaching in Universities

Wongyai et al. (2019) emphasized the growing use of technology in education, aligning with Christensen et al. (2011), who predicted the increasing trend toward online learning in higher education. Online teaching has developed into a flexible, advanced platform suited to various learning contexts. Educators today can choose from numerous available platforms, with the primary goal being to prepare students for future challenges (Stewart et al., 2011). In Thai universities, online teaching is primarily conducted through synchronous and asynchronous methods. Synchronous teaching involves real-time interaction between students and instructor similar to face-to-face classes, while asynchronous teaching offers flexibility, allowing learners to engage with content at different times. Both formats have advantages and limitations, depending on the educational context. Stewart et al. (2011) noted that the key strength of synchronous teaching is its immediate, two-way communication, allowing students to ask questions and receive instant feedback. Partlow & Gibbs (2003) added that a well-designed online learning environment can stimulate student engagement, even if it does not fully replicate in-person learning. In contrast, Stefan (2008) highlighted the flexibility of asynchronous learning, which enables students to access materials anytime, fostering self-

discipline and responsibility. However, limitations may arise from poorly designed content or a lack of readiness among individual learners.

The National Education Act of 1999 in Thailand presently promotes 21st-century skills, including digital literacy, with the goal of preparing students for the modern workforce. Mae Fah Luang University has embraced a blended learning approach, combining synchronous and asynchronous methods across subjects, including the Chinese language curriculum. The main goal is to equip students with the technological skills needed for future teaching roles. As the instructor teaching students in this field, the researcher values students' reflections on their online learning experiences as essential contributions to the broader discourse on online education. This study seeks to analyze students' reflections on online learning in the Chinese language teaching program at Mae Fah Luang University, examining both positive and negative aspects. The research addresses two key questions:

1. What are students' favorable impressions of their online learning experiences?
2. What negative reflections do students have on their online learning experiences?

Methods

The study employs a mixed-methods design, informed by Crawford et al. (2020) and Wongyai et al. (2019), who focus on online learning strategies and disruptive innovation in education. Data were collected from 83 third-year students in the Chinese language teaching program, all of whom had three years of online learning experience since the COVID-19 pandemic began. Purposive sampling was used to include participants with significant online learning experience, aligning with the study's goals. Both quantitative and qualitative data were gathered through open-ended questions (Worley, 2015) and analyzed using content analysis (Erlingsson et al., 2017). The findings were organized into thematic categories and integrated into the discussion to provide insights into students' perspectives on online learning

Results and Discussion

The collected data were categorized into positive and negative reflections on online learning, aligned with the research objectives. A total of 164 comments were analyzed: 119 identified challenges, while 45 highlighted benefits. These comments reflect the experiences of students who engaged in online learning over three academic years (six semesters) following the COVID-19 outbreak as shown in Table 1 and Table 2 below.

Table 1: Problems and obstacles encountered in online learning

Problems and obstacles encountered in online learning	Number	Percent
Internet signal devices and platforms	39	32.7
Emotional state and readiness of learners	34	28.6
Teachers and methods for carrying out activities of teachers	29	24.3
Environment while studying online	10	8.4
Content of online lessons	7	5.8
TOTAL	119	99.8

Table 1 summarizes the 119 negative comments, ranked by frequency. The most common issue, reported by 39 students (32.7%), was related to internet connectivity, communication devices, and platforms. Emotional stress and lack of preparedness accounted for 34 comments (28.6%). Challenges with teachers' methods and online learning environments were noted in 29 comments (24.3%) and 10 comments (8.4%), respectively. The least mentioned issue was the inadequacy of online lesson content, with only 7 comments (5.8%).

Table 2 Benefits of Online learning

Benefits	Number	Percent
Convenience to access to course contents	13	28.8
Development of 21st Century Characteristics	11	24.4
Freedom for learning	6	13.3
Flexible repetition	5	11.1
Safety for health	5	11.1
Others (interaction with teachers, lowering of costs, Modernity, etc..	5	11.1
TOTAL	45	99.98

Table 2 presents 45 positive comments, categorized into six main benefits. The most frequently noted benefit, mentioned by 13 students (28.8%), was the convenience of accessing course materials. Development of 21st century skills followed, with 11 comments (24.4%), while 6 students (13.3%) appreciated the freedom to learn at their own pace and according to their interests. Additional benefits, each noted by 5 students (11.1%), included health safety from infectious diseases, improved interaction with instructors, reduced costs, and the modernity of online learning.

Perspectives on Challenges in Online Learning

Technology and Management Factors. The most commonly reported issues related to technological challenges. Internet instability and limited network availability were significant barriers, which significantly obstruct students' ability to attend live classes or access course materials. Other issues included outdated devices, complex procedures for accessing online platforms, and disruptions caused by environmental factors like weather. These factors contribute to delays in student engagement with both online activities and assessments. For example, one student remarked:

> The system is often unstable, and internet outages frequently disrupt learning, causing delays in responses compared to other students.

Another shared:

> The steps to access online platforms are complicated, and students in dormitories often face difficulties connecting to the internet or accessing programs.

The requirement for multiple devices during online exams added to the burden. As one student noted:

> During online exams, we were required to have at least two devices, which created more difficulties than onsite exams. The limited time given by instructors also caused delays in completing the exams.

These findings as presented above align with previous studies (e.g. Brandt, 1996), which indicate that technological challenges in online learning can be alleviated through adequate institutional support and instructor's training. To ensure effective learning outcomes, educators must improve their technological skills and become proficient in selecting appropriate platforms for students' needs (Ming et al., 2021).

Learner Factors

Students' readiness for online learning appeared as a critical issue. A lack of technological devices and insufficient skills in using online platforms created major obstacles. Moreover, economic and social factors, such as the cost of equipment, created anxiety, while limited opportunities for social interaction led to feelings of isolation and reduced interest in learning. For instance, one student stated:

> I don't have a laptop or iPad, so I can't study like my friends. My mobile phone is outdated, so I learned less than my friends.

Another commented:

> Online learning has many disadvantages because I can't interact with friends or ask questions. Group work is hard since we're in different places. I feel more anxious and bored with studying than before.

The negative impact of unpreparedness was further compounded by environmental factors, such as noise in students' surroundings, which disrupted concentration, as one student shared:

> I had trouble understanding the lesson because it was difficult. My roommates made noise, which distracted me, and I couldn't focus. I was stressed and lost interest in studying. I was also afraid of failing the exam.

These reflections highlight how a lack of preparation for online learning, especially the absence of essential equipment, obstructs students' ability to keep up with their classmates. The financial problem of acquiring technology worsens the challenges. Despite advantages and expected growth of online education, the issues presented here underscore educational inequalities among students in different situations, as noted by La Velle et al. (2020). Besides, students expressed feelings of loneliness, boredom, and disengagement. Some phrases like 'I can't ask my friends', 'I'm more bored with studying than before', 'I can't concentrate', and 'I'm less interested in studying' illustrate these struggles. These challenges

emphasize the need for better support and strategies to help students develop life skills such as self-reliance and self-regulation, which are crucial for fostering a positive learning experience and adapting to the demands of modern education.

Factors Regarding Teachers and Teaching Methods

Challenges related to teachers and teaching methods were also prominent. Many students expressed dissatisfaction with traditional teaching approaches that were not adapted to the online environment. These methods often resulted in unengaging activities, lack of interaction, and reduced understanding. Furthermore, the absence of hands-on activities contributed to boredom, and reduced interaction between instructors and students worsened the experience.

Some students felt neglected, believing that some instructors did not care about their learning progress, leaving them feeling unsupported and disinterested in online learning. For example, one student expressed concerns:

> Some teachers just recorded their lessons and sent us the clips. When I didn't understand something, I couldn't ask questions or clarify anything, so I just let it go. This makes learning incomplete, and we don't participate in any activities.

Another student shared:

> The content is good, but there's no interaction with the teachers, which makes learning boring. Sometimes, students just log in and do other things without the teacher noticing.

These views reflecting common challenges with online instruction align with Partlow and Gibbs (2003) who emphasized the importance of engaging activities and strong interaction between instructor and students during online learning. In the digital age, instructors must take responsibility for preparing students to become competent digital citizens. For doing this, they should continually update their technological skills and explore innovative strategies. For instance, Prensky (2001) highlighted the need for educators to meet the demands of "digital natives" by integrating dynamic, relevant content. Similarly, Wongyai et al. (2019) emphasized the growing importance of online education in higher education, necessitating stronger competencies in educational technology among teachers.

Perspectives on Benefits of Online Learning

Convenience in Accessing Course Content. According to student feedback, the convenience was the most frequently mentioned benefit of online learning, highlighted by both synchronous and asynchronous modes. In synchronous learning, students appreciated the ability to attend classes from any location, saving time and costs associated with travelling. Asynchronous learning provided additional flexibility, allowing students to return to the course materials at their convenience. As student shared:

> Learning with modern technology is much more convenient. I can study from my dorm, avoid commuting, and don't need to wear a uniform. It saves time, and I can study from anywhere.

Another student remarked:

> For me, online learning is good, even if it's not perfect. I liked that I could study whenever I wanted. In some subjects, the teacher posted videos that I couldn't watch immediately, but the benefit was that I could review them later, even multiple times.

These findings are consistent with prior research (Stewart et al., 2011; Stefan, 2008) which emphasizes the motivational benefits of flexible online learning environments. For students and instructors, advancing digital skills supports effective learning and knowledge management, contributing to broader educational goals. In a rapidly evolving world, both students and instructors must continually advance their digital skills. For students, technological proficiency supports efficient learning and knowledge management, while instructors need to be adept in digital tools to meet the growing demands of today's job market.

Development of 21st-Century Skills. With the push toward 21st-century skills as a key educational objective, students recognize that online learning is valuable. Around 20% of the feedback indicated that online learning helped students improve their technology skills across different platforms, especially when overcoming technical challenges. Online learning helped them become more self-reliant and proactive. As one student noted:

> Learning through modern, high-quality apps lets me try out new platforms and become more proficient with technology. When I encounter problems, I have to find ways to solve them myself.

Another student added:

> Online learning is new to me and requires more self-reliance. It takes time to adapt, learn new things, and become more disciplined. Attending live online sessions also requires punctuality. Overall, I feel that online learning has made me more proactive.

These reflections underscore how online learning fosters students' self-awareness and independence in the digital age. Unlike traditional settings, online learning places greater responsibility on students, encouraging the development of critical skills like self-regulation and adaptability. It requires students to take responsibility and adapt to new learning environments. These digital skills are crucial for 21st-century learners and are increasingly necessary for future job markets. Additionally, developing self-regulation is key to online learning success, it helps students stay on their goals and adjust their behaviors when necessary. The acknowledgment of these skills by students is a positive outcome of this study.

Freedom to Seek Knowledge. While not all students highlighted this benefit, some acknowledged the modernity and flexibility of online learning. This kind of learning provided students with greater freedom to explore topics of interest independently, reflecting a shift toward more student-centered learning. Moreover, it motivates students to explore new knowledge and think more independently, beyond the limitations traditionally set by teachers. This benefit highlights the progress of universities in embracing digital education, fostering modern attitudes toward learning, and encouraging independent exploration beyond teacher-guided boundaries. For instance, one student noted:

> Due to the COVID-19 pandemic, universities had to switch to online learning, which reflects modernity and is in line with the times. In some subjects, teachers used engaging media that weren't boring. The quality platforms also helped me become more skilled with new technologies. It feels very modern.

Another student shared:

> Some teachers assigned tasks and recommended resources for independent learning. It was beneficial because it allowed me to explore topics I was personally interested in without pressure. I had the freedom to discover a world of knowledge.

Interestingly, some student mentioned that online learning allowed them for more personal interactions with instructors, as they could ask questions privately during synchronous sessions, felt more private than in a traditional classroom.

As one student remarked:

> Asking questions during synchronous classes felt more private than in a traditional classroom, where I would feel shy about speaking in front of my friends. This made me feel more comfortable and helped me understand lessons better.

This might be due to the student feeling shy about speaking up in front of peers during in-person sessions. The virtual environment provided an opportunity for direct communication with the instructor, which enhanced their learning experience. Such insights highlight the importance of active instructor and student interaction in both physical and virtual classrooms. Active engagement by instructors not only enhances the learning experience but also promotes a supportive and inclusive educational environment.

Conclusion

Online learning has become an integral part of modern education, offering both advantages and challenges. This study explored the perspectives of third-year Chinese language students who have been studying online for three years at Mae Fah Luang University. The analysis revealed that while online learning provides certain benefits, however, most students perceived it as presenting more obstacles than advantages. The primary challenges included technological issues, student-related limitations, and the effectiveness of teachers' instructional methods. On the other hand, some students acknowledged the benefits of online learning, such as convenient access to lessons, the development of digital skills, and the freedom to explore knowledge independently. The findings point out that to maximize the effectiveness of online learning, educators should implement strategies that address these challenges which include enhancing teachers' proficiency with digital platforms, designing interactive and engaging activities, and providing necessary resources to minimize technological and environmental barriers. Additionally, fostering essential life skills, such as self-regulation and self-reliance, can better equip students to navigate the demands of modern education.

Recommendations for Practical Applications

1. University should consider providing subsidized devices, such as laptops or tablets, for students who lack adequate equipment. University could also invest with internet

providers to offer discounted or free internet access for students in remote or underserved areas.

2. Professional development programs should be implemented to continuously train instructors in effective online teaching strategies, including interactive methodologies and the use of digital tools.

3. Both instructors should be encouraged to develop skills in creating learning environments, both synchronously and asynchronously; whereas students should be provided workshops on life-skills: self-regulation, and technological proficiency to enhance their readiness for being survived in digital age.

Recommendations for Further Research

1. To determine whether challenges and benefits vary by level of experience, the perspectives of students across different academic years should be comparatively analyzed.

2. To develop more effective online teaching strategies, the experiences and challenges faced by instructors in delivering online education should be explored.

3. Student expectations for online learning environments should be assessed before each semester starts to proactively address potential challenges and design tailored educational experiences.

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Exploring the Impact of AI Anxiety on First-Year University Students' Data Science Education

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Abstract
As university students have begun to use generative AI daily, their anxiety and attitudes toward AI have changed. Anxiety and attitude toward the learning object may be factors that prevent students from being motivated to learn. This study explores the impact of AI anxiety on first-year university students' willingness to learn and satisfaction with their data science education. We developed questions on impressions of AI from a questionnaire based on the Artificial Intelligence Anxiety Scale and the General Attitudes Towards Artificial Intelligence Scale. The survey was administered to students entering Hiroshima University in 2024. We conducted a factor analysis and identified six factors measuring impressions of AI. We hypothesized two processes as the influence of impressions of AI on university students' education: 1) a three-stage influence of negative attitudes towards AI on their willingness to learn and, consequently, on their teaching on data science; 2) a direct influence of negative attitudes towards AI on their teaching on data science. We tested these assumptions through a covariance structure analysis. We found that negative attitudes towards AI affect the willingness to learn negatively, and the willingness to learn AI positively affects students' sufficiency in class. This means that the hypothesis 1) is confirmed. We also found that the negative attitude did not affect students' ability to be sufficient in class. We can show the possibility of an effective class design for students regardless of their attitude toward AI.

Keywords: AI Anxiety, Generative AI, First-Year University, Data Science Education, Scale Development

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Introduction

Data science forms a crucial foundation for the modern information society, making it essential knowledge for all university students. AI literacy has become increasingly important with the growing integration of artificial intelligence (AI) technologies across various domains. However, the Ministry of Internal Affairs and Communications (2024) reports that the individual utilization rate of generative AI in Japan is only 9.1%, significantly lower than that of countries like China (56.3%) and the United States (46.3%). This stark disparity highlights the pressing need for enhanced AI education to bridge the gap and equip Japanese students with the skills to navigate an increasingly AI-driven global landscape. Addressing these challenges requires a strategic approach to AI education, particularly at the university level.

Japan Inter-University Consortium for Mathematics, Data Science, and Al Education (2024) published a model curriculum in 2018, emphasizing the promotion of AI education. In its revised 2024 edition, the curriculum incorporated generative AI content, reflecting this technology's rapid spread and transformative impact. This proliferation of generative AI has significantly influenced how students perceive AI, necessitating adjustments in educational approaches to AI instruction. Understanding these shifting perceptions is key to designing effective AI education.

Although AI education aims to enhance students' understanding and utilization of AI technologies, previous studies have highlighted that some students hold negative attitudes toward AI, characterized by concerns such as job displacement, misuse, or loss of control. These concerns are often linked to "AI anxiety," a concept encompassing apprehension about learning and using AI technologies and fears about their societal implications. The anxiety has been shown to affect students' motivation to learn and their willingness to engage with AI-related content, which are critical factors for educational success. Investigating these factors provides insights into addressing the barriers to effective AI education.

This study explores the perceptions and concerns of first-year university students at Hiroshima University regarding AI and generative AI. Specifically, it investigates how AI anxiety and attitudes influence students' learning motivation and satisfaction with data science education. By examining these relationships, the study seeks to provide insights into effective educational practices that address students' evolving needs in the era of generative AI. These findings will contribute to developing tailored strategies for overcoming AI-related barriers in higher education.

Background

The concept of AI anxiety has been extensively studied, with researchers identifying multiple dimensions, such as learning-related anxiety, fear of job displacement, concerns about sociotechnical blind spots, and discomfort with humanoid AI configurations (Wang & Wang, 2022). Among these, fears regarding AI's societal and ethical implications resonate strongly with the rapid and widespread adoption of advanced technologies. Supporting this, a recent study conducted at an international university in Japan found that 65% of students identified unemployment as the most pressing ethical issue related to AI (Ghotbi & Mantello, 2022). Additionally, 13% of students highlighted concerns about AI's impact on human emotions and behaviors. These findings underscore the significant role of societal problems, such as job displacement and emotional AI, in shaping students' attitudes toward AI. Addressing

these concerns in educational contexts is critical to alleviating AI-related anxieties and fostering positive engagement with AI technology.

Japan's national education goals emphasize that all university students should have the foundational knowledge of data science and AI. However, the data science curricula in Japanese universities have space for improvement in the rapid proliferation of generative AI. Generative AI accessibility has made AI more familiar to students. Still, their perceptions of AI have been complicated, and an educational approach is required to address these nuanced and evolving attitudes.

Given these factors, it is crucial to reassess students' perceptions of AI, including their anxieties and attitudes, in light of the rapid advancements in AI technologies. Understanding these aspects can contribute to designing effective data science education programs, such as integrating AI ethics discussions and hands-on activities with generative AI tools that mitigate negative attitudes and foster a more positive and productive engagement with AI.

Method

Development of a Scale

To evaluate first-year university students' perceptions of AI, this study utilized and adapted existing scales: the Artificial Intelligence Anxiety Scale (AIAS) (Wang & Wang, 2022) and the General Attitudes towards Artificial Intelligence Scale (GAAIS) (Schepman & Rodway, 2020). These scales were used as the basis for creating a questionnaire tailored to the context of Japanese university students. Below, we review each of its features and subscales.

The AIAS (Wang & Wang, 2022) is a validated scale designed to measure individuals' anxiety about AI. This scale identifies four key dimensions of AI anxiety: learning anxiety, job replacement anxiety, sociotechnical blindness, and AI configuration anxiety**.** For this study, three items with the highest factor loadings from each subscale (12 items) were translated into Japanese and included in the questionnaire. This allowed for a comprehensive evaluation of students' anxieties regarding AI in various contexts.

The GAAIS (Schepman & Rodway, 2020) measures individuals' general attitudes toward AI, distinguishing between positive and negative perceptions. This study focused exclusively on the positive subscale, as its items differed from the AI anxiety scale. Positive items include statements reflecting curiosity and perceived benefits of AI, such as its ability to enhance societal progress and personal convenience.

All items are presented on a seven-point Likert scale, ranging from 1 ("Strongly disagree") to 7 ("Strongly agree"). They were translated into Japanese to ensure cultural and linguistic appropriateness for the target population. The items were also pilot-tested to confirm clarity and alignment with the measured constructs.

To refine the scale and determine its factor structure, an exploratory factor analysis (EFA) was conducted using the initial questionnaire responses. The number of factors was estimated using a scree plot and further evaluated based on fit indices, including Root Mean Square Error of Approximation (RMSEA) and Bayesian Information Criterion (BIC). This process guided the selection of the factor structure most appropriate for the data.

McDonald's omega coefficients were calculated to evaluate the internal consistency of the identified factors. Factors with omega values above the generally accepted threshold of 0.7 were considered reliable, while factors slightly below this threshold were retained if they demonstrated conceptual validity.

Participants and Survey Environment

The survey targeted first-year students enrolled at Hiroshima University in April and June 2024. A total of 1816 students responded from various faculties, including Medicine, Law, Dentistry, Pharmacy, Engineering, Information Sciences, Education, Letters, Science, Applied Biological Science, Economics, and the Faculty of Integrated Arts and Sciences. The participants' diverse academic backgrounds allowed for a broad assessment of perceptions toward AI across disciplines.

The questionnaire survey was conducted in a foundational data science course titled "Introduction to Information and Data Sciences." This course aims to provide students with essential knowledge and skills in information science and data science. The course included lectures, individual assignments, and group discussions. The students completed a questionnaire survey before the start of the course content to capture students' initial perceptions of AI without the influence of the course materials. During group discussions, students experienced a generative AI tool, such as HiGPT (Murakami et al., 2024). The tool facilitates communication, summarizes ideas, and provides an authentic context for interacting with AI applications.

The structure of the course was as follows:

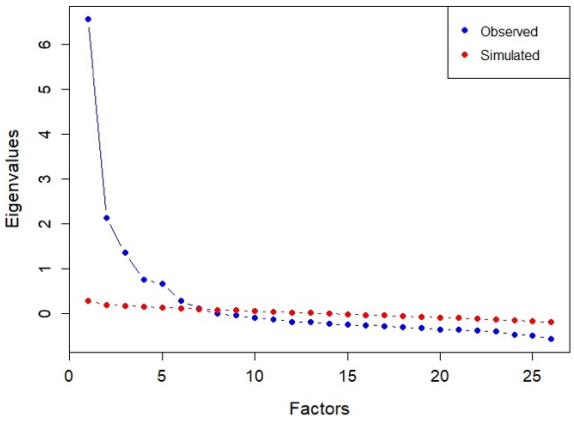
- Pre-class survey: Students completed a questionnaire measuring AI anxiety, motivation, and impressions of AI.
- Lectures and Videos: The course introduced generative AI tools such as HiGPT through instructional videos and discussions.
- Group Discussions: Students participated in group discussions facilitated by the generative AI tool HiGPT on topics like "Can humans and AI become friends?" The tool supported communication, summarized ideas, and enhanced collaborative discussions.
- Post-class survey: Students were asked to evaluate their satisfaction with course components, including the videos, discussions, and generative AI tools. The survey environment was carefully designed to align with the course's objectives while maintaining the integrity of the data collection process. This educational context provided a rich environment for exploring the relationship between students' AI anxiety and motivation and the effectiveness of generative AI tools in a collaborative learning setting.

Model Construction and Fit Evaluation

To investigate the relationship between students' AI anxiety, motivation, and satisfaction with data science education, we adopted a structural equation modeling (SEM) approach. Wang et al. (2022) investigated the impact of AI anxiety on students' AI learning behavior. They used structural equation modeling to examine how learning motivation and self-efficacy affect AI learning intentions. Based on this research, we examined the impact of each of the three elements individually:

1. Negative Attitudes Toward AI (Anxiety): Represented by five factors derived from the AI anxiety scale, including concerns such as job replacement and sociotechnical blind spots.
2. Motivation: Defined using items from the Intrinsic Motivation Inventory (IMI) and the positive factors identified from the questionnaire (Center for Self-Determination Theory (CSDT), 2024).
3. Class Satisfaction: Assessed through students' ratings of their satisfaction with course components, including videos, group discussions, and generative AI tools like HiGPT.

Figure 1: Parallel Analysis Scree Plot



Note: Eigenvalues of actual data (blue) compared with those obtained from resampled data (red).

The proposed SEM model hypothesized two pathways:

1. Negative attitudes toward AI influence motivation, affecting class satisfaction.
2. Negative attitudes toward AI directly influence class satisfaction.

The model was evaluated using fit indices such as the Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), and RMSEA. The pathways with statistically significant coefficients ($p<0.05$) were interpreted as evidence for hypothesized relationships.

Result

AI-Related Factors Contributing to Anxiety

An exploratory factor analysis was conducted based on the results of a questionnaire about AI and anxiety about generated AI. Figure 1 shows a scree plot of the parallel analysis. Simulated represents eigenvalues based on resampled data, and Observed represents eigenvalues based on actual data. Considering the relationship between the eigenvalues based on the observed and simulated, we determined that six factors were appropriate. The Likelihood Chi-Square value was 967.21 ($p<0.001$) with 184 degrees of freedom, indicating the model's statistical significance. The RMSEA was 0.048, with 90% confidence intervals ranging from 0.045 to 0.051, suggesting a good model fit. The TLI was 0.937, the root mean square of the residuals (RMSR) was 0.02, and the df-corrected RMSR was 0.03, indicating minimal residual error. The BIC for the model was -414.61, highlighting a favorable balance between model complexity and fit quality. The fit based on off-diagonal values was 0.99, demonstrating the model's robustness in capturing the factor structure.

Regarding the factor score adequacy, the correlation of regression scores with factors ranged from 0.81 to 0.96 across the six factors. The multiple R-squared values for scores with factors ranged from 0.66 to 0.93, indicating strong relationships between observed variables and their respective latent factors. The minimum correlation of possible factor scores ranged from 0.32 to 0.86, providing additional evidence of the factors' validity. These results confirm that the six-factor model provides a well-fitting and reliable representation of the data, enabling a nuanced understanding of the constructs under investigation.

Table 1 shows the estimated results of the factor loadings for the loading ratio of 0.45 and above. The questions in each row correspond to those in the Appendix. The internal consistency based on these factor structures was evaluated using McDonald's omega, ω.

Table 1: Estimation Results of Factor Loadings (Loadings below 0.45 are omitted)

	mr3	mr1	mr2	mr4	mr5	mr6
ω	0.93	0.90	0.77	0.86	0.77	0.67
c01	0.76					
c02	0.91					
c03	0.88					
c04						0.66
c05						0.72
c06						
c07				0.76		
c08				0.73		
c09				0.65		
c10		0.78				
c11		0.77				
c12		0.78				
d01			0.63			
d10			0.46			
d11			0.53			
d12						
d19					0.51	
e01						
e02						
e03			0.53			
e04						
e05			0.70			
e06			0.66			
e07					0.57	
e08					0.61	
e09					0.50	

Table 2 summarizes the interpretation of the factors and the questions that fall into each category. Factors mr1, mr3, mr4, and m6 correspond to the subscales of the AIAS (Wang & Wang, 2022). A question item of mr5 is about problems and trust in using AI, which was interpreted as distrust of AI. mr2 indicates a positive attitude toward AI, such as a desire to use AI for learning and work. Based on this interpretation, these factors were incorporated into the motivation construct in the structural equation model.

Table 2: Interpretation of Observed Factors

Factor	Summary	Question
mr1	Concerns about AI setup	c10, c11, c12
mr2	Expectations for AI	d01, d10, d11, e03, e05, e06
mr3	Concerns about learning about AI	c01, c02, c03
mr4	Concerns about lack of awareness of social technologies	c07, c08, c09
mr5	Distrust of AI	d19, e07, e08, e09
mr6	Anxiety about job replacement	c04, c05

Table 3: Interpretation of Observed Factors

Construct	**Factor**	**Description**
Negative Attitudes toward AI (anx)	mr1	Concerns about AI setup.
	mr3	Concerns about learning about AI.
	mr4	Concerns about lack of awareness of social technologies.
	mr5	Distrust of AI.
	mr6	Anxiety about job replacement.
Motivation toward AI (imi)	imi01	Values for learning AI.
	imi02	Interest in learning AI.
	imi03	Perceived choice of class enrolment.
	mr2	Expectations for AI
Class satisfaction (cls)	v04	Satisfaction with pre-class instructional videos.
	w04	Satisfaction with group discussions using generative AI tools.
	h04	Satisfaction with the use of generative AI tools, such as HiGPT, in class.

The Structural Equation Modeling (SEM) Analysis

As shown in Table 3, we conducted an SEM analysis of the structural factors of negative attitudes towards AI (anx), motivation to learn AI (imi), and satisfaction with the class (cls).

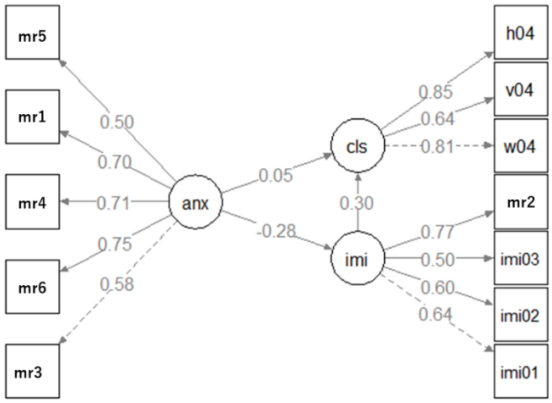
The model's fit indices indicated an acceptable fit, with a CFI of 0.940, a TLI of 0.922, and a RMSEA of 0.063 (90% confidence interval: 0.056-0.071). This suggests that the fit is somewhat low, but when these fit indices are compared with the criteria recommended by Hu et al. (1999), they are within the acceptable range. The Standardized Root Mean Square Residual (SRMR) was 0.050, further supporting the model's adequacy. Although the Chi-square test was statistically significant (Chi-square=263, degrees of freedom=51, $p<0.001$), this result is typical for models with large sample sizes.

Figure 2 shows the standardized regression coefficients from the SEM. These values represent the effect size of each variable in standard deviation units. The factor loadings demonstrated that the latent variable "negative attitudes toward AI" (anx) significantly loaded on five observed variables (anx01, anx02, anx03, anx04, anx05). Similarly, "intrinsic

motivation" (imi) showed significant loadings on imi01, imi02, imi03, and imi04. The latent variable "class satisfaction" (cls) significantly loaded on three observed variables (w04, v04, h04), indicating that these observed variables adequately represent their respective latent constructs.

The standardized regression coefficient for the path from intrinsic motivation (imi) to class satisfaction (cls) was β=0.30, indicating a significant positive relationship ($p<0.001$). This suggests that higher motivation levels enhance students' satisfaction with AI-related classes. Negative attitudes toward AI (anx) significantly negatively affect intrinsic motivation (β=-0.28, $p<0.001$), highlighting an indirect pathway through which negative attitudes can impact satisfaction by reducing motivation. Negative attitudes toward AI (anx) did not significantly affect class satisfaction (cls) (β=0.05, $p=0.238$), indicating that such attitudes do not directly influence students' satisfaction.

Figure 2: The Factor Loadings of SEM



These findings underscore the mediating role of intrinsic motivation in the relationship between negative attitudes toward AI and class satisfaction. While negative attitudes alone do not directly affect satisfaction, their influence on motivation highlights the importance of addressing students' perceptions of AI to foster a more positive and engaging learning environment. This suggests that educational interventions to increase motivation could mitigate the adverse effects of negative attitudes toward AI, ultimately improving students' satisfaction with AI-related education.

Discussion

This study examined the influence of AI anxiety and attitudes on first-year university students' willingness to learn and satisfaction with their data science education. The findings from the SEM analysis illuminate the challenges and opportunities in designing AI education programs catering to students' diverse perceptions and motivations.

The results indicate that negative attitudes toward AI are mediated by intrinsic motivation. Specifically, higher levels of AI anxiety correlate with reduced motivation, which, in turn, leads to decreased satisfaction with AI-related coursework. These findings underscore the complexity of students' emotional and cognitive engagement with AI education. While negative perceptions may not directly hinder their immediate classroom experiences, their indirect effects through reduced motivation highlight the need for targeted interventions.

Contrary to the detrimental effects of negative attitudes, the analysis revealed that positive impressions of AI, reflected in the motivation factor, significantly enhance class satisfaction. Students who exhibit curiosity and recognize AI's potential societal contributions are likelier to enjoy and benefit from AI-related education. This suggests that fostering positive attitudes and intrinsic interest in AI can play a pivotal role in mitigating the adverse effects of AI anxiety, thus creating a more engaging and effective learning environment.

The findings provide actionable insights for designing AI education programs:

1. Addressing negative perceptions: Educational strategies that demystify AI and highlight its ethical and societal benefits can help reduce anxiety. For example, incorporating discussions that explore AI's limitations and safeguards may alleviate concerns about job displacement and sociotechnical risks.
2. Promoting positive engagement: Integrating hands-on experiences with generative AI tools, such as HiGPT, can foster a sense of familiarity and utility, enhancing students' willingness to engage with technology. The emphasis should be placed on showing how AI can complement human skills rather than replace them.
3. Motivational support: Providing autonomy in learning, such as allowing students to explore AI applications aligned with their interests, may strengthen their intrinsic motivation. This autonomy can also help bridge the gap between students with varying prior exposure to AI.

As this study demonstrates, integrating generative AI tools into classroom activities highlights their potential to transform educational practices. These tools serve as learning aids and platforms for fostering collaboration and critical thinking. However, the rapid proliferation of such technologies necessitates continuous evaluation of their pedagogical impact, particularly concerning students' psychological and motivational responses.

Conclusion

This study focuses on first-year university students, providing a snapshot of their initial perceptions of AI. However, the evolving nature of AI technologies and their integration into various disciplines suggest the need for longitudinal studies that track changes in students' attitudes and learning outcomes over time. Additionally, exploring the interplay between cultural factors and AI anxiety could offer a more nuanced understanding of how educational strategies might be tailored to different contexts.

The results of this study show the importance of addressing the negative and positive dimensions of students' attitudes toward AI. By fostering a balanced perspective that reduces anxiety while promoting curiosity and motivation, educators can enhance the effectiveness of AI-related education. These efforts are critical for equipping students with the skills and confidence to navigate an increasingly AI-driven world.

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Appendix

Questionnaire

The items named "c" and "d" are based on the AIAS (Wang & Wang, 2022) and GAAIS (Schepman & Rodway, 2020), respectively. The items named "e" are the original ones.

c01	Learning to understand all of the specialized features related to AI technology and the products that use it makes me uneasy.
c02	Learning about AI technology and how to use products that use it makes me uneasy.
c03	Learning to use AI technology and certain features of products that use it makes me uneasy.
c04	I am concerned that we will become dependent on AI technology and products that use it.
c05	I worry that AI technology and the products that use it will make us lazier.
c06	I fear that AI technology and products using it will replace humans.
c07	I am afraid that AI technology and products using it will be misused.
c08	I am afraid of the various potential problems with AI technology and the products that use it.
c09	I am concerned that we will become dependent on AI technology and products that use it.
c10	I find humanoid AI technology and products using it (e.g., humanoid robots) scary.
c11	I find humanoid AI technology and products using it (e.g., humanoid robots) intimidating.
c12	I don't know why, but I am afraid of humanoid AI technology and products that use it (e.g. humanoid robots).
d01	I am interested in using AI technology and products that use it.
d10	AI technology and products that use it can perform better than humans.
d11	Society would benefit from the widespread use of AI technology and products that use it.
d12	I would rather interact with AI technology and products that use it than humans.
d19	I think AI technology and products using it make a lot of mistakes.
e01	Using AI technology and products that use it for learning feels like cheating.
e02	AI technology and the products that use it can properly evaluate you.
e03	I feel that AI technology and the use of products that use it can help you discover new aspects of yourself
e04	AI technology and products using it can fool humans.
e05	I want to use AI technology and products that use it for learning.
e06	I want to use AI technology and products that use it in my work.
e07	I think there is a problem with the use of AI technology and products that use it.
e08	The output content of AI technology and products that use it cannot be trusted.
e09	Input into AI technology and the products that use it could be leaked.

Virtual International Education Facilitated by Generative AI

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Abstract
Dialogue between students from different cultural backgrounds is useful for learning about global issues and their solutions. The role of the facilitator is important in ensuring that group discussions run smoothly, encouraging all participants to actively participate in the discussion. It is also necessary to remove linguistic barriers to discussion between students with different mother tongues. To support and stimulate online communication among students, we have developed a web application called HiGPT, which allows students to enter multilingual text messages and image files, query generative AI (chatGPT) about their input, and share AI responses and suggestions. In HiGPT all text messages are displayed in the selected language. In 2024, a group discussion using HiGPT was conducted within an online data science class for first-year university students at Hiroshima University and a virtual international class of students from Hiroshima University and the University of Texas. We evaluated the effectiveness of HiGPT based on the results of a self-assessment questionnaire administered after the class. Although there were significant differences in the use of HiGPT among the groups, more than 70% of students were satisfied with HiGPT and many felt that HiGPT helped facilitate discussions, with the indirect intervention by the generative AI providing a sense of security and creating an online environment that facilitated lively discussions, even with first-time partners. In this practice, the generative AI played part of the role of facilitator and was found to be effective in stimulating communication among students.

Keywords: Online Group Work, Virtual International Education, Generative AI, International Collaboration

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Introduction

In today's unpredictable world, the complexity of global challenges continues to grow, making international collaboration a vital element in addressing them. Higher education must adapt to meet the increasing demand for such collaboration. In the introduction of international collaboration into higher education, advances in internet technology and communication tools have significantly reduced the hurdles to remote collaboration, and automated translation tools have lowered linguistic barriers.

During the COVID-19 pandemic, most face-to-face classes had to be replaced by online. To support online learning and communication, ICT tools have been developed. After the pandemic subsided, these efforts have continued. Now, there are numerous reports on online education and its support tools (See for example, Adedoyin et al., 2023, Arifiati et al., 2020, Carrillo & Flores, 2020, García-Morales et al., 2021, Müller & Mildenberger, 2021, Zhang et al., 2022). Under these circumstances, online group work has also become increasingly common.

Our goal is to establish a new educational model that produces internationally educated individuals who embrace advanced technology, understand information ethics, and respect humanity in the age of AI. We propose “Virtual International Education (VIE)” as a new model of the international collaborative education supported by generative AI. It is intended to be one or few lessons in a course so that many students can take it early after enrollment as a first step toward international collaboration. To make VIE effective, we have developed a Web application to translate group discussions into the language of the student's choice, ask the generative AI for discussion topics. The generative AI can also be used to facilitate group work by giving appropriate system prompts.

In this paper we introduce the group discussion support tool, HiGPT, which is based on the generated AI and are used through a web browser. Through the implementation in VIE, we evaluate for its educational effectiveness. Finally, we give some concluding remarks.

Group Discussion Support Tool: HiGPT

Online group work is accessible to a variety of students regardless of their location. On the other hand, it has the disadvantage of limited communication among students and between students and teachers compared to face-to-face sessions. Based on a systematic literature review, Donelan and Kear identify nine key challenges for online group projects and provide strategies for addressing them (Donelan & Kear, 2024).

For the short-term group work assumed in the VIE, the following six of the nine challenges should be considered.

C2: Scheduling or time issues,
C3: Unequal division of tasks and roles,
C5: Ineffective technology and tools,
C6: Lack of preparation in group working skills,
C7: Negative feelings, and
C8: Weak or poor group relationships.

Selecting tools and technology are considered as a strategy to address the challenges, C2, C5, and C7.

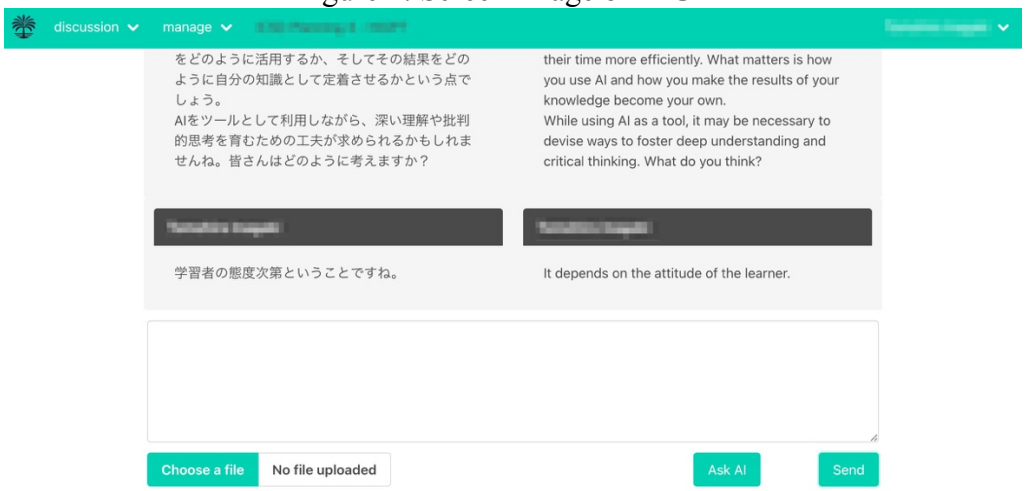
To address the challenges associated with online group work, we have developed an AI-powered tool specifically designed for international online collaboration: HiGPT. It is a platform for multi-user use of the generative AI. HiGPT is built using technologies, including GPT-4o, Python 3.12, Django 4.2, HTML5, CSS and JavaScript. The goal of HiGPT is to create a platform that is easy to access, facilitates smooth discussions, supports multiple languages, and reduces the workload for teachers. To ensure an intuitive and efficient environment for international online collaboration we implement the combination of features in Table 1.

Table 1: Key Features of HiGPT

Student identification without ID or password	Streamlines access by eliminating the need for traditional login credentials.
Simultaneous input and AI use	Multiple students can engage with the platform and interact with GPT at the same time, ensuring collaborative and dynamic discussions.
Multilingual capabilities with sequential translation	The platform provides human-readable translations while the AI directly understands multiple languages, making communication seamless.
Integrated discussion logs	Teachers can retrieve all group discussion logs in their native languages, simplifying review and monitoring.

Students click on individual URLs received via email to access HiGPT with their personal identification. The screen shown in Fig. 1 will then appear. Students enter text or images in the white box at the bottom, click “Send” button to post the message, and click “Ask AI” button to ask the generated AI about what they have entered. All messages are sequentially translated into the language of their choice. The voice input included with OS also allows students to enter messages by voice.

Figure 1: Screen Image of HiGPT



Teachers register students in each room on HiGPT and specify the role of the AI, the expected discussion flow, etc. in the system prompts. By reviewing the discussion logs, teachers can monitor the progress of each group, the performance of each student, etc. at any time.

Virtual International Education: VIE

VIE is an educational model centered on online group work, aimed at fostering intercultural understanding, developing group work skills, and nurturing a collaborative attitude toward international cooperation through practical experiences. It should be a class of multinational students and consists of pre-study, guidance, small group work, and reporting in plenary sessions. Through the Internet, students from different parts of the world can participate in the class. Generative AI is used to reduce the challenges of online group discussions.

The integration of AI in online education offers numerous benefits while also raising critical issues that must be addressed. On the positive side, AI enhances collaboration and fosters a sense of community among students and teachers. It can also generate personalized teaching plans and adaptive learning resources, tailoring the educational experience to individual needs. Additionally, AI leverages various types of data to enable comprehensive monitoring of student progress and engagement.

However, these advancements are accompanied by challenges. Transparency, fairness, and ethical use of AI are essential to ensure trust in its implementation. Furthermore, privacy concerns and the potential for discrimination stemming from AI's imperfections highlight the need for careful oversight and responsible development. Balancing these benefits and challenges is crucial for the effective and equitable integration of AI in online education.

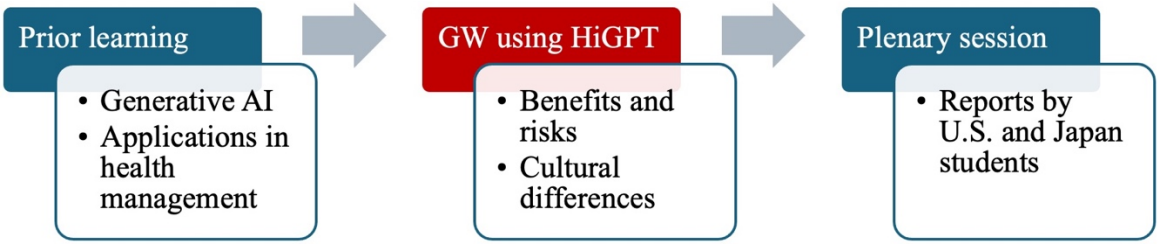
The VIE was incorporated into cooperative classes between Hiroshima University and the University of Texas at Austin as a two-hour class. A trial class was conducted in February 2024 for students interested in international collaboration and was implemented in a course on data literacy and AI fundamentals in April 2024. Table 2 shows the number of participating students in these classes.

Table 2: Number of Dtudents Participating in VIE Classes

	Hiroshima University	University of Texas at Austin
February 2024	6	8
April 2024	19	9

The flow of the class is presented in Fig. 2. The theme of these classes was generative AI and its application to health management, and prior learning videos were prepared. Students attended the class after learning about the basics of generative AI and its application to health management through prior learning videos. In the classes, guidance was given on how to proceed with the group work. Students were then divided into two groups for the February trial class and four groups for the April class. In each group students discussed the benefits and risks of generative AI, and the application of generative AI to health management, while also touching on their cultural background.

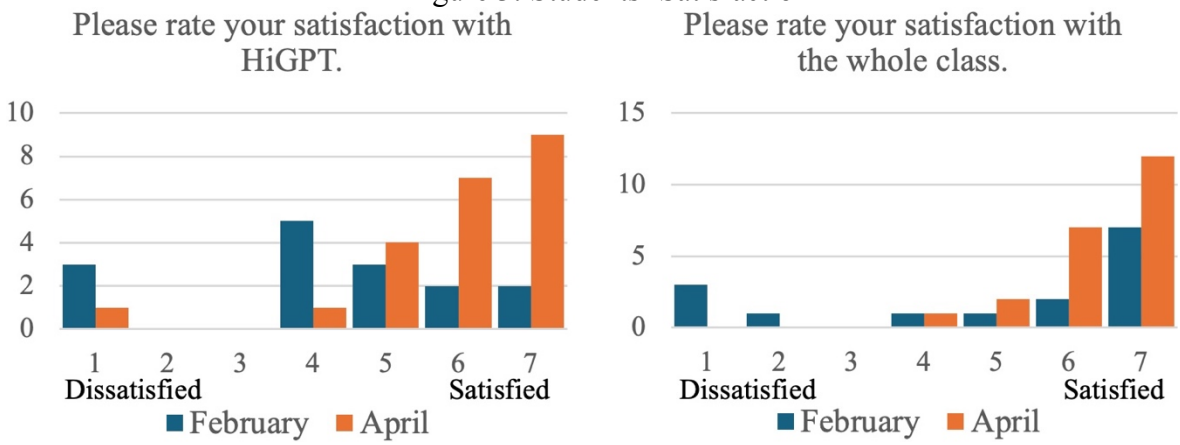
Figure 2: Flow of the Class



In order for HiGPT to support group work, the system prompts were specified to ensure that the AI plays the role of facilitator, and the prompts were adjusted for the April class. In the plenary session after the group work, students from Japan and the U.S. reported on the discussions in the group work, and finally, the students were asked to express their opinions on VIE and the use of HiGPT.

From the after-class student survey, most students were satisfied with HiGPT and VIE in the April class. As is shown in Fig. 3, students' satisfaction with HiGPT increased significantly as a result of prompt adjustments from the February trial class.

Figure 3: Students' Satisfaction



The following is some examples of the students' feedback.

> ... The most valuable additions with HiGPT were its ability to quickly summarize our discussion or provide broad suggestions to the questions. The translation capabilities were pretty good…
>
> It was a good opportunity to exchange opinions with students from overseas and to think about AI. Translation by HiGPT made it possible for me to participate in the discussion without being left behind…
>
> Although it is fun to use AI to have conversations in other languages, I strongly wanted to be able to communicate directly from my own mouth…

These voices indicate the effectiveness of HiGPT in supporting international group work.

Conclusion

We have studied a model of the international collaborative education, VIE. The core of VIE is the international group work supported by the AI tool, HiGPT. Through implementation in the classes, we have concluded that HiGPT were working effectively and made a positive impression on the students with regard to C2 and C7, two of six challenges listed in the short-term online group work. C5 was also reduced by having the AI randomly assign roles within the group. C6 was addressed through prior learning. For C2 and C8, there are still issues such as time difference between Japan and the U.S., and limitations due to language differences.

The contribution of HiGPT to online education is multifaceted, providing support in various areas to enhance the learning experience. HiGPT helps motivate students and create a positive atmosphere by leveraging the use of AI itself, which often inspires curiosity and engagement. It also assists with explanation and instruction by displaying and clarifying key points related to the topics being discussed, ensuring that students have a clear understanding. HiGPT provides support for communication through its language translation capabilities, enabling seamless interaction among students from different linguistic backgrounds. Additionally, it monitors students' status by accumulating and organizing logs of each message, allowing teachers to retrieve and analyze communication data as needed. The platform is equipped to respond to unforeseen situations with reliable and adaptable AI functionalities, ensuring a smooth learning process. It also plays a role in coordinating discussions by facilitating the progress of group interactions. HiGPT also offers students the opportunity to experience generative AI. Through these features, HiGPT enhances both the efficiency and quality of online education.

Since the implementation of VIE, HiGPT has been integrated into several classes, for example, in a large class of 1,000 participants, students were divided into small groups and the AI acted as a facilitator, allowing for effective group work.

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AI-Driven Financial Education: Assessing Long-Term Student Engagement and Investment Behavior

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Abstract
Artificial Intelligence (AI) is reshaping financial education by offering innovative tools to enhance student engagement and learning outcomes. In this study, the researchers investigated the long-term impact of an AI-enhanced financial literacy course on Japanese university students' financial behaviors, with a focus on investment and savings habits. Expanding on prior research, the researchers surveyed both former and current students from three universities—Oberlin, Chuo, and Rissho—to assess how generative AI tools influence financial decision-making. Findings indicated that while AI-assisted instruction improved students' understanding of financial concepts, it did not significantly impact investment participation when compared to traditional learning methods. Students from Rissho University, who did not use AI tutors, exhibited stronger financial behaviors than those in AI-supported courses, suggesting that instructional design and socioeconomic factors may play a greater role than AI itself. Additionally, concerns regarding AI overreliance and the accuracy of financial guidance emerged. This study underscores the benefits and limitations of generative AI in financial education, highlighting the need for a balanced approach that integrates AI with hands-on financial planning experiences. Future research should explore how AI can be optimized to promote long-term financial behaviors and investment confidence.

Keywords: AI-Driven Education, Financial Literacy, Generative AI, Student Engagement, Investment Behavior, Japanese University Students

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Introduction

Artificial intelligence (AI) is reshaping traditional learning environments and presenting researchers and educators alike with opportunities to improve student engagement and academic outcomes (Adel et al., 2024). The adoption of AI in education is reshaping the traditional methods used in teaching and is creating innovative pedagogical solutions (Luna, 2024).

According to Alcázar-Blanco et al. (2024), research on the use of AI in finance has increased significantly since 1995. Cavanaugh (2024) stated that in financial education, generative AI tools have proven to be incredibly helpful in creating learning experiences tailored to students' needs. Generative AI platforms like Chat GPT have played a significant role in changing how education is delivered. These tools allow learners to utilize generative AI as personal tutors that provide instant feedback and help students to better understand complex topics (Batsaikhan & Correia, 2024).

Research conducted by Ravšelj et al. (2025) stated that although AI offers many benefits, using it effectively in educational settings remains challenging. Ravšelj et al. (2025) go on to say that issues such as ethical concerns, data privacy, and students' continued desire for human connection shed light on the need for a thoughtful approach to introducing it in a classroom setting. Instructors are advised to use generative AI as a resource to complement traditional learning methods, which would help students develop critical thinking skills while facilitating independent learning (Ravšelj et al., 2025).

This study expands on research from 2023, which analyzed the short-term impact of a generative AI-enhanced financial literacy course on Japanese students (Gorham & Mills, 2024). The current research shifts focus to examine how generative AI used in financial education impacts student engagement and investing behavior over time. Survey data from both former and current students revealed how effectively students used the financial skills and knowledge they gained in class and applied it to their personal lives. The results highlight the long-term benefits of using generative AI tools in a financial literacy course and help guide students' strategies for improving their educational practices.

Research Purpose and Questions

This study examined the long-term impact of financial literacy courses—both with and without the aid of generative AI—on Japanese university students' financial knowledge, behaviors, and attitudes. The research addressed the following questions:

1. How has the investment behavior of students from the 2023 cohort evolved one year after completing the personal finance course, and what factors influenced their financial decision-making?
2. What differences exist in investment behaviors among current cohorts at three Japanese universities, and how do these differences correlate with demographic, educational, or socioeconomic factors?
3. How does the course delivery mode (e.g., traditional lectures, project-based learning, AI-enhanced learning) impact students' investment behaviors and financial decision-making post-course?

Methodology

Setting and Sample

This study was conducted across multiple Japanese universities over two years. The initial research, conducted in 2023, focused on students from a private university in Eastern Japan (Oberlin University). The follow-up study in 2024 resurveyed students from the original cohort while expanding to include current students enrolled in an AI-enhanced financial literacy course at Oberlin. Additionally, it incorporated students from Chuo and Rissho Universities who studied the same material without generative AI.

The original cohort included 30 students in the pre-survey and 27 in the post-survey, all enrolled in an English-taught elective on personal finance. The follow-up study gathered responses from 121 students, combining feedback from the 2023 participants and new students studying financial literacy. This broader scope allowed for an assessment of the curriculum's long-term impact.

Participants

Participants were undergraduate students enrolled in elective personal finance courses at Japanese universities. The majority were native Japanese speakers with English proficiency at the B1 level of the Common European Framework of Reference for Languages (CEFR). The participants' class standings ranged from first-year to fourth-year students. Demographic data, such as gender, academic year, and financial literacy background, were collected to ensure a comprehensive analysis.

Procedures

The course design for the experimental group (Oberlin University) emphasized project-based learning, incorporating generative AI tools like ChatGPT to provide personalized and interactive support. Key course components included:

- Weekly lessons on foundational financial concepts.
- Utilization of ChatGPT as a tutor to answer questions, explain topics, and assist with assignments.
- Project tasks requiring students to create financial plans, analyze case studies, and develop digital portfolios using Google Sites.

The two other universities (Chuo and Rissho) learned the same material but did not utilize AI-tutors during class activities. All courses were taught primarily in English.

Instrument

The primary data collection tool was a follow-up survey designed to evaluate student financial behavior changes after completing the personal finance course. The instrument consisted of multiple-choice questions, Likert-scale items, and open-ended prompts translated into Japanese to ensure accessibility.

Unlike the original study, which assessed financial knowledge, behavior, and attitudes, this follow-up survey focused exclusively on financial behavior. Students were queried about their real-world financial actions following the course, including their savings habits,

investment decisions, and financial planning practices. The survey included the following key questions:

1. Did you open a NISA account?
   NISA（少額投資非課税制度）口座を開設しましたか？
2. Are you regularly saving for your long-term financial goals (e.g., retirement, purchasing a home)?
   長期的な財務目標（例：退職、家の購入）のために定期的に貯金していますか？
3. Have you continued to track your spending?
   コースが終了してからも支出の記録を続けていますか？
4. Do you have an emergency fund?
   緊急資金を確保していますか？
5. Are you investing in index funds or mutual funds regularly?
   定期的にインデックスファンドや投資信託に投資していますか？
6. How often do you review and adjust your budget?
   どのくらいの頻度で予算を見直し、調整していますか？
7. On a scale of 1-5, how confident do you feel managing your finances now compared to before the course?
   コースを受講する前と比べて、どのくらい自分の財務管理に自信がありますか？（1-5 のスケールで評価してください）
8. What was the most valuable concept or tool you learned from the financial literacy course, and how have you applied it to your personal finances?
   この財務リテラシーコースで学んだ中で最も価値のある概念やツールは何ですか？それをどのように自分の財務管理に適用しましたか？
9. What challenges, if any, have you faced in applying what you learned about personal finance since the course?
   コースで学んだ財務知識を実践する際に、どんな課題に直面しましたか？
10. Which aspects of the course did you find most useful in improving your financial habits?
    コースのどの部分があなたの財務習慣を改善するのに最も役立ちましたか？
11. Have you set any new financial goals since the course? If so, what are they?
    コース終了後、新しい財務目標を設定しましたか？もしあれば、それは何ですか？
12. Please write any additional comments below.
    以下に追加のコメントをご記入ください。

This survey provided direct insights into how students translated their financial education into concrete actions, allowing for an assessment of the long-term impact of the course on their financial behaviors.

Data Collection and Analysis

Data collection spanned the 2023 and 2024 academic years. Surveys were administered via Google Forms and distributed through the universities' learning management systems. Participation was voluntary, and anonymity was guaranteed. Quantitative data were analyzed using descriptive statistics to assess how students applied the knowledge they learned in the courses. Thematic analysis was conducted on open-ended responses to identify recurring themes, such as practical applications of financial knowledge and perceptions of AI tools.

Results

Research Question 1: Follow-Up With 2023 Cohort

To evaluate the long-term impact of AI-enhanced financial education, we conducted a follow-up study on students from the 2023 cohort. The findings revealed that 20% of participants continued to invest regularly in mutual and ETF index funds, applying the knowledge they gained in their course. Additionally, 100% of students maintained their spending tracking habits, utilizing budgeting apps and manual methods to monitor their finances. In terms of saving, 60% of respondents reported saving money each month and the same percentage had successfully built an emergency fund covering three to six months of expenses. In terms of financial confidence, participants reported an average score of 3.5 out of 5, reflecting a moderate improvement from their post-course assessment after completing the AI-enhanced financial literacy program.

Although the 2023 cohort exhibited sustained positive financial behaviors, indicating that they had internalized key lessons from the course, they also faced significant challenges. One major obstacle was the high cost of living, which, compounded by inflation, hindered their ability to save consistently. Additionally, while students demonstrated an understanding of compound growth and investment strategies, actual investment adoption remained relatively low. This reluctance was primarily attributed to risk aversion and a lack of deeper, practical knowledge of investment decision-making.

Research Question 2: Financial Behavior of 2024 Cohorts

This study also investigated the financial habits of students currently enrolled in financial education courses at three universities in Eastern Japan: Oberlin, Chuo, and Rissho.

Regarding savings and emergency funds, 45% and 50% of students at Oberlin and Chuo reported saving regularly, yet only 30% of Oberlin students and 35% of Chuo students had accumulated a three-to-six-month emergency fund by the end of the course. In contrast, students at Rissho University exhibited the strongest saving habits, with 55% saving monthly and 40% maintaining a sufficient emergency fund.

Investment engagement across all cohorts remained low, with only 20–30% of students investing in index funds. However, Rissho students displayed the highest investment participation, with 40% of students opening a NISA (Nippon Individual Savings Account), a tax-advantaged investment tool designed to encourage long-term investing.

In terms of budgeting habits, Rissho students were most likely to review their budgets weekly (30%), followed by Oberlin students (25%). Chou students reported the lowest budgeting engagement (20%).

Finally, financial confidence scores were relatively similar across all three institutions, with Rissho students reporting the highest self-rated confidence at 3.5/5, followed by Oberlin (3.4/5) and Chuo (3.2/5).

Research Question 3: Differences Between Course Delivery

This study also examined whether differences in course delivery methods influenced student investment behavior. At Oberlin University, the course followed a student-centered approach, similar to the 2023 cohort's curriculum. Students used AI tutors to research a specific personal finance topic and then created a website to present their findings. This approach allowed participants to become subject-matter experts in their chosen topic while learning from their peers' research on other financial concepts. In contrast, Chuo and Rissho University students were taught using a more traditional approach, where instructors delivered lectures and guided activities on personal finance topics.

Findings from this study indicate that the course delivery method did not significantly influence students' investment behavior. The table (Table 1) below shows that Rissho University students outperformed their peers at Oberlin and Chuo in every financial behavior category despite following a more traditional instructional approach.

Table 1: Adoption of Financial Behavior by University

Category	Oberlin	Chuo	Rissho
NISA Adoption	30%	35%	40%
Saving Monthly	45%	50%	55%
Tracking Spending	65%	60%	70%
Emergency Fund (3-6 months saved)	30%	35%	40%
Investing Index Funds Monthly	20%	25%	30%
Budgeting Frequency (weekly reviews)	25%	20%	30%

Responses to open-ended questions provided insight into why students had not yet engaged in key financial behaviors. The most frequently cited challenges included:

1. Balancing Financial Goals with Daily Expenses
   - Many students struggled to prioritize long-term savings while managing immediate financial needs.
2. Low Investment Engagement
   - Despite increased awareness of investment tools, actual participation in index funds and NISA remained low (20–30%), largely due to risk aversion and lack of confidence.
3. Emergency Savings Struggles
   - Even though students recognized the importance of an emergency fund, many had difficulty consistently setting aside money to build one.

While AI-assisted learning did not appear to influence investment behavior directly, responses from the AI-tutor cohort (Oberlin) provided valuable insight into the perceived benefits and challenges of using AI for personal finance education (Table 2).

Table 2: Perceptions of Generative AI for Learning

Positive Feedback	Explanation	Negative Feedback	Explanation
Convenience & Accessibility	AI tools helped students quickly find financial information	Accuracy & Reliability Issues	Students noted inconsistencies in AI-generated financial advice
Enhanced Learning	AI-assisted lessons improved understanding of budgeting, taxes, and investments	Lack of Personalization	AI tools often provided general financial advice rather than personalized recommendations
Personalized Guidance	Some students reported that AI helped answer specific financial questions	Risk of Overreliance	Some students feared that depending too much on AI could hinder independent financial decision-making

Discussion

Expanding on our earlier study (Gorham & Mills, 2024) we examined the long-term impact of a personal finance course on students' behavior utilizing both an AI-enhanced curriculum as well as one without. The results showed that while students demonstrated increased financial awareness and maintained positive behaviors such as budgeting and saving, investment adoption remains relatively low. These findings align with existing research demonstrating both the benefits and limitations of generative AI in financial decision-making (Ahangar & Fietko, 2023).

Sustained Financial Engagement and Challenges

Students from the 2023 cohort exhibited a strong commitment to tracking spending (65%) and saving regularly (45%). However, only 30% had built a sufficient emergency fund, and fewer than 25% had invested in index funds. These findings reflect the trends identified by Mancone et al. (2024), who noted that financial education programs often improve awareness but do not necessarily translate into long-term financial behavior. High living costs and aversion to risk were cited as barriers to investment, reinforcing prior research on financial literacy gaps among young adults (Respati et al., 2023).

Effect of AI-Enhanced Learning on Financial Behavior

The role of AI-driven instruction in financial education remains nuanced. ChatGPT provided students with accessible financial insights, enhancing comprehension of key topics like budgeting, investment strategies, and tax-advantaged accounts. These findings align with Batsaikhan and Correia (2024), who emphasized AI's capacity to provide personalized tutoring. However, concerns about overreliance on AI were also prevalent. Some students

noted that AI-generated financial advice lacked contextual depth, echoing concerns raised by Ravšelj et al. (2025) regarding AI's limitations in fostering critical thinking and independent decision-making.

Comparative Impact of Course Delivery Methods

Interestingly, despite Oberlin students receiving AI-assisted instruction, Rissho University students outperformed their peers in nearly all financial behavior categories. This suggests that AI-enhanced learning, while beneficial for engagement, may not necessarily lead to superior financial decision-making outcomes compared to traditional instructional methods. Similar conclusions were identified by Schlosky et al. (2024), who found that while AI tools improved financial literacy, long-term behavioral change depended on factors beyond digital instruction, such as cultural attitudes and real-world financial constraints.

Conclusion

The findings of this study highlight both the benefits and limitations of AI-enhanced learning in financial education. While students demonstrated increased financial awareness and improved budgeting habits, investment participation remained low. Although AI tutors were reported as valuable learning tools, their use did not directly influence students' investment behavior.

Future research should explore additional factors contributing to the more substantial financial behavior outcomes observed in the Rissho University cohort, such as socioeconomic differences that may have influenced their financial decision-making. However, these results do not suggest that AI tools are ineffective in financial education. Instead, they emphasize the need for further study on integrating AI effectively into student learning. For example, curricula should incorporate experiential learning to enhance investment adoption and critical decision-making (Al-Ali et al., 2024). Additionally, future research should investigate hybrid models that blend AI with hands-on financial planning to optimize long-term student outcomes.

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

AI and AI-assisted technologies were used to improve the language and readability of some sections of this article.

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Synergy of Vocational Skills and Soft Skills in Shaping Employability

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Abstract
Proficiency in technical skills is essential for employment in the world being shaped by fifth industrial revolution, yet the cultivation of complementary soft skills remains crucial for career success. National Education Policy (2020) envisions education that prepares students for meaningful and satisfying lives; education that enables personal accomplishment and enlightenment, constructive public engagement, and productive contribution to the society. The Education Department of Chandigarh Administration has been offering Skills Courses under four broad categories viz., Home Science, Health and Paramedical, Engineering, and Commerce with the aim to enhance employability. The present research paper explores the intricate relationship between vocational skills and soft skills within the context of Vocational Education by seeking and analyzing perceptions of teachers and students. Qualitative methodologies being employed for this study presents the prevailing scenario of soft skills development among students enrolled in such Skill Courses. The research examines the extent to which vocational programs equip students with essential soft skills and the evaluation of the role played by teachers. The study findings are envisaged to lead to a comprehensive understanding of the difficulties and opportunities in including soft skills into vocational education so as to inform policy-makers, educators, and industry stakeholders in creating effective courses that prepare school graduates not only for the demands of the emerging workplace but also to lead satisfying lives.

Keywords: Vocational Education, Skills Courses, Emerging Workplace

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Introduction

Employability requires a seamless blend of technical and soft skills. The National Education Policy (NEP) 2020 envisions a holistic redesign of the education system to meet the nation's expanding developmental needs, emphasizing the integration of vocational education into all secondary schools over the next decade. The policy aims to decrease the silos between vocational and academic streams by promoting interdisciplinary and inclusive learning. In spite of these aspirations, in India, vocational education faces significant challenges: only 5.6% of students are enrolled in such programs, with college-level participation limited to 16.2%. Annual Status of Education Report (ASER) 2023 states that the majority of youth join short-term courses lasting six months or less. It significantly restricts opportunities for skill development.

Currently, in Chandigarh, skill courses are functional in 23 government schools, yet systemic challenges persist. As per the Project Approval Board (PAB), Ministry of Education, Government of India (2024), around 11.9% of students drop out following secondary school. Subsequently they are likely to become unskilled workers. This stark reality highlights the crucial role technical and vocational education and training (TVET) must play in improving employability and quality of life. As Stefania Giannini, UNESCO Assistant Director-General for Education, aptly stated, "Through TVET we can equip the youth with the skills and knowledge they need not only to excel in today's job markets, but also to thrive in a rapidly changing world" (World Bank Group, 2023). Though, there are no pendency approvals for the establishment of vocational education labs in chandigarh government schools under the Samagra Shiksha Scheme, according to the Project Approval Board (PAB), Ministry of Education, Government of India (2024), however private sector involvement in vocational education remains absent (UDISE+ 2021-22). This missing link in scalability and innovation fails despite government schools in Chandigarh have an enrolment of 6,898 students.

Various studies signify the importance of soft skills in career success (Al Mamun, 2012; Oviawe, 2020). The paper explores how the synergy of vocational education and soft skills training, can bridge employability gaps by equipping the students for achievement in highly competitive job market.

Findings

Understanding Students' Perceptions of Soft Skills

Awareness Gap in Understanding Soft Skills. Primarily all the students has shown a lack of awareness with the term "soft skills." This awareness gap hinders their ability to understand the importance of these skills in employability.

> Soft skills kya hoti hain? Maine kabhi nahi suna.
> (What are soft skills? I have never heard of them.) – Student 1

> Communication skills ka toh pata hai, lekin soft skills ke baare mein nahi.
> (I know about communication skills, but not soft skills.) – Student 2

These excerpts are suggestive of the fact the soft skills are not introduced to the students. As a result, they remain aloof to its significance in enhancing employability and succeeding in

working spaces. Soft skills are critical for career success (Al Mamun, 2012), but the lack of understanding questions students' readiness for the workplace.

Misconceived Opinion of Communication Skills. Many students demonstrated awareness of communication skills as something that is needed for success in learning and working spaces. However, their understanding is limited to basic conversational abilities or fluency in a particular language specifically English.

> In today's time, communication skills are as important as a degree; otherwise, you won't get a job – Student 1

> Communication toh chahiye, chahe kisi se baat karni ho ya apni baat samjhaani ho.
> (Communication is needed in every field, whether to talk to someone or explain your ideas.) – Student 2

> Communication skills matlab English mein baat karna.
> (Communication skills means to be able to speak in English.) – Student 3

Students equated communication skills with language skills only, not understanding the larger and hidden agenda of effective communication, like establishing relationships, influencing people, or developing teamwork. This narrow understanding indicates the lack of formal discussions or training on soft skills in their curriculum.

These answers highlight the inability of the students to distinguish between proficiency in language and the extensive uses of communication which are vital to professional achievement (Bunyamin et al., 2022).

Students' Perception of Essential Skills and its Relevance. Though students identify certain skills – like coordination, client handling, friendly behaviour, and emotional stability – as important for getting a job and excelling at a working space, they do not categorise them as soft skills. Due to this gap in understanding they further fail to understand that these skills can be intentionally learned through training and practice, rather than being developed incidentally.

Excerpts that illustrate lack of awareness about soft skills as a category:

> Hume soft skills ke baare mein jaankari nahi hai, bas school activities se hi thoda bohat pta chalta hai.
> (We don't have knowledge about soft skills; we just get some exposure through school activities.) – Student 2

> Soft skills ko school mein nahi padhaya jaata, bas extracurricular activities hi hoti hai.
> (Soft skills are not taught in school; only extracurricular activities are organised.) – Student 1

Misconception that these are natural and not trainable traits:

> Clients ke sath friendly rehna ana chahiye par wo kese seekhien.
> (One should know how to be friendly with clients but how to learn to do so.) – Student 3

> Mere profession mein coordination zaruri hai customers key saath. Coordinate karna seekhna nahi padhta.
> (Coordination is important in my profession and it is not learnt.) – Student 4

Limited recognition of the development of soft skill through training:

> Main kabhi yeh nahi socha ki friendly hona aur client handling ko training ke zariye improve kar sakte hain.
> (I never thought that being friendly and handling clients could be improved by training.) – Student 5

The question of whether emotional intelligence would be necessary in the workplace also reflects limited understanding when a student asked, "What is the need of Emotional balance at work?"

Students' Perception of Extracurricular Activities. Students' participation in extracurricular activities is purely as part of routine school programs. There is no focus on soft skills development by students. Many students are not keen to put extra efforts to enhance their soft skills outside of the classroom.

For example, a student stated,

> Main kuch alag nahi karta soft skills ke liye, bas school ke activities mein hi participate karta hoon.
> (I don't do anything extra for soft skills; I just participate in school activities.)

Students are expected to take the initiatives for skill development by either self-directed learning or participation in such activities (Majid et al., 2012). While they lack the required knowledge of the broader purpose of extracurricular activities as a platform for skill development beyond academics, they lose the chance to develop skills like time-management, stress management, leadership, teamwork and so on. These skills are expected to help them in academics as well as their careers (Obilor, 2019).

Some did, however, provide instances of how activities- like theatre and sports- indirectly develop their soft skills.

> Main theatre seekhta hoon. Acting skills improve karna chahta hoon.
> (I learn theatre. I want to improve acting skills.) – Student 1

> Cricket se teamwork and leadership seekhta hoon.
> (Playing cricket teaches me teamwork and leadership.) – Student 2

It is worth noticing that soft skills are enhanced through participation in these activities, however, these benefits are only incidental and not intentional.

The absence of a formal method of approaching extracurricular activities restricts the ability of students to learn essential skills like leadership, teamwork, emotional intelligence, and problem-solving. Debates, sports, and performing arts are inherently meant to teach students teamwork, how to manage pressure, and communicate. Nevertheless, in the absence of

deliberate direction (Tisa et al., 2024), individuals do not fully utilize these experiences in order to grow personally and professionally.

Understanding Teachers' Perceptions of Soft Skills

Role of Soft Skills in Vocational Education. Undoubtedly, Teachers believe that soft skills are importance in vocational Education. According to the teachers, soft skills are essential for students' employability (Wats & Wats, 2009). Most teachers conveyed that technical knowledge is not enough to prepare students to deal with actual job situations, citing the role of communication, teamwork, adaptability and emotional intelligence to achieve success in their careers and life.

> Technical skills alone are not enough. – Teacher 1
>
> If students don't learn public speaking, they will not be confident? – Teacher 2
>
> These skills like adaptability and emotional intelligence are required not just at work but also in life in general. – Teacher 3
>
> Vocational education doesn't just mean to learn about machines. Teamwork is there to learn. – Teacher 4

In general, teachers view soft skills as a component of vocational education.

Perspective of Teachers on Key Soft Skills. Teachers opine that soft skills are as important as technical skills for students throughout their careers. They argue that technical skills are not enough, students must develop soft skills for future success.

Teachers' top soft skills ranked by priority:

- Communication Skills – Expressing thoughts and building relationships
- Creativity – Thinking out of the box, beyond regular
- Teamwork – Encouraging cooperation and companionship
- Stress Management – Managing working space pressure effectively

Communication skills were ranked as the most important soft skill for students in academic and professional life. According to the teachers, without the communication skills students will struggle expressing their views, exceling in job interviews and collaborating with others. This skill was seen essential for maintaining sociable terms with peers, mentors, and employers (Kapur, 2020).

> If students can't express themselves, how will they move forward? What's the point of everything if they are unable to communicate properly? – Teacher 1
>
> Most of them are from slums, their language is a bit crude, using curse words is also very common among the students. – Teacher 2

Teacher 2 has brought the socio-economic background of the students into picture. Due to the influence of the environment, students are more prone to use informal and rough language. However, such communication patterns can become a hinderance in workplace interactions.

Creativity is also considered important as it allows students to stand-out. Creativity helps students to think beyond textbook solutions to problems.

> We want our students to think outside of the textbook.– Teacher 3

Continued discussion of creativity, teacher teaching Fashion Design for 14 years now says, "Fashion is all about uniqueness. Students who can mix colours and designs in new ways, succeed." Originality comes with a creative mind. Similarly, a teacher of subject Automobile remarks that a creative automobile mechanic can discover smarter ways to increase the performance and efficiency of vehicles. Summing up, creativity does not mean to have an artistic mind but it is a practical requirement in vocational fields to stand-out of the crowd.

Teamwork emerged as another crucial skill. Teachers pointed out that group in-class activities prepare students for real-world.

> Students complete projects in groups.– Teacher 1

> Being a team player is a requirement, as no one can do stand-alone work.– Teacher 2

By performing group activities or projects, students tend to be confident and gain mutual support. This prepares them for professional working spaces. Working in a team, collaborating with others, working together cohesively builds trust and respect among team members which is an essential component of success (Kumar & Deswal, 2023).

Apart from these skills, teachers emphasized the requirement of stress management for students to cope with stress in personal and professional spaces. They describe it as a skill to handle pressure at school and at work. Some excerpts to support the notion are as under:

> Students must learn how to handle stress effectively as they enter the workforce. – Teacher 1

> Stress management is equally necessary in personal life. – Teacher 2

Stress management is an essential skill for students as they enter the job market, and it is also crucial in their personal lives. Evidence exists that the capacity to manage stress helps in academic and professional achievement (Chen, 2016).

Teachers' Role in Developing Soft Skills. Teachers consider their role as pivotal in soft skills inculcation among the vocational education students, especially because they come from a modest background. Teachers view their role beyond teaching the academic content. Teachers acknowledge that soft skills are integral to students' future no matter what career path they choose. Here are some of the excerpts from the interviews:

> It's not just about teaching a course; we are helping them learn how to communicate and work with others. – Teacher 1

> These are things they'll use every day, no matter what job they do. – Teacher 2

Several teachers discussed how they incorporate soft skill development in their daily interactions and expressed the feeling of pride on watching students grow through their efforts.

A teacher explained:

> When we give them group tasks or ask them to explain their ideas, they develop confidence.

Another added:

> Sometimes it's not a formal lesson; it's the guidance we provide that make a big difference.
>
> It feels great when a student who was shy in the beginning starts speaking up or taking charge of a group activity. That's when you know you've made an impact.
>
> We're not just teaching subjects; we're helping them become better individuals who can handle challenges.

Teachers highlighted the deep influence of students' family background on their capacity to acquire soft skills. Most students enrolled in skills courses are from disadvantaged backgrounds with minimal exposure to skills such as grooming, English speaking, and interpersonal behavior. Such a background creates a greater responsibility for teachers to educate students not only academically but also socially and professionally.

One teacher shared:

> Ye colony ke bache hai, inko zyada pata nahi hai. Humse hi observe karke seekhte hai grooming, English bolna, manners.
> (These are kids from local colonies/slums; they don't know much. They observe and learn grooming, speaking English, and manners from us).

This observation highlights the socio-economic plight of disadvantaged children, more so those who live in slums, according to Arora (2016). Students come from homes where initial exposure to refined communication, professional courtesy, and building confidence is limited. Parents may be working in daily wage jobs, small enterprises, or other physically demanding work, leaving little time or means to devote to skills development. The domestic setting, though nurturing on its own terms, may fall short on the discipline or experience needed to develop such soft skills.

The role of teachers, therefore become highly crucial. They act as mentors by fostering soft skills via classroom interactions, where they correct students' language, teach professional presentation styles, and encourage better grooming habits.

Challenges Being Faced by Teachers in Soft Skills Teaching

Lack of Teacher Training. Vocational teachers do not feel fully equipped in teaching soft skills, reporting the lack of training in soft skills teaching. They also feel the dearth of time and proper channels or resources in doing so.

As one teacher shared:

> We understand soft skills are crucial, but we don't have time or resources to teach them specifically in a well-planned way.

Therefore, without structured training, teachers feel unequipped to prepare students for professional demands.

Reduction in Practical Work. Another key issue for teachers is the drastic decline in practical work in vocational courses, which they think is essential for developing skills. Previously, 60% of vocational education was hands-on practical work, but this has now fallen to 40%, compromising students' capacity to convert theoretical knowledge into practical skills:

> Earlier, 60% of the work was practical, but now it's only 40%. Practical work is essential in vocational courses, but it has reduced significantly. – Teacher 1

> Fieldwork has been reduced. Earlier, students were sent to local shops for internships, and they were graded based on that. – Teacher 2

Practical training being reduced is preventing students from getting real-world experience, as a result their readiness for employment is getting compromised. Teachers believe, on expanding the practical work, vocational education will prove more impactful.

Obsolete Equipment and Restricted Usage. Another limitation highlighted by teachers is the obsolete equipment in vocational labs (Sharma, 1997). Students are also restricted to use them, primarily over the risk pertaining to the potential damage to the equipment. Hands-on training is replaced by mere demonstrations. As a result of the limited exposure to tools or equipment, students' readiness for the world of work is at stake. Here are some excerpts from the interview:

> If students damage it, the responsibility falls on the teacher, so only demonstrations are given. – Teacher 1

> Instead of allowing students to use the equipment, they are just shown how it works. This affects their learning. – Teacher 2

Soft Skills Integration. Teachers pointed out that soft skills training needs to be intentional as it can not develop naturally through vocational training alone. It needs explicit instructions. However, the current curriculum lacks specific modules or allocated time for soft skills. It is also pointed out by the teachers that extracurricular activities assist, but are not enough to teach soft skills.

> Soft skills are important, but they are not included in the syllabus. We don't have time to teach them separately. – Teacher 1

> If specific lectures were included in the syllabus, we would teach soft skills specifically. – Teacher 2

Successful soft skill development necessitates intentional curriculum design and intervention activities directed at market demands (Sanwal & Chouksey, 2019).

Teacher Constraints. Vocational teachers are confronted with enormous challenges by contractual employment, reduced salaries, and limited job security, affecting their motivation and job satisfaction. Rice et al. (2024) emphasize that low pay and job insecurity are long-standing concerns, which contribute to frustration and undervaluation.

> I teach on contractual basis, get paid less, but do full-time work. – Teacher 1

> Not getting permanent status reduces motivation, but we still try to do our best. – Teacher 2

Teachers are committed despite these difficulties, but lack of support may interfere with their capacity to be fully engaged in teaching and professional development.

Student Attitude and Perception. A common issue emphasized by instructors is the absence of student interest in vocational studies. Students view these programs as an alternative option instead of a preferred profession, primarily because of a lack of awareness about their importance (Sharma, 1997).

> Sometimes students don't take admission out of choice; they join vocational education due to unsuccessful admissions elsewhere. – Teacher 1

This lack of awareness influences motivation and engagement, hindering students' ability to understand the real-world applications of vocational skills. In the absence of recognizing their significance, students are inclined to perceive learning as solely academically focused, which diminishes enthusiasm for practical training. This situation not only impacts individual career readiness but also detracts from the overall efficacy of the vocational education framework.

Discrepancies in Implementation of Employability Skills: A Researcher's Perspective

Employability skills in vocational education are a compulsory component, as mandated by the National Education Policy (NEP) 2020. However, it is facing a number of implementation gaps. While the Central Board of Secondary Education has incorporated employability skills with 5 units namely- communication, self-management, ICT, entrepreneurial, and green skills into the curriculum from IX to XII standards, insights drawn from interviews with teachers and students indicate that the desired outcomes are not being entirely achieved on the ground.

Employability skills need to be imparted through experiential learning, extra-curricular activities, practical projects, institutional leadership and academics-industry linkages to be impactful (Nghia, 2019; Tiwari & Malati, 2020). But these skills are being imparted in a theoretical and examination-oriented format, and hence students cannot practice them in real-life situations. Here are some excerpts from the interviews:

> CBSE has incorporated employability skills into the syllabus, but it has not provided adequate training for teachers. – Teacher 1

> Employability skills are instructed just to sit the theory exam, but not put into practice. – Teacher 2

Although CBSE has conducted teacher training webinars and programmes with regards to employability skills, however, their adoption is uneven, with most educators continuing to find it difficult to incorporate this subject into practical learning activities. As stated by a teacher, "We explain it in theory class, and there is no time for activities."

Teachers report that assessment frameworks focus more on theory that practical applications, which restricts students' motivation as well.

> Students would be helped if these skills are integrated are projects or internships. They need to observe how these skills are required in actual work settings.

The sample question papers, available on the official website, of CBSE, reflect that the focus is given almost entirely on written examinations rather than competency-based testing. Researcher, therefore, argues that without practical assessments and workplace-based learning, students will struggle to translate employability skills into real career opportunities.

Recommendations and Conclusion

Raising Awareness About Skill Education

Students should be informed of the significance of skill education (Rahate Ellah & Azmi, 2023; Sharma, 1997), which covers technical skills as well as soft skills—both necessary for future careers (Tisa et al., 2024). Although technical skills equip individuals with the required information for particular professions, interpersonal skills like communication, collaboration, and analytical problem-solving enable professional growth. With the aim to achieve this goal, schools should establish awareness programs, workshops, counselling sessions, guest lectures, and interactions with professionals. Students must be encouraged to participate in extracurricular activities that promote soft skills. By raising awareness at an early stage, students will appreciate the need to develop technical and interpersonal skills, hence being better equipped for the changing job market.

Embedding Soft Skills Into the Core Curriculum

Educational institutions must officially incorporate soft skills courses into their curriculum (Akinbode et al., 2023; Romanova, 2022). This includes creating structured modules or courses that instruct students on how to effectively interact in a work environment. The courses do not have to be purely theoretical and can include real-life training like; interactive classes in which students participate in group work and discussions, role-playing exercises that simulate workplace scenarios, helping students learn how to handle real-life challenges, project-oriented learning that fosters group work and cooperation, and case studies to examine real-life examples of good and bad communication, leadership, and decision-making.

Apart from this, tests of soft skills and employability skills have to be unlike regular examinations. Rather than written examinations, organizations can conduct tests by giving presentations, organizing group discussions, and project-based problem-solving exercises.

Teacher Wellbeing in Soft Skills Teaching

For teachers to effectively impart instructions and skills, their own wellbeing plays a vital role (Belmonte et al., 2022; Ghamravi et al., 2023; Schmitz, 2024). Soft skills training is not a one-time activity, thus, continuous professional development by way of workshops, seminars, and online resources will help them be updated to the changing trends and practices of soft skills training.

Improving contractual status of teachers is also important. Fair and competitive salaries; opportunities for permanent employment can keep the teachers motivated and emotionally sound. This can have a positive impact on their teaching practices as researches have inferred that teachers' wellbeing is positively correlated with the socio-emotional development in students.

Conclusively, the study reveals gaps in vocational students' knowledge, adoption, and use of soft skills despite their essentiality for job success. Students are keen to learn and the teachers are agreeable to teaching them, yet institutional obstacles such as ignorance, poor teacher training, and an overemphasis on theoretical knowledge delay effective implementation. A multifaceted solution is thus essential, prioritizing curriculum restructuring, teacher training, and experiential learning experiences. Filling these gaps not only will increase the employability of students but also will give them the confidence and resilience required to survive and succeed in an evolving professional world.

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Exploratory Factor Analysis Applied to the Study of Sensory Vocabulary in the Exterior Design of Electric Vehicles

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Abstract
This study used exploratory factor analysis (EFA) to help students classify and apply descriptive adjectives to the exterior design of electric vehicles, enhancing their sensory abilities through visual aids. The research involved two main phases. First, sharp and rounded edges were selected, and 300 adjectives were categorized from vehicle models. After screening by 25 participants, eight adjective groups were chosen: "streamlined," "flexible," "smooth," "comfortable," "well-proportioned," "modern," "stable," and "neat." Next, the data was collected through online questionnaires with images of 30 vehicles and evaluated according to the adjective groups. After selecting 30 representative models, 60 valid questionnaires were collected to analyze key design factors. SPSS analysis revealed two key components: "modern and smooth" and "stable and comfortable," explaining 90.35% of the total variance. The results show that the adjectives can be grouped into two main factors, providing a precise basis for evaluating electric vehicle design. The study enhanced participants' knowledge of the design vocabulary. It introduced an alternative to thinking in electric vehicle design and educational research for increased critical thinking / psychomotor integration.

Keywords: Expert Method Analysis, Cluster Analysis, Fuzzy Theory, Electric Vehicle, Industrial Design

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Introduction

With the rapid evolution and advancement of electric vehicles (EVs), it is essential to explore the adjectives associated with automotive design in these vehicles. As electric cars continue to gain popularity, there is an increasing demand for more diverse and innovative designs to cater to different consumer preferences. With the rising EV presence in the world market, OEMs have designed. They continue to create various vehicle styles and shapes for different customer segments. According to a comprehensive consumer survey, Descriptive adjectives for these vehicles are essential for effectively identifying and targeting multiple markets. These adjectives can provide valuable insights that assist manufacturers in developing car models that better align with consumer preferences.

Conducting thorough surveys in current market trends and consumer vehicle preferences is essential for remaining competitive. It is this understanding that will empower companies to and create models that satisfy the aesthetic aspirations of consumers — as well as that of their functional expectations, even as their products compete overall. The automotive industry is in a major state of transformation as it transitions to electrification, and this will greatly increase the options for vehicles available to consumers. That way, manufacturers can help steer the arc of EV design moving forward, so that new models can evolve to meet changing market demands without leaving what's doable behind.

In everyday life, most vehicle designs have already reached a standardized form, with consistent shapes and functions that consumers have widely accepted. Consumer habits today reveal that a vehicle's exterior design and overall aesthetics are among the most significant factors influencing purchase decisions. Beyond the price factor, many consumers choose vehicles based on their exterior design features, such as color and overall shape. These visual components play a massive role in how vehicles elicit an emotional response from a consumer and, therefore, are key to automakers. Thus, manufacturers must develop design iterations and innovative features that sync with the market demand and consumer perspective.

Many designers in vehicle outer designs utilize their preferences, design skills, and individual assessments. While this approach is subjective and can result in designs tailored to a particular group, it can also compromise the quality of the work produced. For example, a designer's choice of colors can differ from their interpretation of how descriptive language is used, which aids in determining the external aspect of the vehicle in relation to its internal part.

Being made by many people gives us tremendous money and fame because it helps ensure that consumers will like the final product and satisfy market trends, so we do not need to install overly bespoke or idiosyncratic designs. In this way, they will adopt a more responsible attitude, properly considering market accommodation but adequately meeting all market segments so that those who buy their products are satisfied and helped along in success within a highly competitive environment.

This study examines and classifies adjectives related to electric vehicle (EV) design. How can words influence people's feelings about attractiveness, desirability, and marketability? In the painstaking examination of people's wording to describe electric vehicles, designers can avoid mistakes that put their new cars out of line with consumer preferences. Yet, they remain practical and have fresh designs. In the end, this research will encourage a more

objective and inclusive method for EV design, resulting in higher customer satisfaction and success in a competitive market.

Research Questions

1. How can exploratory factor analysis (EFA) be utilized to determine the key perceptual dimensions related to consumers' views on electric vehicles? Exterior design?
2. How do different design elements (sharp edges versus rounded edges) affect consumers' emotional responses to electric vehicle exterior designs?
3. How does the screening and classification process of perceptual vocabulary help designers understand consumers' preferences for the appearance of electric vehicles?

Research Objective

1. Exploring consumers' emotional responses to electric vehicle exterior design.
2. Using Exploratory Factor Analysis (EFA) to Identify Key Perceptual Dimensions of Electric Vehicle Appearance Design.
3. Classify and assess adjectives relating to the appearance design of electric vehicles.
4. Makes an exploration of consumers' aesthetic expectations for electric vehicles to help the design expert.

Methodology

Research Trends and Methods

In such a study, Exploratory Factor Analysis (EFA) is adopted as the primary data processing mode for the purpose of expanding and confirming what bedimming effect it would have if consumers saw an electric car in front of them that looked anything but exactly like what they expected from one means this life-altering event. The research process includes data collection, adjective vocabulary screening, questionnaire design and survey, and data analysis using SPSS.

Data Collection and Adjective Vocabulary Screening

Collection of adjective vocabulary: This study first collected 300 adjective vocabularies related to the appearance design of electric vehicles through the Internet and databases (Figure 1). These words cover different design features of both sharp edges and rounded edges.

Questionnaire design and screening: A questionnaire was designed to allow subjects to select the 30 adjectives that best describe the appearance of electric vehicles from these adjective vocabularies. Next, the expert method was used to select the eight most representative adjectives from the adjectives chosen by the subjects.

Subject Selection and Sample Design

This study selected 60 subjects, who were randomly chosen from ordinary consumers. It evaluated 30 black and white vehicle pictures taken at a 45-degree angle in a questionnaire (Figure 2).

Each picture is paired with eight adjectives, and the subjects must choose the most appropriate adjective based on the appearance characteristics of the image.

Data Analysis Methods

KMO (Kaiser-Meyer-Olkin) test and Bartlett's sphericity test (Figure 3)(Figure 4): First, the collected data were subjected to a KMO suitability test, and the result was 0.783, indicating that the data were suitable for factor analysis. At the same time, the Bartlett sphericity test was used to test the data's correlation, which showed a significant correlation between the data and was suitable for subsequent analysis.

Exploratory Factor Analysis (EFA): Using SPSS software to conduct EFA, we identified two main factors that influence consumers' perception of electric vehicle exterior design:

Modern and Smooth: This factor explained 56.56% of the variance.

Stable and comfortable: This factor explains 33.79% of the variance.

Variance Explained: Together, these two factors explained 90.35% of the total variance, indicating that these factors have a high explanatory power for understanding consumers' design preferences.

Figure 1: 300 Adjective Vocabulary

After reading the diagram, please check the most suitable adjective vocabulary for the sharp car, there are two pages for 30 to check!

	Streamlined		Lightweight		Knife-cut
	Exquisite		Rigid and soft		institutional
	Stylish		Explicit		Scrub
	Dynamic		Perfect		Smooth
	Tough		Beautiful		Cold
	succinct		Efficient		sensitive
	Futuristic		Gorgeous		Alert
	Vibrant		Brilliant		Ahead of its time
	High-tech		Reckless		Bright
	Meticulous		Inspired		of light and shadow
	fearless		Charismatic		Fresh
	Magnificent		Witty		Brilliant
	Luxury		bright		A great sense of speed
	Neat		Interesting		Fearless

	Highbrow		smooth		Gorgeous
	Steadily		Well-bodied		Fine
	dynamic		Flamboyant		Energetic
	Powerful		Palatial		Avant-garde
	prompt		Textured		Challenging
	modern		soft		Three-dimensional
	Confident		Plump		Full of energy
	Expressive		Sharp		Shocking
	Modern		Shocking		Icy cold
	portable		Minimalist		Abstract
	Neat and tidy		advanced		Stylized
	dispassionate		Sharp		Strong
	abundant		Technological		Lively
	Textured		Sci-fi		simple
	Comfortable		unique		Eclectic
	Mild		Modern		Sharp
	Classic		Extreme		excessive
	Flexible		Fantastic		traditional
	Plump		Surreal		Flappy
	Elegant		Extremely fast		Radical
	Colorful		Detonated		Gorgeous
	Complex		Extreme		Inspiring
	Eco-friendly		Dynamic		Uninhibited
	Stunning		prominent		Evolved
	Rustic		Plasticity		organic
	Flowing		Minimalist		Unrestrained
	Jumping		Rounded		Popular
	double		Gentle		linear
	Soothing		Exquisite		Vigorous
	Pulsating		Gentle		Moving
	classical		Playful		Passionate
	Calm		Volumizing		Majestic
	Scorching		Wild		Relaxed
	Cold		Feminine		Wild
	Rapid		Challenging		Three-dimensional
	Brisk		Uninhibited		Fashion-forward

Figure 2: Black and White Vehicle Pictures Taken at a 45-Degree Angle

流線型的	○	○	○	○	○
輕快的	○	○	○	○	○
光滑的	○	○	○	○	○
舒適的	○	○	○	○	○
豐勻的	○	○	○	○	○
摩登的	○	○	○	○	○
穩重的	○	○	○	○	○
俐落的	○	○	○	○	○

Figure 3: KMO (Kaiser-Meyer-Olkin) Test

KMO與Bartlett檢定

	Kaiser-Meyer-Olkin 取樣適切性量數。	.783
Bartlett 的球形檢定	近似卡方分配	326.845
	df	28
	顯著性	.000

Figure 4: Bartlett's Sphericity Test

解說總變異量

	初始特徵值			平方和負荷量萃取		
元件	總數	變異數的 %	累積%	總數	變異數的 %	累積%
1	4.525	56.561	56.561	4.525	56.561	56.561
2	2.703	33.793	90.354	2.703	33.793	90.354
3	.408	5.105	95.460			
4	.169	2.110	97.569			
5	.092	1.144	98.713			
6	.048	.603	99.317			
7	.032	.396	99.713			
8	.023	.287	100.000			

萃取法：主成份分析。

Results and Discussion

Exploratory Factor Analysis (EFA) Results

KMO and Bartlett's Test: The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was 0.783, which indicates that the data was suitable for factor analysis, as values above 0.7 are generally considered acceptable. Bartlett's test of sphericity yielded a chi-square value of 326.845 with a p-value of 0.000, confirming that the correlations between the variables were significant and suitable for exploratory factor analysis.

Principal component Analysis (PCA): The Factor Extraction: PCA identified two factors that cumulatively explained 90.35% of the variance in the dataset:

> *Factor 1*: "Modern and Streamlined" (56.56% Variance Explained) – Streamlined, sleek, and super modern- elements of a contemporary design with the latest available technologies.
>
> *Factor 2*: "Safe & Comfy" (33.42% of variance explained): Adjective form preferences indicate stability, comfort, and smoothness, stressing the preference for comfort, reliability, and stability in design.

With respect to electric vehicle (EV) appearance, the two main dimensions that sagaciously determine consumer preference for the EV were found to be. Other than their relevance, here you go for consumer perception of EV design, which is heavily influenced by taste and a bit by growing nose dependence on the availability of stability.

The two dimensions that primarily determine consumer preference for electric vehicle (EV) appearance were identified. The relevance of these two factors gives way to the consumer perception of EV design being heavily dependent on the desire for aesthetics and comfort with ever-nose-depending stability.

Adjective Categorization

The eight adjectives selected for evaluation were categorized into the two main factors derived from the EFA:

> *Modern and Streamlined (Factor 1):* This factor emphasizes vehicle design's sleek, futuristic, and contemporary nature. This list of adjectives indicates what consumers consider modern design in a contemporary EV: smooth, aerodynamic looking, and cutting edge appearances. Words such as "streamlined," "sleek," and "modern" mean the design is not only efficient but utilizes modern aesthetics as well.
>
> *Stable and Comfortable (Factor 2):* This one describes the attributes of trustworthiness and comfort. The words "stable," "comfortable," and "smooth" immediately bring home a feeling of safety, luxury, and durability for EVs as safe, user-friendly machines. There is a push for more EVs that offer looks and the consoling that comes with that desire for raw aesthetic effect.

Discussion of Results

Consumer Preferences for Design Dimensions: The two factors identified—modern and streamlined vs. stable and comfortable—suggest two consumer willingness for EV design-related differences distinct consumers. Some people want a modern, futuristic look- the setup matched with state-of-the-art technology and refined appearance.

Others will value others like comfort and stability; that's literally how practical one maintains their car design.

Takeaways for Designers: These insights are instructive (or at least empirical) to industrial designers. And manufacturers in the electric vehicle industry. To cater to these differing preferences, designers should consider offering design options for both groups. Electric vehicle models may be made with minimalist and futuristic designs mainly targeted at newer consumers who care for the latest buzz and development. Alternatively, some could use more traditional design to communicate reliability & comfort if they want to appeal to these a spects.

Trends of the Market: These two things support current trends of the automotive market. The growing interest in electric cars, as well as successive generations of body design and technology, shows consumers are more enthralled with contemporary aesthetics and the natural evolution of comfort and stability. Awareness of these significant factors will also better position manufacturers to guide their EV design processes to best meet consumer demand and elevate market competitiveness.

Limitations and Future Research

Sample diversity: The sample of the study was largely from Taiwan, which may limit the generalizability of the findings to other regions or cultural contexts. Future research should explore these dimensions of EV design preferences in diverse geographical locations and cultural settings to determine, supposing these two conditions hold in all markets:

> *Adjective Range*: Although this study restricted its analysis to a subset of adjectives, future research could broaden the adjectives included in the range or investigate other design qualities (ex, color, texture, material) for a complete civilization of consumer taste for EV design.

Analysis Of Additional Design Aspects: Different design features, especially those that pertain to the vehicle's interior, such as interior elements, color schemes, and new technologies, may be analyzed in future studies to assess their impact on how consumers think about the aesthetics or the design of the vehicle as a whole. This sophisticated method may provide key insights regarding consumer behavior towards electric cars.

Conclusion

This study's results have revealed some facts concerning the psychological components that form. Customer-cognitions.

Consumer perceptions of electric vehicle exterior designs. Through exploratory factor analysis, the research identified two key factors—modern and streamlined. Those factors can help designers understand how to develop electric vehicles that are more appealing to the market, thereby improving their marketing potential and increasing their sales.

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AI-Generated Questions in an OER Textbook: Evaluating the Performance of Formative Practice

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Abstract
The ubiquitous use of digital learning resources like etextbooks has shifted the learning experience in higher education. Digital learning has led to both new learning tools as well as research in how learning works via the large, rich data sets those digital resources generate. Advances in artificial intelligence have made it possible to develop and scale learning methods—such as formative practice integrated in etextbook content in a learning by doing approach. A primary benefit of generating formative practice is to bring this highly effective learning approach to millions of students using digital textbooks. This paper focuses on an automatic question generation system that has proven to generate effective formative practice for higher education textbooks, as measured through large-scale analyses of question performance metrics and in-classroom implementations. Open education resources (OER), such as OpenStax, offer students and faculty a learning resource without the high cost. In this paper, we evaluate performance metrics such as difficulty and persistence for the automatically generated questions added to an OER textbook for the first time. Used in several large, online chemistry courses at a major public university, this paper showcases the viability of automatically generated questions combined with OER content for increasing the access and affordability of formative practice as a feature in digital textbooks. Key question performance metrics, such as question difficulty and persistence, along with student interaction patterns and behavior, are analyzed, and future applications of OER content with automatically generated questions are discussed.

Keywords: Open Education Resources, Automatic Question Generation, Learning by Doing, Formative Practice

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Introduction

Textbooks are a central component of many higher education courses, serving as the primary resource from which instructors expect students to read, learn, and apply knowledge to assignments and assessments. Although textbooks have traditionally been regarded as the gold standard for delivering learning content, they present challenges related to engagement and active learning. First, despite being assigned by instructors, students often do not engage with textbooks as intended (Berry et al., 2010; Burchfield & Sappington, 2000; Connor-Greene, 2000; Schneider, 2001). Data from etextbook platforms have confirmed low reading rates among students, with conventional instructional strategies—such as reading quizzes or discussions—yielding mixed results in increasing engagement (Russell et al., 2023). However, studies indicate that incorporating formative practice is more effective in promoting student engagement than any other reported strategy (Brown et al., 2024). Second, textbooks primarily support passive learning, which is not the most effective approach to knowledge acquisition. Research from Carnegie Mellon University's Open Learning Initiative has demonstrated that embedding formative practice within text content, following a learning-by-doing approach, is about six times more effective than reading alone (Koedinger et al., 2015; Koedinger et al., 2016). This principle, known as the doer effect, has been empirically shown to have a causal relationship with learning outcomes (Koedinger et al., 2016; Koedinger et al., 2018). Further replications of research on the doer effect confirm that this methodology is broadly applicable and should be made available to as many learners as possible (Van Campenhout et al., 2021a; Van Campenhout et al., 2022; Van Campenhout et al., 2023a).

Despite these findings, the integration of formative practice within digital textbook content remains uncommon in higher education. Courseware platforms provide highly effective learning-by-doing experiences but are often challenging to scale due to development costs and adoption barriers. Recent advancements in artificial intelligence have made it feasible to generate the volume of formative practice required for the learning-by-doing model. Automatic question generation (AQG) systems have been increasingly explored by research groups worldwide for a range of educational applications (Kurdi et al., 2020). While various approaches exist for generating and applying these questions, Kurdi et al. (2020) noted that a universally accepted gold standard for automatically generated (AG) questions had yet to be established and more research was needed that used student data to evaluate AG question performance.

An AQG system was developed to generate formative questions directly from textbook content (evaluated in this study). These AG questions were initially integrated into courseware learning environments alongside human-authored questions and evaluated across six courses. The findings indicated no significant differences between AG and human-authored questions in key performance metrics, including engagement, difficulty, persistence, and discrimination (Johnson et al., 2022; Van Campenhout et al., 2021b). Subsequently, these AG questions were embedded into the VitalSource Bookshelf ereader as a study tool called CoachMe. In what is currently the largest known analysis of AG questions using student data, performance metrics from prior evaluations were replicated, confirming these benchmarks at scale (Van Campenhout et al., 2023b). Notably, both the initial comparison of AG and human-authored questions (Van Campenhout et al., 2021b) and subsequent research on CoachMe questions (Van Campenhout et al., 2023b; Van Campenhout et al., 2023c) revealed that the most significant variations in performance metrics were due to the cognitive process dimension of the question type rather than whether the questions were AG or human-

authored. Recognition-based matching questions generally exhibited higher engagement, difficulty indices, and persistence rates, whereas recall-based fill-in-the-blank (FITB) questions tended to show lower averages in these metrics. The distinction between recognition and recall question types has been well-documented for decades (Anderson et al., 2001; Andrew & Bird, 1938), and this research contributes further examples of how these differences influence question performance and student behavior. Additional studies examining student interaction with these questions (Van Campenhout et al., 2023c) and the impact of feedback (Van Campenhout et al., 2024a) have provided new insights into learning behaviors.

Research conducted in natural learning environments is valuable for ensuring external validity and generalizability (Koedinger et al., 2015; Van Campenhout et al., 2023a). Unlike controlled or semi-controlled experiments, classroom-based research does not risk altering natural student behaviors and mitigates ethical concerns related to withholding potentially beneficial learning interventions. While large-scale studies aggregating data from hundreds of thousands of students and millions of answered questions are useful for establishing performance benchmarks, they may not always reflect the nuances of classroom-specific dynamics. In particular, these very large datasets often reflect situations in which the CoachMe questions are optional, whereas instructors who integrate the questions into their courses, e.g., by assigning them directly, tend to see different patterns of student engagement. Studies have shown that students in university courses assigning CoachMe questions engaged with them differently, leading to higher first-attempt accuracy rates and increased persistence (Van Campenhout et al., 2023b; Van Campenhout et al., 2024b), as well as distinct interaction patterns (Van Campenhout et al., 2023c). Since etextbooks are widely used as the primary learning resource in many courses, it is essential to examine how AG questions function in real classroom settings. Given the substantial influence that course context and instructor implementation strategies can have on student engagement and learning, understanding their impact on AG question usage is a critical area for further investigation (Kessler et al., 2019; Van Campenhout & Kimball, 2021).

Open Educational Resources (OER) have emerged in recent decades as an alternative learning resource option in higher education, providing freely accessible and openly licensed learning materials aimed to help eliminate financial barriers for students. The rising costs of textbooks have been shown to negatively impact student access to required course materials, with many students opting to forgo purchasing textbooks due to affordability concerns (Raneri & Young, 2016; Nagle & Vitez, 2019). While OER offers one path to mitigate this issue, OER has not received widespread support from faculty and administrators, with content quality being a major concern cited (Raneri & Young, 2016; OnCampus Research, 2024). Studies investigating its use in higher education have demonstrated that courses using OER can yield comparable (or in some cases even improved) learning outcomes when compared to commercial textbooks, that faculty perceived equal preparedness from students, and that overall student and faculty perceptions were positive (Bliss et al., 2013; Clinton & Khan, 2019； Fischer et al., 2015; Hilton, 2016). Hilton's synthesis of research published between 2015 and 2018 further supports these findings, showing that OER adoption does not negatively impact student learning and is generally perceived positively by both students and faculty (2020). A meta-analysis by Clinton and Khan (2019) also found OER adoption was associated with lower course withdrawal rates, indicating potential benefits for student retention. Similarly, research by Colvard, Watson, and Park (2018) found that students using OER had higher course grades and lower DFW (drop, fail, withdraw) rates, with the greatest benefits observed among historically underserved student populations. While OER adoption

at universities has been slowly increasing, there are still barriers to OER adoption, such as instructor concerns about quality and lack of insight into OER availability and adoption paths (OnCampus Research, 2024).

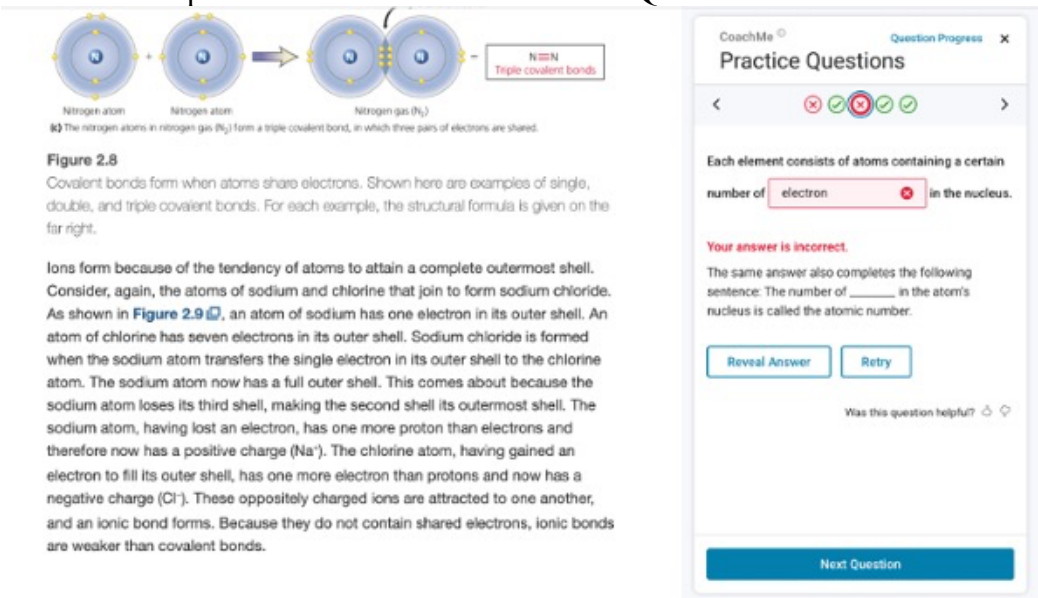
OER textbooks are passive learning environments—the same as traditional textbooks—and can often have fewer opportunities for interactive learning compared to commercial textbooks. The integration of OER with additional technologies—such as automatic question generation—offers new opportunities to enhance student engagement and support personalized learning experiences. This study aims to extend the existing research on AG question performance in classroom settings by examining questions generated from an OpenStax chemistry textbook. Faculty at a major public university used the OER textbook with the AG questions in a fall semester of Chemistry 101 and a spring semester of Chemistry 101 and Chemistry 102. With a combined 1,555 students and 30,529 questions answered, the data collected from these courses provide insight into both implementation practices and student behaviors as well as question performance metrics for OER textbooks, providing necessary insights into the quality of questions generated from this source content.

Methods

Formative Practice

The AQG system utilized in this study is a rule-based system designed by experts. Neither of the question types examined in this paper (matching and FITB) was generated using large language models. Instead, the system processes the course textbook as its corpus for natural language processing and by leveraging both syntactic and semantic information, it identifies key sentences and important terms, which are then transformed into questions through a structured set of rules (for further details on the AQG system, see Van Campenhout et al., 2021b; Van Campenhout et al., 2023b). Once generated, these questions are embedded alongside the corresponding textbook section. As illustrated in Figure 1, students receive immediate feedback upon submitting an answer. For FITB questions, scaffolding feedback incorporating an additional example from the textbook has been shown to be the most effective in promoting student persistence and improving second-attempt accuracy rates (Van Campenhout et al., 2024). When students respond incorrectly, they have the option to either retry the question—resetting it in the process—or reveal the correct answer, with additional retry attempts available. A progress panel allows students to track their completion percentage, view the correctness status of each question, and navigate between different questions and question sets. Prior research has demonstrated that this progress panel enhances student motivation, encouraging them to complete more, if not all, of the available required practice (Van Campenhout et al., 2023d).

Figure 1: An Example of an FITB Formative Practice Question With Immediate Feedback



As students interact with the etextbook and answer questions, the ereader platform continuously collects clickstream data, assigning timestamps to each user action. This fine-grained, contextual microlevel data is highly valuable for educational data science (Fischer et al., 2020; Van Campenhout & Johnson, 2023e), enabling researchers to address both longstanding and emerging questions in education (McFarland et al., 2021). In this study, we leverage this data to investigate both well-established issues—such as textbook engagement and the benefits of formative practice—as well as the evolving research area of automatic question generation.

Implementation

The Chem 101 and 102 courses were both run at a major public university. In fall 2023 (F23) Chem 101 was co-taught by two faculty, as the course was a combination of many sub-sections and consisted of more than 700 students. Deployed as an online synchronous course, students were expected to attend lectures and do several different types of assignments each week. Reading chapters from the textbook was an expectation; however, not all sections of each chapter were included in the assigned reading and the practice was incentivized but not assigned. If students completed a total of 65% of the practice in the assigned chapters (1–9) by the end of the course, they could drop their lowest reading quiz score. In spring 2024 (S24), the same faculty members no longer co-taught one class, but rather taught either the repeat section of Chem 101 or the continuation of Chem 102. Chem 101 included two more chapters (1–11) than the F23 section. Chem 102 continued from the F23 Chem 101 course with chapters 10–17 assigned.

While these three course sections are from the same university and involve the same instructors, it is not realistic to compare the fall and spring semesters directly for several reasons. First, the change from co-teaching to teaching separately still introduces differences in course policy and delivery of content that affects student behavior. Second, fall and spring semesters are often comprised of different student cohorts with different characteristics (as will be seen in the results analysis), which also restricts direct comparison. Lastly, the question performance cannot be directly compared even for the Chem 101 sections as the questions were changed between semesters. An advantage of the AQG system is that it can

be updated over time with iterative improvements and textbooks can be "rerun" to produce a new question set. Between these semesters, a book rerun was scheduled that updated the question set prior to student use in the spring. However, these comparisons while knowing these changes does shed light on some interesting student behaviors.

Results

As has been seen in other implementations of this formative practice, not assigning the practice leads to depressed overall engagement (Van Campenhout et al., 2024b). F23 Chem 101 averaged 15.8 questions answered per student. S24 Chem 101 had 37.6 questions per student, more than double the F23 course. Chem 102 was similar to F23 Chem 101 with 16.3 questions per student. However, this average per student is not representative of student engagement behavior, as it is more common for some students to do all the practice and some do none. In F23 Chem 101, 47% of students did questions and 53% did none; in S24 Chem 101, 62% of students did questions and 38% did none; in S24 Chem 102, 53% of students did questions and 47% did none.

Difficulty and persistence are two performance metrics that provide insight into the question performance. Difficulty in this instance refers to the difficulty index, where a higher value means more students answered the questions correctly and a lower value means fewer students answered the questions correctly. Table 1 shows the mean values for matching questions and FITB questions for each section. Consistent with prior research (Van Campenhout et al., 2023), the matching questions have a higher difficulty mean than the FITB questions (meaning students get the matching correct on their first attempt more frequently than the FITB). What is unusual is the differences in difficulty between course sections. The F23 Chem 101 section has very low difficulty means. This is surprising as research on classroom implementations have found difficulty means to be much higher than the aggregated dataset means (Van Campenhout et al., 2023b; Van Campenhout et al., 2024b). It is difficult to discern the exact reason for this given the complexity of the context—it could be related to the course assignment policy, the strategy and motivation of the students who chose to answer, or the questions. As an internal validation step, the research team did review the question set to ensure this question set was not an outlier compared to other textbooks.

Even more interesting is the dramatic difference in difficulty means for the S23 Chem 101 course. With a mean of 83.88% for matching and 79.31% for FITB, this course is consistent with prior research on classroom implementations. The textbook was the same, but it was a different semester, different student cohort (possibly with different motivational characteristics), one instructor instead of two, and a different question set. Due to these variations, it is not possible to ascertain the specific reason for the difference, but it does eliminate concerns that an OER title might not be suitable for quality AG questions. The S24 Chem 102 course had difficulty means between the F23 and S24 Chem 101 means.

When students answer questions incorrectly on their first attempt, persistence is the rate that students continue to answer a question until they reach the correct response. Persistence is therefore a subset of the difficulty data set. Prior research has shown that persistence is higher for matching (recognition type) than FITB (recall type) (Van Campenhout et al., 2023b; 2024b), which is consistent with these results, shown in Table 1. The same course trends seen for difficulty are seen for persistence; F23 Chem 101 has the lowest persistence rates while S24 Chem 101 had the highest persistence rates.

Table 1: Difficulty and Persistence Metrics

Section	Students	Question Total	Total Answered	Matching Mean	Matching Persistence	FITB Mean	FITB Persistence
F23 101	744	119	11,769	61.94	52.54	43.27	48.64
S24 101	260	403	9,774	83.88	83.82	79.31	77.31
S24 102	551	207	8,986	73.39	63.01	59.69	62.14

Formative practice is intended to support the learning process and therefore assigning it is based on completion and not first attempt accuracy, as that would negate the goal of formative practice as low or no-stakes practice. However, instructor concerns about student behaviors around cheating are valid. How do we know students are taking the practice seriously and not just inputting garbage at the last minute to get their points? To investigate this, we identified a set of rules to analyze the FITB responses that capture the majority of responses deemed "non-genuine," meaning not a legitimate attempt at the correct response. This includes responses under three characters, punctuation, no vowels, and known responses such as "idk." The non-genuine response rate for the aggregated big data set was 12% (Van Campenhout et al., 2023), but this rate varies in classroom contexts (Van Campenhout et al., 2024b).

Table 2 shows the non-genuine response rates were highest for F23 Chem 101 at 15.4% and lowest for S24 Chem 101 at 5%, with S24 Chem 102 in the middle at 10%. These percentages are consistent with the trends of difficulty and persistence for these courses, and are also clustered around the aggregated non-genuine response rate. Once the non-genuine response rate is calculated, this set of questions is further analyzed for persistence. For the questions that students input a non-genuine response, how often do those students persist in submitting the correct answer? In all courses, it is higher than the aggregated rate of 46%, with F23 Chem 101 coming in the lowest at 53.17% of the time. S24 Chem 102 was in the middle at 68.33% and S24 Chem 101 was the highest at 85.05%. These persistence rates indicate that the majority of students who input a non-genuine response may have done so as a strategy in order to see feedback or request an answer reveal. These students went through the effort of retrying and entering the correct response which indicates they were not merely trying to game the system just for points.

Table 2: Non-genuine Response Rates and Persistence

Section	Students	Question Total	Total Answered	FITB Non-Genuine Answers	FITB Non-Genuine Persistence
F23 101	744	119	11,769	15.4%	53.17%
S24 101	260	403	9,774	5.0%	85.05%
S24 102	551	207	8,986	10.0%	68.33%

These courses provide another unique opportunity for analysis, as there are students who took F23 Chem 101 who either moved on to S24 Chem 102 or retook S24 Chem 101. There were 427 of 744 students who continued to S24 Chem 102 and 81 students who retook Chem 101 in S24. In Tables 3 and 4, we investigate the difference in matching and FITB question difficulty means by students who would continue to Chem 102 or retake Chem 101.

In F23 Chem 101, the 427 students who would persist to S24 Chem 102 had slightly higher matching mean difficulty than their peers, but a slightly lower FITB mean difficulty.

Interestingly, once in the Chem 102 course, the students who had continued from Chem 101 had a *lower* mean first attempt for both matching and FITB than their peers. It is unclear why this is, but it is reasonable to connect the low mean difficulty from F23 Chem 101 and the lower mean scores with the students who continued on as a related outcome, perhaps as a characteristic of the cohort or level of importance they placed on the optional assignment.

The data for students who retook Chem 101 tell a different story. In F23 Chem 101, students who would retake the course had substantially lower mean first attempt difficulty on both questions than their peers. This is not surprising given their retake status. However, those same students in S24 Chem 101 then outperform their peers on both question types. The difference for the FITB questions is dramatic: 28.74% in the fall compared to 86.72% in the spring. Those students clearly decided to make better use of the questions with more effort on their first attempts.

Table 3: Question Difficulty for Students Who Continued From Chem 101 to Chem 102

Question Type	Student Persisted	F23 Total Answered	F23 Mean	S24 Total Answered	S24 Mean
Matching	Persist	3960	62.95	2616	72.17
	N/A	1842	59.77	607	78.58
FITB	Persist	4088	42.37	4695	58.64
	N/A	1879	45.24	1068	64.33

Table 4: Question Difficulty for Students Who Retook Chem 101

Question Type	Student Persisted	F23 Total Answered	F23 Mean	S24 Total Answered	S24 Mean
Matching	Retake	528	50.00	297	85.16
	N/A	5274	63.14	18.12	83.66
FITB	Retake	581	28.74	1009	86.72
	N/A	5386	44.84	6656	78.19

One final metric useful for gaining insight into student perceptions of the questions is the thumbing rate. After answering a question, students have the option of providing a thumbs up or thumbs down on the question. This thumbing data is used by a platform-wide adaptive content improvement system that uses the thumbing data to determine if questions should be removed and replaced (Jerome et al., 2022). Using a dataset of over 3,594,408 answered questions, the overall thumbs down rate was 1.9% per thousand questions and the thumbs up rate was 3.3% per thousand questions. In these semesters (Table 5), the thumb up rates were much higher—between 48 and 57 per thousand. The thumbs down rate was between 1 and 6 per thousand. Instructors did point out the thumbing option but there were no expectations for student thumbing, so the high thumbs up rates indicate overall student satisfaction. It's also noteworthy that the highest thumbs up rate was in F23 Chem 101, which had the lowest mean difficulty on questions.

Table 5: Thumbing Rates per 1,000 Sessions by Course

Section	Thumbs Up	Thumbs Down
F23 101	56.59	5.86
S24 101	51.38	1.74
S24 102	48.64	2.56

Conclusion

This study provides strong evidence supporting the effectiveness of automatically generated questions as a scalable and viable solution for integrating formative practice into Open Educational Resource (OER) textbooks. Across multiple large-scale chemistry courses, AG questions performed comparably to prior research in key performance metrics such as difficulty and persistence. The positive student response as reflected in the high thumbs-up ratings for AG questions further validates their perceived value in the learning process. While the course policy of not assigning the questions depressed overall engagement, the spring 2024 Chemistry 101 course demonstrated significantly higher student engagement, with students answering more than twice the number of questions compared to the fall 2023 section, suggesting that course design and instructional context play a crucial role in shaping student behavior. The ability to analyze students who moved from Chem 101 to Chem 102 or retook Chem 101 gave a unique view into student behaviors and performance. Notably, students who needed to retake Chem 101 performed dramatically better on the formative practice, indicating a new motivation for taking advantage of learning tools.

The successful addition of AG questions within an OER textbook underscores the potential for AI-driven formative practice to enhance the student learning experience in addition to access and affordability in higher education. These findings align with broader research on OER efficacy, which has consistently shown comparable or improved student outcomes compared to traditional textbooks while reducing financial barriers.

As digital learning environments continue to evolve, integrating AI-generated formative practice within any content, including OER, presents new opportunities for improving student engagement and learning outcomes. Future research should explore how different instructional strategies impact student interaction with AG questions and how that supports diverse learner needs. The findings from this study contributes evidence demonstrating that AG questions are an effective solution for expanding high-quality formative practice within OER textbooks, as previously demonstrated with commercial publisher textbooks.

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The Use and Appropriateness of Connectives in Academic Writing

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Abstract
This study presents a qualitative and quantitative analysis of discourse cohesion, focusing on the use of connective devices in the academic writing of native Chinese speakers who speak English as a second language. The research investigates how discourse cohesion manifests in the range, frequency, and grammatical and syntactical appropriateness of various lexical connectors, or linkers, in relation to English proficiency. Cohesive devices serve as essential text organizers that enhance the logical structure and conceptual clarity of a written piece. The current analysis explores the use of connectives through a comparative study of fifty writing samples, aiming to determine whether there are differences in cohesive device usage among students with the same first language. Additionally, this study seeks to identify fundamental differences in the use of connectives between students with poor and strong writing skills. Previous research has indicated that L2 academic writers often overuse and misuse connectives, while also underutilizing those commonly employed in formal academic English necessary for developing arguments. The findings of this study reveal that Chinese students employ a diverse range of connectives in their writing and tend to use them appropriately. While no significant differences were observed between good and poor writing in terms of the total number of connectives, notable variances were found in the types of connectors used.

Keywords: Connectives, Academic Writing, Discourse Analysis

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Introduction

Halliday and Hasan (1976) emphasize that connectives play a crucial role in demonstrating cohesion within a text and are common features of academic writing. Their primary function is to link different parts of discourse, allowing writers to effectively construct ideas and express opinions. Therefore, the aim of this study is to examine this hypothesis by analyzing samples of academic writing produced by Chinese-speaking university students.

The research specifically seeks to examine:

a. whether there is a relationship between the variety and suitable application of connective devices and improved academic outcomes/performance.
b. the degree to which students utilize different types of cohesive features regarding their range and frequency.
c. the extent to which they use these features appropriately.

As cohesion is vital for enhancing argumentation, description, and explanation in academic writing, making the text more coherent and easier to understand, analyzing the effective use of conjunctive devices can provide insights into a writer's proficiency in English. Given that Chinese students are a significant group of international students in the UK and that previous research has examined their use of cohesive devices (Field & Yip, 1992; Meisuo, 2000), this study specifically focuses on the lack of studies on writing for examination purposes.

Research shows that non-native speakers often overuse and misuse connectors in academic writing, significantly exceeding native speakers' usage (Field & Yip, 1992; Granger & Tyson, 1996; Hinkel, 2001; Meisuo, 2000). This study hypothesizes that lower-quality writing will display connector overuse and misuse. Neuner (1987) found that poorer writing tends to have a higher incidence of connector issues compared to stronger writing, with advanced writing showing a better use of conjunctive devices than lower-rated work.

Cohesive devices in writing primarily appear as conjunctions, a key category of cohesion highlighted by Castro (2004). Correctly using these devices is essential for clear writing and coherent arguments, which can be challenging for students. In UK higher education, academic writing is vital for assessments, requiring clear and well structured essays. Therefore, evaluating how well students organize their thoughts is important, with cohesion playing a key role. Cohesion involves connecting meanings across sentences (Johnstone, 2008). Understanding academic writing requires analyzing how students select and use cohesive devices.

Literature Review

Widdowson (2007) points out that written texts possess distinct linguistic and structural patterns influenced by their purpose, including reasons for writing, content, and audience, which define their genre, such as university essays. Effective academic writing requires a logical flow of ideas, linking thoughts coherently (Halliday & Hasan, 1976). Coherence demands careful planning and strategic organization of words and sentences to create connections.

Academic writing serves multiple purposes, including persuasion, argumentation, and description, often signaled by connectives like “so” “therefore” and “because” (Hulkova, 2005). Organizational patterns, such as comparison and contrast, use terms like “like” and

"unlike" to clarify relationships between ideas and enhance comprehension. The formality of an essay is reflected in its sentence structure and vocabulary, which together shape the text's register regarding its level of formality and structure.

The effect of discourse devices on writing is significant because they provide grammatical tools for achieving cohesion in discourse. Halliday and Hasan (1976) emphasize that a strong grasp of linguistic ties is essential for creating cohesive and understandable texts. Yule (1996) further supports this, highlighting that structural connections between sentences contribute to cohesion. Examining cohesion reveals the text's organization and the relationships of meaning within it. Yule (1996) also notes that cohesion arises when the interpretation of one element depends on another. Cohesive devices include reference, ellipsis, substitution, and conjunctions, which can be classified as additive, adversative, causal, and temporal, with examples like "in addition", "so on", therefore", and "furthermore".

Halliday and Hasan (1976) emphasize that cohesion is a crucial element in text formation, alongside information and thematic structure. They argue that cohesion, rooted in semantics, relates to meaning relations within the text. When discourse elements connect, coherence occurs, creating cohesive ties that fulfill readers' predictions and enhance comprehension. Proper cohesion also minimizes redundancies; for example, in "John went to the cinema. He had a really good time," "he" substitutes "John" in the second sentence, avoiding unnecessary repetition.

Halliday and Hasan (1976) highlight the importance of coherent and cohesive discourse in effective writing. Coherence stems from interconnected sentences using text-forming devices, while cohesion illustrates how meanings connect. Analyzing cohesion in essays reveals how students structure their texts.

Halliday and Hasan (1976) introduced the theory of cohesion, categorizing cohesive devices into conjunction, reference, ellipsis, substitution, and lexical cohesion. Conjunctions, a key category, are further divided into sub-categories: - *Additive*: Indicates additional information (e.g., "moreover", "for example" "in addition"). - *Adversative*: Moderates or qualifies previous information (e.g., "however", "but", "nevertheless"). - *Causal*: Shows cause and consequence (e.g., "so", "consequently", "hence"). - *Temporal*: Relates events by timing of their occurrence (e.g., "first", "previously", "finally").

Conjunction, as defined by Halliday and Hasan (1989), highlights relationships that are clear only when referring to other parts of the text, making logical connections visible. It links sentences and ideas semantically, guiding the reader's expectations for what follows. For example, using "however" indicates that the next statement will present a contradiction, as in: "John went to the cinema. However, he did not have a really good time".

The role of conjunction in discourse is to represent logical relations and facilitate the analysis of texts. It connects textual meanings to the mode and context of discourse, such as academic writing (Stoddard, 1990). Conjunctive relations reflect the passage's purpose and different social purposes based on the mode or register type. Analyzing conjunctive relations is essential for understanding interpersonal meanings and the stages of argumentation. Connectives like "first" and "next" indicate argument sequence, while transition words highlight changes in the discussion. Successful arguments require logical reasoning and support, using conjunctions like "therefore" and "because" to establish connections (Hulkova, 2005).

When sentences are connected through additive, adversative, temporal, or causal relationships, these connections act as cohesive agents known as conjunctions or conjunctive adjuncts. Each type of connection has a corresponding preposition that can govern a reference item, forming a cohesive adjunct. According to Halliday and Hasan (1976), conjunctive adjuncts can be categorized into three kinds: “simple adverbs” (e.g., “but”, “then”, “so,” and “next”), “compound adverbs” ending in –ly (e.g., “accordingly”, “subsequently”), and other compound adverbs (e.g., “therefore”, “furthermore”, “nevertheless”, “besides”, “anyway”, and “finally”). Additionally, prepositional expressions like “as a result of that”, “instead of that”, and “in addition to that” serve as cohesive adjuncts as well.

Conjunctive adjuncts typically begin a sentence and encompass its entire meaning unless later renounced. While they usually set the context for the whole sentence, some may appear in the middle, linking to previous clauses. This interplay creates cohesion between sentences while also reinforcing the internal structure of individual sentences. Thus, conjunctions can limit the influence of prior conjunctions and enhance internal cohesion (Halliday & Hasan, 1976).

Halliday and Hasan (1989) found that conjunctive elements express meanings that depend on other components in discourse, linking what follows to what has been previously mentioned. When describing conjunctions as cohesive devices, the emphasis is on their function in relating successive linguistic elements rather than on the semantic relations in the language's grammar.

Few studies have explored the role of cohesive devices in essay writing, although cohesion is essential for quality writing. Research by Liu and Braine (2005) indicates that both native and non-native English speakers struggle with cohesive devices, with L2 students often relying on basic conjunctions like “but” and “so”. This reliance affects the quality of argumentative writing, particularly among Chinese undergraduates.

Neuner’s (1987) study on freshman essays identified that cohesive devices, including conjunctions and reference chains, were sometimes overused or misapplied. Higher-graded essays tended to use a broader range of conjunctive devices compared to their lower-graded counterparts.

Field and Yip (1992) found that Hong Kong secondary ESL students used more conjunctive devices and in initial paragraphs, while native speakers showed more varied placement. The most frequently used conjunctions among students were adversative, followed by additive and causal types with temporal types being less frequent.

The argumentative mode of essay writing often requires adversative connectives. The study found that students misapply phrases like “on the other hand” to introduce additional points instead of contrasts. Field and Yip (1992) noted that Chinese students typically used connectives such as “moreover”, “furthermore”, and “besides” at the beginning of essays, with “besides” frequently misused, reflecting differences between formal written English and L1 English speech. Inappropriate use of conjunctive devices affects both non-native and native speakers, likely due to insufficient instruction.

Granger and Tyson (1996) identified a tendency for L2 writers to overuse additive connectives and underuse contrastive ones, possibly due to native language transfer. Non-native speakers often struggle with crucial contrastive connectives like “however” and “therefore”, which limits their argumentative depth. Effective argumentation relies on the

proper use of these devices, while an over-reliance on additive connectives undermines meaningful discourse. Similarly, Ostler (1987) noted that cohesion in languages such as Arabic can affect L2 writing.

Meisuo's, (2000) study on Chinese EFL students' writing found that conjunctions were the second most common cohesive device used in essays, following lexical cohesion. The research aimed to assess the usage and appropriateness of cohesive devices. While conjunctions were prevalent, they were often overused and misused, particularly in the categories of additive and temporal conjunctions.

A study by Hinkel (2001) examined the essay writing of native English, Japanese, and Korean speakers. It found that non-native speakers (Japanese and Korean) used conjunctions and pronouns extensively, while native English speakers used them less frequently. This suggests that L2 speakers of English may overly rely on conjunctions in their academic writing, indicating a lack of effective skill in using these cohesive devices.

A study by Castro (2004) found that students commonly use conjunctives as cohesive devices in academic writing, helping to establish logical connections between ideas. However, L2 English speakers often struggle with effective argumentation, and excessive use of conjunctions can lead to illogical discourse and informality. Therefore, students should be taught to practice these connectives in context, understand their relationships, and recognize that swapping connectives within the same category can be misleading.

Altenberg and Tapper (1998) examined the use of adverbial connectives in argumentative essays written by advanced Swedish learners compared to British university students. They identified overuse and underuse of connectives by analyzing their frequency in Swedish essays against British ones. Swedish students overused connectives such as "for instance" and "furthermore", often placing them at the beginning of sentences, while British students used them less frequently and in varied positions. The study also found an underuse of contrastive connectives like "however" and "hence", suggesting that even advanced learners struggle with effective academic writing, as evidenced by their frequent use of the informal connective "so".

In conclusion, cohesion is a vital aspect of written discourse, enhancing the logical flow of the text. For non-native English speakers, the choice and use of cohesive devices often reflect first language interference and can lead to overuse, which may obscure poor writing. This overreliance on connectives can hinder achieving true cohesion since readers can mentally create logical links without them. Therefore, while linguistic devices are crucial for academic writing, teaching effective discourse cohesion strategies is essential, as L2 learners frequently struggle with their application, and correct usage would improve cohesion in EFL writing.

Methodology

The study aimed to analyze the use of connectives as cohesive devices in academic texts written by L2 English speakers from China. A discourse analysis was conducted using both qualitative and quantitative methods, guided by Halliday and Hasan's framework (1976). This approach emphasizes the role of connectives in creating logical connections between sentences. By combining both methods, the analysis identifies general trends and offers insights into the linguistic construction of the texts. Granger and Tyson (1996) highlight the importance of using both approaches for studying L2 English speakers, comparing frequency

and semantic and syntactic usage. The chosen methodology ensures a systematic analysis, enhancing the validity and reliability of the results.

Data Source

Writing samples were collected from L2 University English learners' examination texts, focusing on academic English skills. Using examination writing provides a realistic portrayal of students' language abilities, contrasting with previous studies that used uncontrolled samples, which may compromise validity. The research employed purposive sampling (Denscombe, 2007), selecting students with the same L1 and similar writing tasks. The participants were prospective students from China, all of similar age and attending the same university in China, minimizing additional variables.

The examination targeted students who did not achieve the required score on recognized English proficiency tests. Fifty examination scripts totaling 14,000 words were analyzed, focusing on a final task where students wrote approximately 250 words on an education-related topic. This task aimed to evaluate academic writing skills through argumentation, description, and explanation, making it suitable for the study's goals.

The task was scored out of 20, and overall student proficiency was likely low since the examination targets those not meeting university entry standards. The highest grade was 14, and the lowest was 5, with the following sample distribution: Grade 5: 1; Grade 6: 4; Grade 7: 2; Grade 8: 5; Grade 9: 1; Grade 10: 9; Grade 11: 19; Grade 12: 5; Grade 13: 1; Grade 14: 3.

For this study, texts were categorized based on grades: those below 10 were deemed poor, while those with a grade of 10 or above were considered good.

Procedure

The written data samples were analyzed using discourse analysis, focusing on specific linguistic features. Instances of connectives were identified and analyzed for frequency and range, both manually and with concordance software, following the framework established by Halliday and Hasan (1976).

The handwritten data from test papers was typed for concordance analysis. Each text was assigned a code, and personal data was stored separately to ensure ethical standards. The texts were initially examined for specific connectives, followed by software analysis to determine their frequency in the corpus, providing contextual examples for both quantitative and qualitative analysis (Baker, 2006).

The concordance analysis was conducted using Wordsmith Version 6, which created a corpus from individual samples. This enabled queries to display the total instances found in the entire corpus and in each individual script.

A concordance query was conducted for each connective, displaying its occurrences in the corpus along with five words before and after. This query revealed the total number of instances and the specific texts where each connective appeared. It also provided context, allowing for analysis of the position and appropriateness of each connective's usage.

The following is a demonstration of a concordance search performed for the connective “finally”:

to check. It is useful to our education.	**Finally** , computer technology can make teachers
progess that something chang by your hands.	**Finally** Internet have be used, if you want find
it is conducive to student to learning.	**Finally** , use computers to education will save time

The connective has been found three times in the writing corpus, with the concordance program displaying the context of each instance. It initially shows five words before and after the term but can expand to show more of the surrounding text. This feature helps to analyze the use of connectives and their relationship with grades. For example, examining the connective “finally” requires context to see if it correctly introduces the final idea in a paragraph or the entire text. Below is an expanded example of the concordance search:

> Finally Internet have be used if you want find some information by computer. Right, what I would to say is computer is a tool of surfer on Internet. There are many esays, report, which you have to write if you just find reference in libraries, it may spent you too much time Look, computers make your study life easier. Consequently, computer have many advantages are linked to student’s study life. Find the way which the computers make your study life easier. (S45)

The analysis examined the frequency of connectives at the start of sentences and their overall occurrences in samples. It calculated the total number of different connectives per sample and classified their use.

Both quantitative and qualitative approaches were used in the data analysis. The quantitative aspect measured frequency and range, while the qualitative component explored the context of each connective's use. This distinction was important, as some connectives may have additional semantic functions. For example, “overall” can function as an adjective in one context and does not connect ideas, and as an adverbial connective summarizing previous conclusions in another.

file731262	it is not to say that it can give people	**Overall**	view of advantages all the time. Instead
file731249	face a computer, It is hard for improve	**Overall** ,	we need computer for our study. It is

The qualitative approach to data analysis was used to determine the appropriate use of connectives based on their context. For instance, the analysis of the linker “finally” focused on whether it served a temporal function or introduced a concluding proposition.

Ethical Considerations

The research adhered to the ethical guidelines from the University Ethics Committee. Personal data of prospective students was typed and stored in a password-protected file to ensure confidentiality. Data was transcribed verbatim, including errors, to maintain accuracy.

Samples were coded for anonymity, and measures were taken to ensure authenticity by using samples produced under controlled conditions.

Analysis of Data

The study examined the frequency and appropriateness of connectives, "additives, adversatives, causal, and temporal", in Chinese students' writing tasks. The fourteen-thousand-word corpus was analyzed to classify the use of forty logical connectives based on Halliday and Hasan's (1976) framework. It focused on which connectives appeared in the writing samples and categorized them accordingly.

The study adapted Halliday and Hasan's categorization to fit its goals, expanding their list to include all relevant connectives in academic English writing. Instead of breaking connectives into smaller categories, a comprehensive table of potential connectives was created from the writing samples. This table would help compare the variety of connectives used and enhance understanding of their overall range in the students' writing.

List of Connectives

Additive	and and nor or or else furthermore in addition additionally incidentally by the way	that is I mean in other words for instance for example likewise similarly in the same way alternatively besides	as moreover what is more
Adversative	Yet though although only but only but however nevertheless nonetheless	despite this in fact actually as a matter of fact on the other hand at the same time instead rather in contrast at least	in any case anyhow at any rate
Causal	so hence therefore consequently because for this reason on account of this as a result for this purpose with this in mind	for thus it follows on this basis arising out of this to this end in that case in such an event that being so under the circumstances	in this respect in this regard with reference to this otherwise in other respects aside from this

Temporal	then	overall	at this moment
	next	first(ly)	up to now
	after	second(ly)	at this point
	at the same time	next	to sum up
	previously	at once	in short
	before	thereupon	briefly
	finally	soon	to resume
	at last	later	last but not least
	in conclusion	meanwhile	on …occasion
	all in all	until	to return to…

In Halliday and Hasan's categorization, connectives are divided into subcategories, with some appearing multiple times. For clarity, each connective is only listed once in this study. Certain connectives like "after that" and "before that" were simplified to "after" and "before". Outdated connectives, such as "hitherto," were removed. Additionally, connectives not found in Halliday and Hasan's list were included based on definitions from the literature review and categorized accordingly.

In the additive category, eleven out of twenty-three connectives were found in the corpus. In adversatives, eight were used, and in causals, seven out of twenty-five connectives were analyzed. Lastly, fourteen out of thirty temporal connectives were identified.

The study not only identifies the frequency and categories of connectives used but also analyzes patterns related to students' word counts, grades, and overall connective usage to differentiate between higher and lower graded work based on the variety of connectives employed.

Findings

The tables present a comparative analysis of the total and initial position of connectives in the corpus. Additive and temporal connectives were the most frequently used, with many appearing at the start of sentences.

Table 1: Total and Initial Positions of Additive Connectives in the Corpus

Additive	**Total**	**Initial position**
Additionally	2	2
In addition	10	10
For example	21	19
Furthermore	1	1
Moreover	3	3
Also	59	4
For instance	3	3
What is more	3	3
And	332	46
As	13	13
Besides	6	6

Table 2: Total and Initial Positions of Adversative Connectives in the Corpus

Adversative	**Total**	**Initial position**
However	23	21
Nevertheless	1	
Though	3	1
Nonetheless	1	
Although	7	5
On the other hand	10	10
In contrast	1	1
Instead	4	2

Table 3: Total and Initial Positions of Causal Connectives in the Corpus

Causal	**Total**	**Initial position**
So	47	24
Hence	1	1
Thus	2	2
Because	19	10
Therefore	3	3
Consequently	3	2
As a result	1	1

Table 4: Total and Initial Positions of Temporal Connectives in the Corpus

Temporal	**Total**	**Initial position**
First(ly) , At first	12	12
Secondly	7	7
Then	25	11
Next	5	1
After	11	3
Before	27	4
Finally	3	4
In conclusion	5	5
To sum up	5	5
Last but not least	1	1
All in all	3	3
Overall	5	3

The second part of the findings analyzes each student's grade, word count, and the four categories of connectives used, as shown in Table 5.

Table 5: Frequency of Connectives Used by Each Student

Student	Grade	Words	Additive	Adversative	Causal	Temporal	Total
S 1	11	284	4	3	2		9
S 2	12	322	1	3			4
S 3	11	255	4			2	6
S 4	12	329	4			1	5
S 5	12	274	5	1	4	3	13
S 6	11	251		1			1
S 7	11	283	4		1	1	6
S 8	11	284	1	1		1	3
S 9	11	253		1			1
S 10	11	270	1		1	1	3
S 11	11	220			3		3
S 12	12	272	6	1		2	9
S 13	13	213	2	1			3
S 14	14	240	5	1		1	7
S 15	14	301			2	1	3
S 16	14	261	3	1	1	4	9
S 17	12	300	3	2			5
S 18	11	291	1	1			2
S 19	11	219	1	1	1	5	8
S 20	11	297		2			2
S 21	9	331	4	1			5
S 22	8	189					
S 23	8	248	3			1	4
S 24	8	280	7		1	1	9
S 25	8	306	1		1	4	6
S 26	8	245	2	2	1	2	7
S 27	7	238			1	1	2
S 28	7	293	5	2	2		9
S 29	6	166	2	1	1		4
S 30	6	312	3	1	1		5
S 31	10	320	2	1	3	1	7
S 32	10	232	2				2
S 33	10	228	1	1	1	3	6
S 34	10	298	4	3	1	3	11
S 35	10	291	2	2		2	6
S 36	10	202	6	1	1	1	9
S 37	10	180	2	1	1	1	5
S 38	10	253	3	1	1		5
S 39	10	274	3	3	1	3	10
S40	11	380	2	1	2	3	8
S 41	11	237	5	1		2	8
S 42	11	220	2	1			3
S 43	11	333		1			1
S 44	11	229	1		1	1	3
S 45	11	205	2				2
S 46	11	232	2	1	3		6
S 47	11	254	3	2			5
S 48	6	187		2	1	2	5
S 49	6	324	1	1	1	2	5
S 50	5	205					

The third part of the findings provides a comparison of the two performance groups in their use of connectives.

Table 6: Group of Students Achieving a Score Below 10

Grade	Total students	Total connectives	additive	adversative	causal	temporal
5	1	0				
6	4	16	6	2	4	4
7	2	10	5	2	2	1
8	5	26	13	2	3	8
9	1	5	4	1		
10	9	54	22	11	9	12
Total	22	111	50	18	18	25

Table 7: Group of Students Achieving a Score Above 10

Grade	Total students	Total connectives	additive	adversative	causal	temporal
11	19	82	34	15	14	19
12	5	36	19	7	4	6
13	1	3	2	1		
14	4	19	8	2	3	6
Total	29	140	63	25	21	31

Table 8 shows the total number of connectives students used in their writing, listed from highest to lowest totals. It also includes their grades and the different types of connectives.

Table 8: Highest to Lowest Frequency per Student

Student	Grade	Words	Additive	Adversative	Causal	Temporal	Total : 0
S 5	12	274	5	1	4	3	13
S 34	10	298	4	3	1	3	11
S 39	10	274	3	3	1	3	10
S 16	14	261	3	1	1	4	9
S 12	12	272	6	1		2	9
S 1	11	284	4	3	2		9
S 36	10	202	6	1	1	1	9
S 24	8	280	7		1	1	9
S 28	7	293	5	2	2		9
S 19	11	219	1	1	1	5	8
S40	11	380	2	1	2	3	8
S 41	11	237	5	1		2	8
S 14	14	240	5	1		1	7
S 31	10	320	2	1	3	1	7
S 26	8	245	2	2	1	2	7
S 3	11	255	4			2	6
S 7	11	283	4		1	1	6
S 46	11	232	2	1	3		6
S 33	10	228	1	1	1	3	6
S 35	10	291	2	2		2	6
S 25	8	306	1		1	4	6
S 4	12	329	4			1	5
S 17	12	300	3	2			5
S 47	11	254	3	2			5
S 37	10	180	2	1	1	1	5
S 38	10	253	3	1	1		5
S 21	9	331	4	1			5
S 30	6	312	3	1	1		5

S 48	6	187		2	1	2	5
S 49	6	324	1	1	1	2	5
S 2	12	322	1	3			4
S 23	8	248	3			1	4
S 29	6	166	2	1	1		4
S 15	14	301			2	1	3
S 13	13	213	2	1			3
S 8	11	284	1	1		1	3
S 10	11	270	1		1	1	3
S 11	11	220			3		3
S 42	11	220	2	1			3
S 44	11	229	1		1	1	3
S 18	11	291	1	1			2
S 20	11	297		2			2
S 45	11	205	2				2
S 32	10	232	2				2
S 27	7	238			1	1	2
S 6	11	251		1			1
S 9	11	253		1			1
S 43	11	333		1			1
S 22	8	189					
S 50	5	205					

In this table the findings from the previous table are organized by grade, from highest to lowest, to highlight the total number of connectives used in each writing sample.

Table 9: Highest to Lowest Grades

Student	**Grade**	**Words**	**Additive**	**Adversative**	**Causal**	**Temporal**	**Total : 0**
S 16	14	261	3	1	1	4	9
S 14	14	240	5	1		1	7
S 15	14	301			2	1	3
S 13	13	213	2	1			3
S 5	12	274	5	1	4	3	13
S 12	12	272	6	1		2	9
S 4	12	329	4			1	5
S 17	12	300	3	2			5
S 2	12	322	1	3			4
S 1	11	284	4	3	2		9
S 19	11	219	1	1	1	5	8
S40	11	380	2	1	2	3	8
S 41	11	237	5	1		2	8
S 3	11	255	4			2	6
S 7	11	283	4		1	1	6
S 46	11	232	2	1	3		6
S 47	11	254	3	2			5
S 8	11	284	1	1		1	3
S 10	11	270	1		1	1	3
S 11	11	220			3		3
S 42	11	220	2	1			3
S 44	11	229	1		1	1	3
S 18	11	291	1	1			2
S 20	11	297		2			2
S 45	11	205	2				2
S 6	11	251		1			1
S 9	11	253		1			1
S 43	11	333		1			1
S 34	10	298	4	3	1	3	11
S 39	10	274	3	3	1	3	10
S 36	10	202	6	1	1	1	9
S 31	10	320	2	1	3	1	7

S 33	10	228	1	1	1	3	6
S 35	10	291	2	2		2	6
S 37	10	180	2	1	1	1	5
S 38	10	253	3	1	1		5
S 32	10	232	2				2
S 21	9	331	4	1			5
S 24	8	280	7		1	1	9
S 26	8	245	2	2	1	2	7
S 25	8	306	1		1	4	6
S 23	8	248	3			1	4
S 22	8	189					
S 28	7	293	5	2	2		9
S 27	7	238			1	1	2
S 30	6	312	3	1	1		5
S 48	6	187		2	1	2	5
S 49	6	324	1	1	1	2	5
S 29	6	166	2	1	1		4
S 50	5	205					

The table below shows use of connectives from highest to lowest word counts.

Table 10: Highest to Lowest Word Count

Student	**Grade**	**Words**	**Additive**	**Adversative**	**Causal**	**Temporal**	**Total : 0**
S40	11	380	2	1	2	3	8
S 43	11	333		1			1
S 21	9	331	4	1			5
S 4	12	329	4			1	5
S 49	6	324	1	1	1	2	5
S 2	12	322	1	3			4
S 31	10	320	2	1	3	1	7
S 30	6	312	3	1	1		5
S 25	8	306	1		1	4	6
S 15	14	301			2	1	3
S 17	12	300	3	2			5
S 34	10	298	4	3	1	3	11
S 20	11	297		2			2
S 28	7	293	5	2	2		9
S 18	11	291	1	1			2
S 35	10	291	2	2		2	6
S 1	11	284	4	3	2		9
S 8	11	284	1	1		1	3
S 7	11	283	4		1	1	6
S 24	8	280	7		1	1	9
S 5	12	274	5	1	4	3	13
S 39	10	274	3	3	1	3	10
S 12	12	272	6	1		2	9
S 10	11	270	1		1	1	3
S 16	14	261	3	1	1	4	9
S 3	11	255	4			2	6
S 47	11	254	3	2			5
S 9	11	253		1			1
S 38	10	253	3	1	1		5
S 6	11	251		1			1
S 23	8	248	3			1	4
S 26	8	245	2	2	1	2	7
S 14	14	240	5	1		1	7
S 27	7	238			1	1	2
S 41	11	237	5	1		2	8
S 32	10	232	2				2
S 46	11	232	2	1	3		6

S 44	11	229	1		1	1	3
S 33	10	228	1	1	1	3	6
S 11	11	220			3		3
S 42	11	220	2	1			3
S 19	11	219	1	1	1	5	8
S 13	13	213	2	1			3
S 45	11	205	2				2
S 50	5	205					
S 36	10	202	6	1	1	1	9
S 22	8	189					
S 48	6	187		2	1	2	5
S 37	10	180	2	1	1	1	5
S 29	6	166	2	1	1		4

Table 11 displays ten uncommon connectives that each appeared fewer than ten times in the corpus, along with their occurrences per grade level.

Table 11: Least Used Connectives

GRADE	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
although		1					3	2		
besides				1		1	1	1	1	1
consequently				2						
for instance				1				1		1
hence										1
instead						1	1			
last but not least						1				
moreover								1		1
Nevertheless									1	
though										1

Table 12 displays ten of the most common connectives identified in the corpus, with each connective occurring more than ten times. It outlines the total number of instances found for each connective across different grades.

Table 12: Most Used Connectives

GRADE	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
and				5	3	11	20	5		2
as			2			3	3	3	1	1
because		1				5	8			1
first/firstly/at first		1		1		1	4			2
for example		6		4		3	1	4		1
however		2	1	1	1	9	5	2		
in addition			1	1		1	5	1		
on the other hand			1				7			2
so		2		1		4	7	1		1
then		2		1		2	4	2		

Each student's grade, the number of words they wrote, and the connectives they used are presented in Appendix.

Discussion

The findings analyze students' use of connectives in their academic writing, highlighting preferences and their impact on performance. While students used various connectives, some choices could hinder effective writing. A comparison with the Methodology section reveals limited connective usage, likely due to the students' overall low proficiency, as noted in prior research (Neuner, 1987). The focus on initial-position connectives may contribute to their appropriate use, as students avoided connectives in other positions, possibly due to a lack of exposure or reluctance to use unfamiliar ones.

Most students utilized a variety of connectives appropriately, with a predominant placement at the beginning of sentences, consistent with Field and Yip's (1992) findings. For example, the connective "besides" appeared six times at the start of sentences. This pattern supports the assertion that "besides," "moreover," and "furthermore" are often used initially in essays by Chinese students. Below is an example from the concordance search showing that all six instances of "besides" were in initial position.

file731265	convenient. You don't need spend much time.	**Besides**	this, you can get more information on computers
file731260	identify the theories we read on textbook.	**Besides**	teachers came from different schools can
file731232	but also makes them memorise more deeply.	**Besides**	, some homework can be finished by computers
file731231	the same time do some practice use online.	**Besides**	, my school provided 'Internet class' student
file731222	computer and make us understand easier.	**Besides**	, our chemistry teacher always find some
file731246	foreigner like you live in other countries.	**Beside**	of this, there also many software by used

Some students underestimated the importance of connectives, leading to sentences that would have been clearer if they had begun with a connective. Below is an example from a writing sample that illustrates this issue:

> People know all about computers have game, for example Computer game; on-line game. Some time student cannot up the game from the computer, they will be miss the class… (S50)

The example illustrates that the two sentences could be linked with a connective to enhance the argument. The second sentence introduces a contradiction, and using an adversative connective like "however" would improve cohesion and flow: "People know all about computers have game, for example Computer game; on-line game. Some time student cannot up the game from the computer, they will be miss the class". Using "however" creates a clear connection between the sentences and demonstrates a progression of thought. While readers might make connections without a connective, using one can clarify the writer's intent, which is essential in academic writing. The observation that some students avoid connectives suggests a desire to prevent mistakes, contributing to their limited use overall. While most do use them correctly, their texts often lack sufficient connectives. Analysis shows an average of five connectives per student in texts averaging 250 words, indicating a low frequency

compared to the total corpus word count of 14,000. This highlights the need for a better understanding and application of connectives to strengthen writing skills.

This study found that not all students used connectives in their writing. Two students (student 22 and student 50, Appendix 1) did not use any connectives, and two others (student 6 and student 43) used only one. Notably, the writing sample without connectives received the lowest grade (5), while the one with minimal connectives received a grade of 8. These results support earlier research by Neuner (1987) indicating that students with poor writing tend to use fewer connectives. The study revealed that additive connectives were the most frequently used, followed by temporal and causal connectives, while adversative connectives were used less often. This contradicts Field and Yip (1992), who found that adversatives were the most common. One explanation could be that their study included also native speakers, impacting the frequency of adversatives. These findings suggest that students may struggle with argumentative writing, which requires more adversative connectives. This difficulty may be linked to their overall low proficiency, as they were prospective university students without formal English qualifications.

The most common additive connectives in the writing samples were “in addition” (10 times), “for example” (19 times), and “as” (13 times). However, “and” was the most frequently used connective, appearing 46 times. This suggests that students, especially those with weaker writing skills, often begin sentences with “and,” contributing to an informal tone that is inappropriate for academic writing. Students should avoid informal connectives like “and” and “so,” particularly at the start of sentences, and instead use formal alternatives such as “in addition,” “moreover,” and “furthermore.” This reliance on familiar informality, noted by Altenberg and Tapper (1998), may stem from their comfort with these connectives in casual speech (Field & Yip, 1992) or insufficient instruction on academic writing conventions.

In terms of adversative connectives, “however” (21 instances) and “on the other hand” (10 instances) were more common among higher-quality writing samples, suggesting better competency in argumentation. Interestingly, many low-graded students (ten or below) also used these connectives effectively, indicating that grades may not always reflect connective usage (Neuner, 1987). However, certain patterns do relate connective use to grades (as shown in Table 9). While both high- and low-performing students used “however” and “on the other hand,” the overall limited use of adversatives indicates a lack of skills to advance arguments effectively, leading students to focus more on adding information (Granger & Tyson, 1996). This trend is underscored by the heavy reliance on additive connectives in the study.

In the realm of causal connectives, the most commonly used terms are “so,” appearing twenty times, and “because,” used ten times. This prevalence suggests that students may lack the skills necessary for proficient academic writing, favoring these informal connectives over more formal options like “hence” or “therefore” (Altenberg & Tapper, 1998). For temporal connectives, “first,” “firstly,” and “at first” occur ten times, while “then” appears eleven times. However, the connective “finally” is used only four times, indicating that students often do not fully complete the sequences of ideas they begin. Of the thirty-seven temporal connectives used to introduce or continue ideas, only twenty-one were found to conclude them. Interestingly, two out of four students used “finally” to end their essays rather than previous points. For instance, in the methodology section (pg. 17), “finally” introduces a new paragraph with additional information, which disrupts text cohesion and may confuse readers about the argument's conclusion. This highlights a potential misunderstanding of how to effectively use “finally” and structure their arguments. Additionally, since the writing was

done under exam conditions, time constraints may have contributed to the lack of cohesion, with students possibly altering their content to meet word limits without considering the overall flow.

Table 6 shows that students who achieved grades 5 and 6 used a total of 16 connectives, while those with grade 8 used 26 connectives, and grade 12 students used 36 connectives. This suggests that higher-graded writing generally features a greater frequency of connectives. However, students with grades 13 and 14 used only 22 connectives, fewer than those in grades 8 and 12, and displayed less use of adversative connectives. Interestingly, the writing from grades 13 and 14 included a wider variety of connectives, with two grade 14 students utilizing all four categories, indicating a strong awareness of different connectives in academic writing. Despite the observed patterns, the writing samples from grade 14 did not show a higher frequency of connectives than expected. This could be due to inconsistent marking or other factors influencing the evaluation. Table 8 highlights that the highest frequencies of connectives were found in writing samples graded 10 or above, supporting the idea of a general trend towards more connectives in higher-graded writing. Table 10 displays the frequency of connectives alongside word counts. It was found that lower word count samples tended to contain fewer connectives; for example, the samples with 187, 180, and 166 words had 5, 5, and 4 connectives, respectively. However, the most frequent use of connectives occurred in samples with average word counts between 270 and 300 words.

There is no clear relationship between grade level and word count, as samples with the highest word counts did not consistently achieve the highest grades. For example, the ten highest word counts spanned grades 6 to 12, indicating that both good and poor writing can feature high word counts. This suggests that, despite the quantity of words used, the quality of language may not be high, possibly due to excessive vocabulary repetition and a low use of connectives. The analysis revealed that some connectives were used frequently, while others appeared infrequently. Ten less common connectives, each occurring fewer than ten times, were analyzed alongside ten more common ones, each appearing more than ten times. Most instances were found in samples graded above 10, with only five instances scattered across grades 5 to 9. Notably, grades 11, 12, and 14 showed a greater frequency and variety of less common connectives. This indicates that higher-graded students tend to use more formal connectives, which are expected in academic writing. There are exceptions, such as grade 8 scripts containing more connectives than grades 10 and 13. The lack of multiple grade 13 samples may have affected the consistency of results. Overall, while higher grades correlate with better use of less common connectives, even advanced writers tend to use them infrequently, highlighting that proficiency in formal writing varies among students.

After analyzing the least common connectives in the corpus, we examined ten more frequently used connectives for differences in usage. The findings in Table 12 show that more common connectives were predominantly used in writing samples from grades 5 to 9, reflecting informal speech patterns. Conversely, grades 10 and 11 displayed the highest use of these connectives, likely due to the larger number of samples from those grades. Furthermore, the commonly used connectives identified in this study are consistent with those found by Liu and Braine (2005). Overall, Tables 11 and 12 reveal that less common connectives are associated with higher-grade samples, while both common and well-known connectives appear in both good and poor writing.

Teaching Implications

The findings of this study highlight important opportunities for improving English as a Foreign Language (EFL) teaching, particularly in English for Academic Purposes (EAP). Many L2 students would benefit from targeted instruction on using connectives effectively in academic writing. Students often rely on informal connectives, while higher-quality writing samples feature more formal ones. This underscores the need for teaching specific connectives, which are essential for achieving proficiency. Providing direct instruction on connectives, along with clarifying the differences between academic writing in their native language versus English, can foster better understanding. By emphasizing the functions of connectives and their role in coherence and argumentation, educators can empower students to enhance their writing skills.

Limitations and Implications of the Study

While this study provides specific marking criteria for grading writing tasks, it's unclear if all samples were graded by the same examiner, which raises concerns about consistency and reliability. Some tasks may receive low grades despite effective use of connectives due to issues in other language skills, while others may be penalized for not fully meeting task requirements. A more standardized grading system could offer better insights into the relationship between connectives and writing quality.

Additionally, the study has an unequal distribution of writing samples across grades, with fewer samples for grades 10 and below, which may affect findings. The focus on students without prior English qualifications suggests generally low proficiency, potentially explaining the absence of higher-grade samples among L1 speakers. Analyzing a more balanced set of samples could reveal different outcomes.

The study examines connectives in the academic writing of a specific group of L2 English speakers, and results may not apply to other L1 groups. Exam conditions could also impact language use, leading to errors that do not reflect true abilities. Lastly, the framework used for categorizing connectives may limit findings, as different frameworks might uncover different patterns. These factors should be considered when interpreting the conclusions of the study.

Considerations for Further Study

This study assumes that the writing samples come from students with similar educational backgrounds, as they are all prospective university students of the same age. However, analyzing samples from students at various educational levels with the same first language (L1) could yield valuable insights into their use of connectives. For example, comparing pre-undergraduate, undergraduate, and postgraduate writing might reveal differences in the range and frequency of connectives. This approach could highlight how age, education level, and L1 influence English academic writing. If pre-undergraduate and postgraduate students use certain connectives similarly, it may suggest that preferences are more influenced by L1 than by educational level or language proficiency.

Conclusion

The aim of this study was to investigate the use of connectives in the academic writing of Chinese students learning English as a second language (L2). It focused on the range, frequency, and appropriateness of connectives used in their writing samples. The findings showed a variety of connectives, with additive connectives being the most frequently used, followed by temporal and causal connectives. This contrasts with previous studies that identified adversative connectives as the most common. The results align with research indicating that students with lower English proficiency often struggle with forming arguments, tending to add information rather than develop their ideas. Analysis revealed differences between higher-graded and lower-graded writing samples. Higher-graded samples featured a broader range of connectives, while lower-graded samples included more informal connectives typical in everyday speech. Generally, students used connectives appropriately in context, though there were a few instances of incorrect usage. These findings suggest implications for EFL teaching, particularly in academic contexts. Ineffective instruction may have contributed to students' challenges with connectives and cohesion. This highlights the need for improved teaching methods to help students develop their argumentation skills and understand the distinction between formal and informal connectives. Thus, further development in this area of EFL teaching is recommended.

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Appendix

Student 1		**Grade :11**		**Words: 284**		**Total : 9**	
Additive		Adversative		Causal		Temporal	
Additionally	2	However	1	Thus	1		
Also	1	On the other hand	1	Because	1		
As	1	So	1				
Total	4		3		2		0
Student 2		**Grade :12**		**Words: 322**		**Total : 4**	
Additive		Adversative		Causal		Temporal	
And	1	However	1				
		Therefore	1				
		So	1				
Total	1		3		0		0
Student 3		**Grade :11**		**Words: 255**		**Total : 6**	
Additive		Adversative		Causal		Temporal	
In addition	1					To sum up	1
And	3					After	1
Total	4		0		0		2
Student 4		**Grade :12**		**Words: 329**		**Total : 5**	
Additive		Adversative		Causal		Temporal	
Besides	1					In conclusion	1
And	3						
Total	4		0		0		1
Student 5		**Grade :12**		**Words: 274**		**Total : 13**	
Additive		Adversative		Causal		Temporal	
For example	2	Although	1	So	4	To sum up	1
As	1					Then	2
And	1						
Furthermore							
Total	5		1		4		3
Student 6		**Grade :11**		**Words: 251**		**Total : 1**	
Additive		Adversative		Causal		Temporal	
		However	1				
Total	0		1		0		0
Student 7		**Grade :11**		**Words: 283**		**Total : 6**	
Additive		Adversative		Causal		Temporal	
And	4			So	1	At first	1
Total	4		0		1		1
Student 8		**Grade :11**		**Words: 284**		**Total : 3**	
Additive		Adversative		Causal		Temporal	
And	1	Although	1			In conclusion	1
Total	1		1		0		1
Student 9		**Grade :11**		**Words: 253**		**Total : 3**	
Additive		Adversative		Causal		Temporal	
		On the other hand	1			Firstly	1
						Secondly	1
Total	0		1		0		2
Student 10		**Grade :11**		**Words: 270**		**Total : 3**	
Additive		Adversative		Causal		Temporal	
Overall	1			So	1	Before	1
Total	1		0		1		1

Student 11		**Grade :11**		**Words: 220**		**Total : 3**	
Additive		Adversative		Causal		Temporal	
				So	3		
Total	0		0		3		0
Student 12		**Grade :12**		**Words: 272**		**Total : 9**	
Additive		Adversative		Causal		Temporal	
In addition	1	In contrast	1			All in all	1
Moreover	1					In conclusion	1
For example	1						
For instance	1						
As	2		1		0		2
Student 13		**Grade :13**		**Words: 213**		**Total : 3**	
Additive		Adversative		Causal		Temporal	
Besides	1	Nevertheless	1				
As	1						
Total	2		1		0		0
Student 14		**Grade :14**		**Words: 240**		**Total : 7**	
Additive		Adversative		Causal		Temporal	
Moreover	1	On the other hand	1			In conclusion	1
For example	1						
For instance	1						
Besides	1						
As	1		1		0		1
Student 15		**Grade :14**		**Words: 301**		**Total : 3**	
Additive		Adversative		Causal		Temporal	
				So	1	At first	1
				Because	1		
Total	0				2		1
Student 16		**Grade :14**		**Words: 261**		**Total : 9**	
Additive		Adversative		Causal		Temporal	
What is more	1	On the other hand	1	Hence	1	Firstly	1
And	2					Secondly	1
						Finally	1
						All in all	1
Total	3		1		1		4
Student 17		**Grade :12**		**Words: 300**		**Total : 5**	
Additive		Adversative		Causal		Temporal	
In addition	1	however	1				
For example	1	Although	1				
What is more	1						
Total	3		2		0		0
Student 18		**Grade :11**		**Words: 291**		**Total : 2**	
Additive		Adversative		Causal		Temporal	
In addition	1	However	1				
Total	1		1		0		0
Student 19		**Grade :11**		**Words: 219**		**Total : 8**	
Additive		Adversative		Causal		Temporal	
In addition	1	however	1			Firstly	1
		On the other hand	1			Secondly	1
						After	1
						Then	1
Total	1		2		0	Before	1
Student 20		**Grade :11**		**Words: 297**		**Total : 2**	
Additive		Adversative		Causal		Temporal	
		On the other hand	2				
Total	0		2		0		0

Student 21		**Grade :9**		**Words: 331**		**Total : 5**	
Additive		Adversative		Causal		Temporal	
Also	1	However	1				
And	3						
Total	4		1		0		0
Student 22		**Grade :8**		**Words: 189**		**Total : 0**	
Additive		Adversative		Causal		Temporal	
			0				
Total	0		0		0		0
Student 23		**Grade :8**		**Words: 248**		**Total : 4**	
Additive		Adversative		Causal		Temporal	
In addition	1		0			Before	1
For instance	1						
What is more	1						
Total	3		0		0		1
Student 24		**Grade :8**		**Words: 280**		**Total : 9**	
Additive		Adversative		Causal		Temporal	
For example	3		0	consequently	1	All in all	1
And	4						
Total	7		0		1		1
Student 25		**Grade :8**		**Words: 306**		**Total : 6**	
Additive		Adversative		Causal		Temporal	
Besides	1			consequently	1	First	1
						Firstly	1
						Secondly	1
						Finally	1
Total	1		0		1		4
Student 26		**Grade :8**		**Words: 245**		**Total : 7**	
Additive		Adversative		Causal		Temporal	
For example	1	however	1	So	1	Then	1
And	1	Though	1			Before	1
Total	2		2		1		2
Student 27		**Grade :7**		**Words: 238**		**Total : 2**	
Additive		Adversative		Causal		Temporal	
			0	Therefore	1	Overall	1
Total	0		0		1		1
Student 28		**Grade :7**		**Words: 293**		**Total : 8**	
Additive		Adversative		Causal		Temporal	
Overall	1	however	1	Therefore	1		
In addition	2	On the other hand	1				
As	2						
Total	5		2		1		0
Student 29		**Grade :6**		**Words: 166**		**Total : 4**	
Additive		Adversative		Causal		Temporal	
For example	2	however	1	So	1		
Total	2		1		1		0
Student 30		**Grade :6**		**Words: 312**		**Total : 4**	
Additive		Adversative		Causal		Temporal	
For example	3			Because	1		
Total	3		0		1		0

Student 31		**Grade :10**		**Words: 320**		**Total : 6**	
Additive		Adversative		Causal		Temporal	
Moreover	1			Because	3	After	1
And	1						
Total	2		0		3		1
Student 32		**Grade : 10**		**Words: 232**		**Total : 2**	
Additive		Adversative		Causal		Temporal	
Also	2						
Total	2		0		0		0
Student 33		**Grade : 10**		**Words: 228**		**Total : 5**	
Additive		Adversative		Causal		Temporal	
And	1			Thus	1	First	1
						Secondly	1
						To sum up	1
Total	1		0		1		3
Student 34		**Grade : 10**		**Words: 298**		**Total : 11**	
Additive		Adversative		Causal		Temporal	
For example	1	however	2	Because	1	In conclusion	1
As	1	So	1			Then	2
And	2						
Total	4		3		1		3
Student 35		**Grade : 10**		**Words: 291**		**Total : 6**	
Additive		Adversative		Causal		Temporal	
And	2	However	2			To sum up	1
						Next	1
Total	2		2		0		2
Student 36		**Grade : 10**		**Words: 202**		**Total : 9**	
Additive		Adversative		Causal		Temporal	
In addition	1	However	1	So	1	After	1
For example	1						
And	4						
Total	6		1		1		1
Student 37		**Grade : 10**		**Words: 180**		**Total : 5**	
Additive		Adversative		Causal		Temporal	
Besides	1	However	1	So	1	Finally	1
And	1						
Total	2		1		1		1
Student 38		**Grade : 10**		**Words: 253**		**Total : 4**	
Additive		Adversative		Causal		Temporal	
As	2	However	1	Because	1		
Total	2		1		1		0
Student 39		**Grade : 10,5**		**Words: 274**		**Total : 6**	
Additive		Adversative		Causal		Temporal	
For example	1	However	2	So	1	Last but not le	1
		Instead	1				
Total	1		3		1		1
Student 40		**Grade :11**		**Words: 380**		**Total : 8**	
Additive		Adversative		Causal		Temporal	
And	2	Although	1	Because	1	Then	3
				So	1		
Total	2		1		2		3

Student 41		**Grade :11**		**Words: 237**		**Total : 9**	
Additive		Adversative		Causal		Temporal	
And	5	Although	1			First	1
						Secondly	1
						Finally	1
Total	5		1		0		3
Student 42		**Grade :11**		**Words: 220**		**Total : 3**	
Additive		Adversative		Causal		Temporal	
Besides	1	On the other hand	1				
And	1						
Total	2		1		0		0
Student 43		**Grade :11**		**Words: 333**		**Total : 1**	
Additive		Adversative		Causal		Temporal	
		On the other hand	1				
Total	0		1		0		0
Student 44		**Grade :11**		**Words: 229**		**Total : 3**	
Additive		Adversative		Causal		Temporal	
As	1			So	1	To sum up	1
Total	1		0		1		1
Student 45		**Grade :11**		**Words: 205**		**Total : 2**	
Additive		Adversative		Causal		Temporal	
In addition	1						
As	1						
Total	2		0		0		0
Student 46		**Grade :11**		**Words: 232**		**Total : 5**	
Additive		Adversative		Causal		Temporal	
And	2			So	2		
				Because	1		
Total	2				3		0
Student 47		**Grade :11**		**Words: 254**		**Total : 5**	
Additive		Adversative		Causal		Temporal	
For example	1	However	1				
And	2	Instead	1				
Total	3		2		0		0
Student 48		**Grade :6**		**Words: 187**		**Total : 4**	
Additive		Adversative		Causal		Temporal	
		However	1	Although	1	Then	2
Total	0		1		1		2
Student 49		**Grade :6**		**Words: 324**		**Total : 4**	
Additive		Adversative		Causal		Temporal	
For example	1			So	1	Firstly	1
						Secondly	1
Total	1		0		1		2
Student 50		**Grade :5**		**Words: 205**		**Total : 0**	
Additive		Adversative		Causal		Temporal	
Total	0		0		0		0

Challenges in Learning English Phrasal Verbs: An Investigation of Receptive and Productive Knowledge Among Japanese University Students

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Abstract
There has been a growing interest in the use and learning of multi-word items in L2 due to the recognition that the appropriate use of formulaic language contributes to naturalness and fluency in the language (Siyanova & Schmitt, 2007; Wray, 2002). Phrasal verbs (PVs) are one type of formulaic language that has received increasing attention in educational settings (Garnier & Schmitt, 2016; Schmitt & Redwood, 2011; Strong & Leeming, 2024). Despite their widespread use in everyday language, their polysemous meanings and syntactic complexity seem to pose persistent difficulties for L2 learners, which can persist even at advanced levels of proficiency. The present study investigated the knowledge of English PVs among thirty Japanese university students. Using a recognition and recall test of forty PVs with 100 polysemous meanings taken from the PHaVE List (Garnier & Schmitt, 2015), learners' receptive and productive knowledge of English PVs was measured. Additionally, the study examined how the learners' vocabulary knowledge and overall English proficiency affected their acquisition of PVs. The results indicated that learners scored higher on the receptive knowledge test than on the productive knowledge assessments, suggesting that their knowledge of PVs develops from recognition to productive use over time. Reporting on the impact of vocabulary knowledge and overall L2 proficiency, the study suggested that mastering PVs is a challenging task for L2 learners, requiring significant time and practice. However, beyond teaching and learning PVs per se, vocabulary expansion is a crucial element of instructional strategies designed to enhance L2 learners' mastery of PVs.

Keywords: Phrasal Verbs, Receptive Knowledge, Productive Knowledge

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Introduction

Corpus studies involving large linguistic datasets have shown that formulaic language constitutes a significant portion of both spoken and written language among native speakers (Erman & Warren, 2000). In recent years, considerable attention has been devoted to its role in facilitating natural, fluent, and efficient language use and processing (Schmitt, 2010; Wood, 2010). In the field of second language (L2) learning, research on the processing and use of formulaic language—encompassing collocations, idioms, and phrasal verbs (PVs)—has gained prominence (Siyanova-Chanturia & Pellicer-Sánchez, 2019). It is now widely acknowledged that mastering formulaic language is essential for achieving proficient language use (Sinclair, 1991; Wray, 2002). However, despite its ubiquity and importance in discourse, L2 learners often struggle to acquire formulaic language effectively (Schmitt, 2010; Wood, 2010; Wray, 2002).

Among various formulaic expressions, PVs—such as *show up* and *put off*—are often regarded as "one of the most notoriously challenging aspects of English language instruction" (Gardner & Davies, 2007, p. 339). Over the years, English PVs have garnered increasing attention from researchers. Some studies have explored their semantic and syntactic properties (Cappelle, 2008; Sawyer, 1999), while others have investigated the tendency of L2 learners to underuse these verb combinations. The latter research focuses on the concept of avoidance in L2 learning, highlighting a strong preference among L2 learners for synonymous one-word verbs over PVs, primarily due to their perceived difficulty (Dagut & Laufer, 1985; Hulstijn & Marchena, 1989; Liao & Fukaya, 2004; Siyanova & Schmitt, 2007). These findings suggest that many L2 learners have not fully developed a solid understanding of PVs. In the context of L2 teaching, many studies emphasize the importance of exploring ways to enhance L2 learners' mastery of PVs (Sonbul et al., 2020; Strong, 2013; Strong & Boers, 2019a, 2019b). Researchers have also examined effective methods for presenting these verb combinations to L2 learners in order to facilitate their successful acquisition (Lindstromberg, 2022; Strong & Leeming, 2023, 2024).

The present study examines PVs and investigates the challenging they pose for L2 learners in both receptive and productive contexts. It also explores the influence of learner's vocabulary knowledge and overall English proficiency on their acquisition of PVs. Understanding how these often-difficult PVs are incorporated into learners' language knowledge and how they develop alongside general L2 knowledge and vocabulary is crucial for fostering learners who can use L2 more naturally.

The Definition of PVs

PVs are defined as two-part verbs consisting of a verb plus a particle, which act "to some extent either lexically and syntactically as a single verb" (Quirk et al., 1985, p. 1150). A particle is morphologically invariable (Quirk et al., 1985, p. 1150) and is "an accented item that does not take an object and that usually has a fairly close bond with the verb" (Cappelle, 2004, p. 29). Consider (1).

(1) a. The plane has now *taken off*. (Quirk et al., 1985, p. 1552)
b. Someone *turned on* the light. (Quirk et al., 1985, p. 1553)

In (1a), the particle *off* follows a lexical verb *taken*, and the combination behaves as a single word on lexical and syntactic terms. Similarly, in (1b), a lexical verb *turn* is followed by a

particle *on*, and the two-part verb acts as a single unit as a verb. Crucially, this verb combination is different from other multi-word verbs which look identical to PVs on the surface as in (2a).

(2) a. Jill ran up a big hill.
b. Jill *ran up* a big bill. (Cappelle, 2004, p. 29)

In (2a), *up* functions as a preposition, indicating the direction of Jill's running. The noun phrase, *a big hill*, serves as the object of the preposition *up*, forming the prepositional phrase *up a big hill*. As a result, the verb is classified as a prepositional verb. In contrast, in (2b), *up* does not combine with the following noun phrase to form a constituent. Instead, it acts as a particle, combining with *run* to form a PV that conveys a meaning akin to *accrue*.

Importance of Learning English PVs

PVs deserve significant attention in L2 teaching for several reasons. Firstly, they are highly prevalent in colloquial English, as noted by Gardner and Davies, 2007, making them inherently valuable to learn. In the context of L2 learning, learners encounter one PV in every 150 words of English they are exposed to (Gardner & Davies, 2007). Furthermore, PVs occur nearly 2000 times per million words (Biber et al., 1999). They thus play a critical role in supporting fluent spoken and written communication. In addition, as many of them are highly polysemous, mastering PVs allows learners to comprehend and express a wide range of lexical meanings, including some that cannot be conveyed precisely through other means.

Challenges in Learning PVs

Despite these merits, PVs are generally more challenging to acquire than other types of vocabulary, such as single words (Wolter, 2020), for several reasons. One of the features that make PVs very difficult for L2 learners is their non-compositionality; i.e., the meaning of a PV cannot be derived by computing the meanings of its component. For example, understanding the words *call* and *off* does little to clarify the meaning of *call off* in the phrase *call off the game*. Another reason PVs are particularly challenging for learners is their semantics complexity: they typically have multiple meanings. Gardner and Davies (2007) found that the most common PVs in English have an average of 5.6 distinct meanings. For instance, the different meanings of *hold back*, as in *hold back the laughter*, *hold back the crowd, hold back from joining the team*, and *hold back their potential*, are not intuitively connected. For learners, some meanings are easy to figure out from the literal meanings of the individual words in the verb, but others with a figurative meaning can be difficult because of the mismatch in the calculation. This lack of clear connection makes it harder for them to grasp the full range of its usage. Their syntactic complexity further poses significant difficulties. While PVs consist of a verb and a particle that function together as a single unit, the particle's position can vary depending on the context. For example, both *switch off the light* and *switch the light off* are appropriate, but L2 learners must also learn the rule that when the object is a pronoun, the particle must follow it; for instance, *switch it off* is correct, whereas *switch off it* is ungrammatical. Furthermore, in the case of prepositional verbs such as *call on*, they must understand that the particle's placement before the object is acceptable, as in *She called on her friend,* but its placement after the object is not acceptable, as in **call her friend on*. Thus, the complexity of PVs in terms of their meaning, usage, and syntax makes them a significant hurdle for language learners, requiring focused attention and practice to master.

Previous Studies

Okuwaki (2015) investigated the use of formulaic language in L2 writing by Japanese learners with different L2 proficiency levels and examined whether the number of their usage correlated with L2 proficiency, vocabulary knowledge, and writing assessments. The study found that, in total, L2 learners used 211 formulaic expressions for a descriptive essay and 436 for an argumentative essay. However, the amount and distribution of formulaic expressions throughout the essays were highly variable. While collocations, personal stance markers and transitions were frequently used, idioms and PVs were rarely employed by learners. As this study demonstrates, among the categories of infrequent formulaic language use, PVs appear to be the most difficult for them to incorporate into their writing.

Some studies have specifically focused on the use of PVs by L2 learners. It is generally agreed that mastering PVs is a particularly challenging task for them, especially when their first language is non-Germanic. This is because verb + particle combinations are a specific feature of Germanic languages such as English, German and Dutch (Dagut & Laufer, 1985). Notably, many studies reported that learners avoid using PVs; in other words, they often choose not to use a particular L2 form, even if they are familiar with it. Furthermore, L2 learners have been shown to exhibit a tendency to prefer single-word verbs over PVs in both writing and speaking (Dagut & Laufer, 1985; Hulstijn & Marchena, 1989; Liao & Fukaya, 2004). These findings highlight how unlikely learners are to use PVs voluntarily. It is worth noting that this infrequent use of PVs stands in stark contrast to the frequent use of PVs by native speakers.

Schmitt and Redwood (2011) examined 68 learners with their productive and receptive knowledge of highly frequent English PVs, as well as the impact of frequency on this knowledge. The results revealed that they had strong receptive knowledge (65. 2%) and moderate productive knowledge (48.2%) of the tested PVs. Overall, the relationship was not strongly linear, but PVs with higher frequencies were clearly learned by more participants than those with lower frequencies.

Although Schmitt and Redwood's (2011) study provided valuable insights into PVs and their connection to frequency in the language, it did not offer a comprehensive account of the impacts of meaning, as polysemy—one of the most critical features of PVs—was not considered. To address this limitation, Garnier and Schmitt (2016) explored L2 learners' productive knowledge of highly polysemous PVs and the factors influencing their acquisition. They assessed productive knowledge of PVs by Chilean learners and examined the factors determining L2 knowledge of various meanings using a productive measurement test derived from the PHaVE list (see Garnier & Schmitt, 2015, for detailed description). The results showed that participants were able to produce an average of 40.56 out of 100 tested meanings.

Lastly, Sonbul et al. (2020) examined L1-Arabic learners' receptive and productive knowledge of polysemous PVs. They assessed 60 participants using a recall test adapted from Garnier and Schmitt (2016) to measure productive knowledge and a multiple-choice test designed to evaluate receptive knowledge. It was shown that learners produced 30.57% of the senses, while the average score was higher for receptive knowledge at 49.12%, indicating stronger receptive knowledge of polysemous PVs.

Research Questions

Based on the findings of previous studies, three research questions were formulated to explore leaners' knowledge of English PVs.

1. How well do L2 learners know English PVs?
2. Is there a difference between L2 learners' productive and receptive knowledge of English PV?
3. Is there a relationship between learners' knowledge of PVs and their overall L2 proficiency or L2 vocabulary size?

The Study

Participants

A total of thirty Japanese female learners of English participated in the study. They were undergraduate students at a female university in Japan and learning English as an L2 in the curriculum. Their age range was 19-22 years (*M*=19.3, *SD*=1.37). As for their proficiency levels, the mean TOEIC score was 595.8 (*min*.=300, *max*.=885, *SD*=164.42).

Instruments

The Updated Vocabulary Levels Test (UVLT). The UVLT (Webb et al. 2017) was used to measure breadth of vocabulary knowledge of the learners. Like the original VLT, the UVLT uses a word–definition matching format (Table 1). At each frequency level: 1000, 2000, 3000, 4000, 5000, there are 30 test items in 10 clusters each, with a total score of 150. Participants took the online version of the test.

Table 1: Sample Item Set From the Updated Vocabulary Levels Test

	game	*island*	*mouth*	*movie*	*song*	*yard*
land with water all around it		✔				
part of your body used for eating and talking			✔			
piece of music					✔	

Test Items. 40 PVs with 100 meaning senses were selected from The PHaVE List (Garnier & Schmitt, 2015), which identifies the most frequently used meanings of the most common English PVs. The list consists of 150 PVs, previously identified as highly frequent by Liu (2011), each appearing at least 10 times per million words in either COCA or BNC. The present study utilized the PV test from Garnier and Schmitt (2016), which extracted 40 PVs form the PHaVE List, including 100 meaning senses. The test items are presented in Table 2.

Table 2: Items Used in the PV Test

back up	*come out*	*hand over*	*pull back*	*sit back*
break down	*cut off*	*hold back*	*put in*	*stand out*
break off	*get down*	*keep up*	*put on*	*take back*
bring in	*get off*	*look back*	*put out*	*take in*
clean up	*get on*	*look out*	*put up*	*take out*
come along	*give out*	*make out*	*reach out*	*turn around*
come in	*go down*	*move up*	*run out*	*turn over*
come on	*go up*	*pay off*	*set out*	*turn up*

The examples of polysemous meanings of *hold back* are shown below. It has a literal meaning ("to prevent SB/STH from going somewhere"), as in (3), but it also has a figurative meaning ("to decide not to do or say STH"), as in (4).

(3) Security guards tried to *hold back* the crowd.
(4) They should not *hold back* from joining us if they want to.

Productive PV Test. In the productive test, learners read each sentence and filled in the missing words (a PV) in the space provided below the sentence. To assist them, the first letter of each word was shown, and a definition of each PV was provided after each sentence. The test consisted of 100 sentences, with some using the same PV. A sample test item is presented below.

Sample：
I didn't think he would **b___ u___** the subject. **(mention, introduce)**

_____
【Answer: *bring up*】

Receptive PV Test. In the receptive test, learners read each sentence and selected the best answer to fill in the blank. If they did not know the answer, they could choose the "Don't Know" option, represented as "?". Similar to the productive test, they are given a definition for each PV after every sentence. There were 100 sentences in total, some of which included the same PV.

Sample：
The prisoners are hoping to _____ of jail soon. **(leave)**
get out
go out
leave out
stand out?
?
【Answer: *get out*】

Procedure

The test was administered at a woman's university located in Tokyo, Japan. Before participating in the survey, all participants were provided with an explanation of the study's purpose, the expected duration, its voluntary nature, and data confidentiality. All tests were conducted online. In the first week, participants completed the online UVLT test at home, followed by the production test one week later. After a two-week interval, the receptive test was administered online. It was ensured that there was at least a two-week gap between the productive and receptive tests to minimize any memory advantage.

Results

The first area of focus in this study was the vocabulary level of each participant. A clear pattern emerged across the five individual frequency levels, as expected. As shown in Table 3, the mean scores gradually decreased from the most frequent level (1K) to the least frequent level (5K). This trend reflects the well-documented finding that a word's frequency in a language correlates with the likelihood of it being known. As mastery is considered to be a score of 86% or higher on that frequency band (26 correct out of 30), the results showed that most participants demonstrated proficiency with the first two bands of the UVLT, indicating strong knowledge of higher-frequency words. However, only a small number of participants were able to master the lower-frequency bands, specifically the 3000 to 5000 bands.

Table 3: Descriptive Statistics of the UVLT (N=30) in the Scores

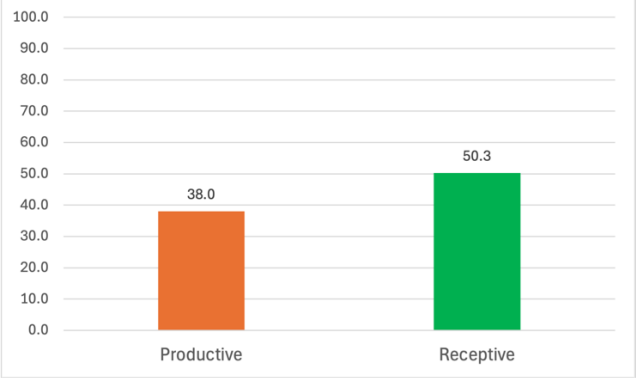
Level	*Mean*	*SD*
1000-word	28.7	1.98
2000-word	27.4	2.99
3000-word	23.6	4.63
4000-word	20.8	5.83
5000-word	17.4	5.34
Total score (k=150)	117.9	17.73

The main focus of the present study was to explore how well L2 learners know English PVs. When compared to the stable knowledge demonstrated in the general vocabulary knowledge test in Table 3, the results of the PV test indicated the difficulty participants faced in the area. As shown in Table 4 and Figure 1, participants answered just over 50% of the items correctly on the receptive test, and even fewer (38%) on the productive test at 38%, showing that PVs are a challenging aspect for L2 learners to acquire.

Table 4: *Mean* Scores and *SD*s of Productive and Receptive Tests

Type	*Mean*	*SD*
Productive Test	38.0/100	23.75
Receptive Test	50.3/100	18.78

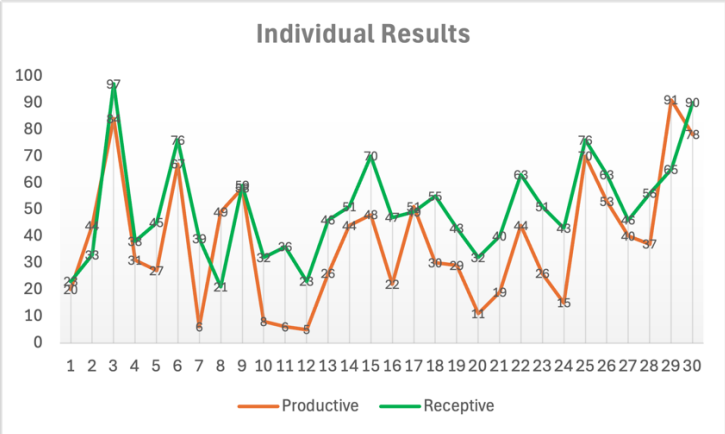
Figure 1: The Number of Correct Answers in Two PV Tests



In order to examine the differences between the productive and receptive test, a two-tailed *t*-test was conducted at a significance level of 5%. The result showed a significant difference in *mean* scores between the two ($t(38)=2.225$, $p<.05$, Cohen's $d=0.57$), indicating a

medium-sized effect. Thus, it was shown the learners generally had difficulty with PVs, but when compared, they had more difficulty producing PVs than recognizing them. Individual data also showed that, with a few exceptions, most learners had a greater amount of receptive PV knowledge than productive PV knowledge, as shown in Figure 2.

Figure 2: Individual Results of Productive and Receptive Tests



As for the relationship between vocabulary knowledge and PV knowledge measured in the tests, there was a moderate positive correlation between UVLT and Productive test ($r(28)=0.46$, $p<.05$), and a strong positive correlation between UVLT and Receptive test ($r(28)=0.64$, $p<.000$) (Figure 3). However, the correlations were only weak between vocabulary knowledge and general language proficiency: A weak positive correlation between TOEIC and Productive test ($r(28)=0.23$, $p=.217$), and a moderate positive correlation between TOEIC and Receptive test ($r(28)=0.33$, $p=.074$) (Figure 4).

Figure 3: Correlations Between UVLT and PV Tests

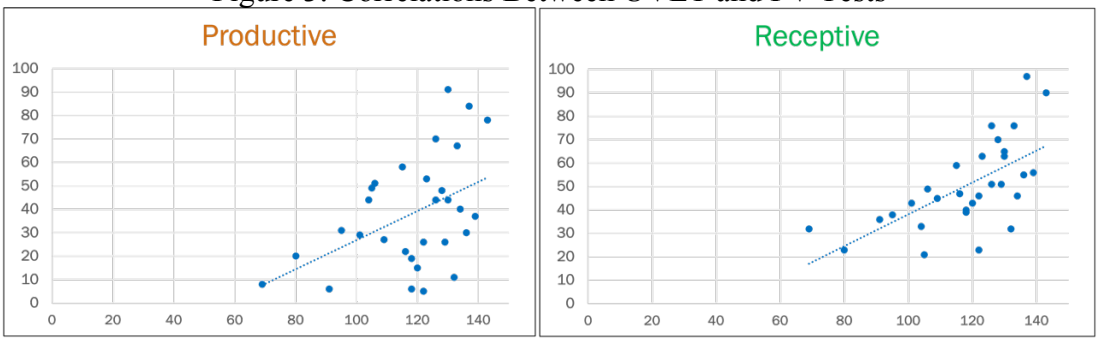
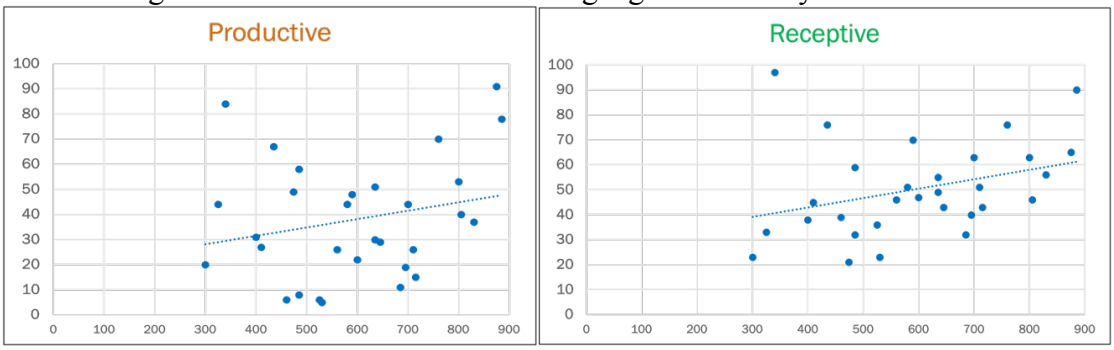


Figure 4: Correlations Between Language Proficiency and PV Tests



Discussion

Regarding the first research question on the extent of L2 learners' knowledge of English PVs, the data showed the difficulty participants had in both productive and recognizing PVs, with the former being even more challenging (average scores: 38.0% on the productive test and 50.2% on the receptive test). This is similar to what Garnier and Schmitt (2016) reported for the production test (40.56% on average). Comparing the result of UVLT, where participants performed reasonably well in general vocabulary knowledge, their knowledge of PVs turned out to be inadequate and less robust. This suggests that learners lack knowledge particularly on the multi-word expressions rather than single words. I speculate that this may be because PVs are typically learned in instructed settings, while they are generally used in more informal settings, making them more difficult for learners to acquire.

The second issue concerns the contrast observed between the performance on productive and receptive assessments. The data showed participants knew half of the 100 senses receptively but only a third of these productively. This suggests, in real communication, learners may be able to understand PVs used in the situation, but it will be more challenging for them to actually use them in a voluntary way. I suggest that this provides an important implication for the teaching and learning of PVs in instructed settings.

The study also found L2 learners with a larger vocabulary size demonstrated a greater ability to both understand and produce PVs. This suggests a strong relationship between overall vocabulary knowledge and the acquisition of PVs, which are often challenging for learners due to their idiomatic nature and multiple meanings. Based on this finding, I propose that expanding vocabulary size may be a critical factor in developing not only PVs but also overall L2 proficiency. In other words, a richer vocabulary base may enable learners to recognize patterns, infer meanings from context, and use PVs more naturally and accurately in communication. Therefore, in addition to teaching and learning PVs per se, vocabulary expansion should be considered another key component of instructional strategies aimed at improving L2 learners' command of PVs.

Conclusion

This study examined Japanese university students' knowledge of English PVs and explored how learners vocabulary knowledge and overall English proficiency influenced their acquisition of PVs. The findings revealed that, although their vocabulary knowledge was reasonably strong, learners still faced difficulties with PVs. As for the type of knowledge, they performed better on receptive knowledge tests than on productive ones, suggesting that PV acquisition progresses from recognition to active use over time. Regarding the role of vocabulary knowledge and overall proficiency, the study highlighted that mastering PVs is a challenging process for L2 learners, requiring considerable time, effort and practice. However, a richer vocabulary foundation may help learners expand their PVs knowledge by encouraging them to recognize more patterns in input, helping them infer meanings from context, and enabling them to use PVs more naturally in communication.

For future research, it is necessary to explore whether the type of meaning—literal or figurative—affects acquisition difficulty, and which type of knowledge—receptive or productive—has a greater impact. PVs are widely used in everyday language, but their polysemous meanings and syntactic complexity present ongoing challenges for L2 learners,

even at advanced proficiency levels. This highlights the need for systematic teaching and learning approaches to PVs.

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The Perception of Djiboutian Elementary School Teachers Toward Tablet Devices

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Abstract
This study explores the Djiboutian elementary school teachers' perceptions regarding the integration and use of tablet devices in the classroom. Employing a quantitative approach, the researcher administered a questionnaire survey to 65 elementary school teachers across Djibouti, incorporating primary schools from rural and urban areas. The questionnaire items which were based on the Technology Acceptance Model (TAM) developed by Davis (1989) assessed critical aspects such as teachers' perceived ease of use of the tablets (PEU), their perceived usefulness (PU), their tablet self-efficacy, their attitude toward tablets and their behavioral intention to use these devices in their classrooms. The results revealed that a majority (66%) of the surveyed teachers had a positive outlook on tablet integration into the curriculum. They also recognized the potential of these devices in enhancing teaching efficiency and students' engagement.

Keywords: Tablets, Primary Education, Teacher's Perceptions

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Introduction

The necessity of incorporating Information and Communication Technologies (ICT) into Djibouti's education system was emphasized in the national consultation on education held in December 1999 (Bahdon, 2012) and then stated in the law on education of August 2000 (Journal officiel de la république de Djibouti, 2000). As part of this strategy, the first 10,000 tablets were introduced eleven years ago, and 20,000 more were distributed across elementary schools nine years ago (Revue semestrielle de l'Observatoire de la Qualité de l'Enseignement-Apprentissages, 2018). Currently, tablets are used in the first, second, and third grades of Djiboutian elementary education (Ali, 2024). Thanks to their versatility and advanced features, tablets have emerged as significant educational tools. Equipped with high-resolution touchscreens and a wide range of applications, tablets are being adopted more frequently worldwide (Johnson et al., 2014). These devices provide internet connectivity options, such as Wi-Fi and mobile networks, granting students access to an extensive array of educational content that enhances their learning experience.

Like many other technological devices, the successful integration of tablets into educational settings is greatly determined by the attitude of its primary users, namely the teachers. A positive perception among them can facilitate a smooth and effective tablet integration, while a negative perception might hinder the process. Therefore, assessing teachers' perceptions of using tablets in primary schools is crucial for understanding their behavioral intention to use these devices in their classrooms. This assessment of teachers' perceptions is particularly important in the Djiboutian context, where tablet integration is recent and where no empirical study has yet evaluated teachers' perceptions of it. Although the focus is on Djiboutian elementary education, this research contributes to the broader global dialogue about the role of tablet devices in education, especially in developing countries. By presenting substantial evidence on teachers' perceptions toward tablets, this study can serve as a valuable case study for other nations facing similar socio-economic challenges and provide a foundation for future research on integrating tablet technology in educational settings. The research is guided by the following question: What are the perceptions and the attitudes of grade 1 to 3 of elementary education teachers on tablets integration into education.

Table 1: Features of the Tablet

Features	**Details**
Brand	Haier
Model	P8B
Operating system	Android 11
Display	8 inches touchscreen display
Internal storage	32GB (expandable via micro SD)
Connectivity	Wi-Fi, Bluetooth, GPS

Literature Review

As ICT evolved, so did its integration into classrooms. It has undoubtedly laid the groundwork for the use of multimedia resources in teaching and learning. More recently, the rapid and widespread adoption of mobile devices like tablets and smartphones has revolutionized the educational landscape. Coupled with the growing availability of internet connectivity, these mobile devices, namely tablets, have made interactive learning tools accessible to more learners and offered greater flexibility in how and when learning can take place. They facilitate online communication, multimedia integration, and interactive learning

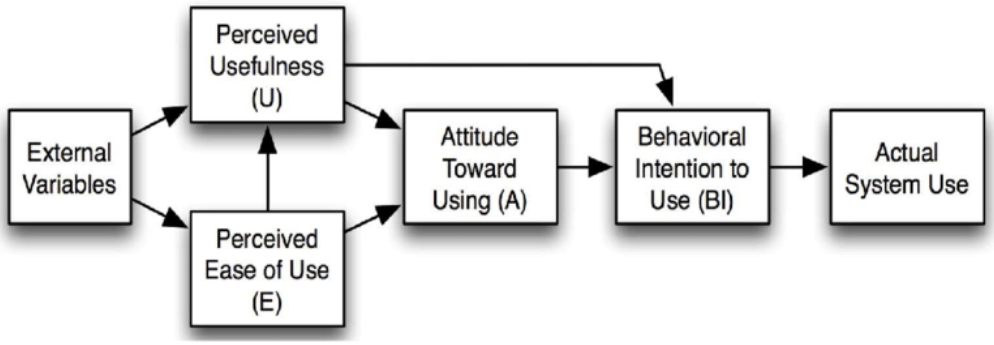
through applications, fostering more engaging and personalized educational opportunities (Valstad, 2010). Additionally, tablets transform learners into active participants by encouraging creativity and the generation of original work while also strengthening their critical thinking and problem-solving skills (Johnson et al., 2014). The portability of the tablets is another key factor in their educational value. Tablets allow students to move freely while engaging with educational content, enabling more interactive and dynamic learning experiences. Students can collaborate in groups beyond their usual classmates and seek feedback and guidance from their teachers at their desks. They can even access learning material virtually outside the classroom. These possibilities empower learners and, therefore, create a more dynamic and student-centered environment (Clark & Luckin, 2013). However, some researchers expressed skepticism about tablets' educational potential. For instance, Falloon (2017) argues that the research that was conducted right after the devices were integrated into the classroom might not be reliable as the positive outcomes they reported are influenced by the novelty of the tablets in the educational landscape and in the student's environment. He argued that they did not assess the true impact on students' learning and emphasized the need for long-term research. Moreover, Murray and Olcese (2011) further argued that a significant number of the applications available on tablets focus primarily on the delivery of the content while they should focus on the promotion of collaboration among students.

The TAM proposes that a user's intention to use technology (Behavioral Intention, BI) is shaped by their attitude toward it. This attitude is influenced by two main factors: perceived usefulness (PU) and perceived ease of use (PEU). Attitude (ATT) refers to the user's overall emotional evaluation of the technology. According to TAM, PEU directly impacts PU—if a technology is easier to use, it is more likely to be seen as useful. Together, PU and PEU determine the user's intention to use the technology, which in turn influences actual usage behavior. PU is defined as "the degree to which an individual believes that using a particular system would enhance his or her job performance," while PEU is defined as "the degree to which an individual believes that using a particular system would be free of physical and mental effort" (Davis, 1985, p. 26).

TAM also highlights the influence of external factors on users' behavioral intentions. These include Computer Self-efficacy (EFF), Subjective Norms (SN), and Facilitating Conditions (FC). Computer self-efficacy refers to a person's belief in their ability to handle difficulties in using or learning about technology, distinct from perceived ease of use. Even if someone finds a technology challenging, they may still feel confident in their ability to overcome those challenges. Subjective norm reflects the social pressure individuals perceive regarding their use of technology, often from peers or authority figures. Facilitating conditions are the resources, knowledge, and support available to help users adopt and utilize the technology (Gokcearslan, 2017).

TAM has been widely applied to various forms of technology, including educational systems (Gokcearslan, 2017). Typically, TAM is assessed through surveys that use Likert scales, allowing respondents to express their level of agreement, ranging from "strongly disagree" to "strongly agree."

Figure 1: Technology Acceptance Model (Davis, 1985)



Methodology

Based on Technology Acceptance Model (Davis, 1985), the questionnaire comprised 17 questions organized into five distinct categories, each designed to capture different dimensions of teachers' perceptions and experiences.

Category 1: Demographic Information

This category collected respondents' essential demographic data, such as age, gender, and years of teaching experience. Respondents' demographic information is key in conceptualizing the findings and exploring the potential correlations between teachers' demographic information and their perceptions of the tablets.

Category 2: Teachers' Perceived Usefulness of Tablet

This category, comprising three questions, assesses how teachers perceive tablets' usefulness in enhancing learning. Using a Likert scale ranging from strongly disagree to strongly agree, the questions were designed to evaluate the extent to which teachers believe tablets can improve student engagement and enhance overall teaching effectiveness.

Category 3: Teachers' Perceived Ease of Use of Tablet

This section, constituted of four questions, focused on tablets' user-friendliness. It examined how comfortable teachers felt with the device's functionalities and characteristics, the pace with which they mastered its utilization, and the effectiveness of the ICT training they received. It also contained an open-ended question to inquire about potential obstacles encountered by the respondents, where they were asked to describe the nature of the obstacle faced, if any.

Category 4: Confidence in Using Tablets

Comprising only one question inviting the respondents to auto-assess their tablet self-efficacy and rate their level of self-efficacy regarding their ability to integrate tablets into their teaching. The question addressed how confident teachers felt using tablets for instructional purposes using a Likert scale ranging from not confident to very confident.

Category 5: Attitude and Intentions to Use Tablets in the Future

This final section examines teachers' attitudes toward tablets, their behavioral intention to use tablets in their teaching practices, their opinion about a potential tablet generalization in elementary education, and their willingness to take further ICT-related training to enhance their tablet self-efficacy. Understanding these intentions is crucial for predicting the long-term adoption of tablet technology in the classroom.

The 65 Participating teachers were selected based on their experience teaching the first three grades, where tablet technology is currently being implemented.

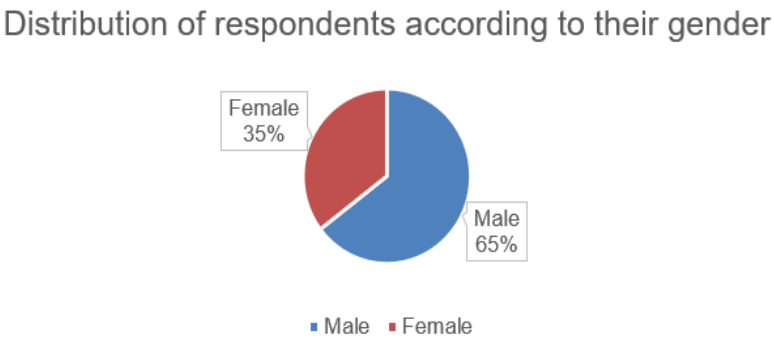
The survey was conducted in 7 different schools with varying characteristics to capture diverse perspectives. Some schools were located in the country's northern region, while others were in the south. The selection also comprised a school from the capital city and a school from a rural area in the Dikhil Region. It also included a bilingual elementary school in the Tadjourah region.

Results

The survey results provide insights into the demographic profile and professional experience of the teachers who participated in the study. As shown in Figure 2, 42 of the 65 respondents are male (64.6%), and 23 are female (35.4%), indicating a slight male predominance among participants.

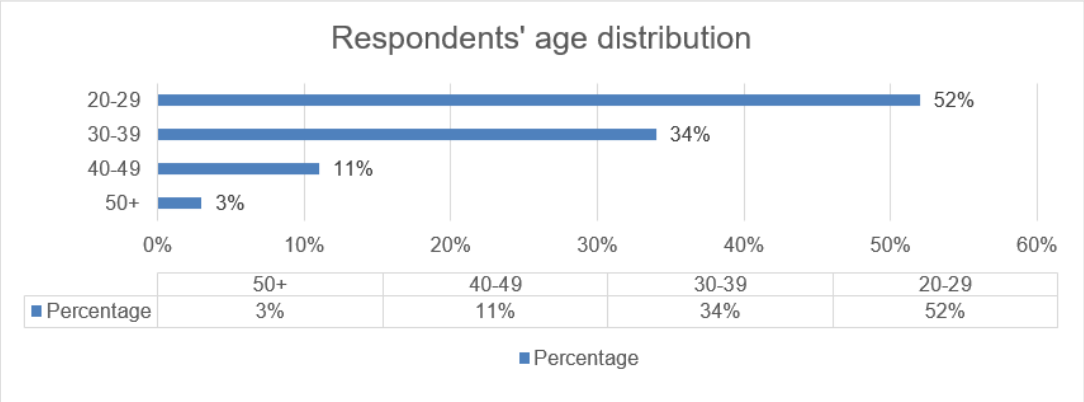
Demographic Information

Figure 2: Distribution of Respondents Based on Their Gender



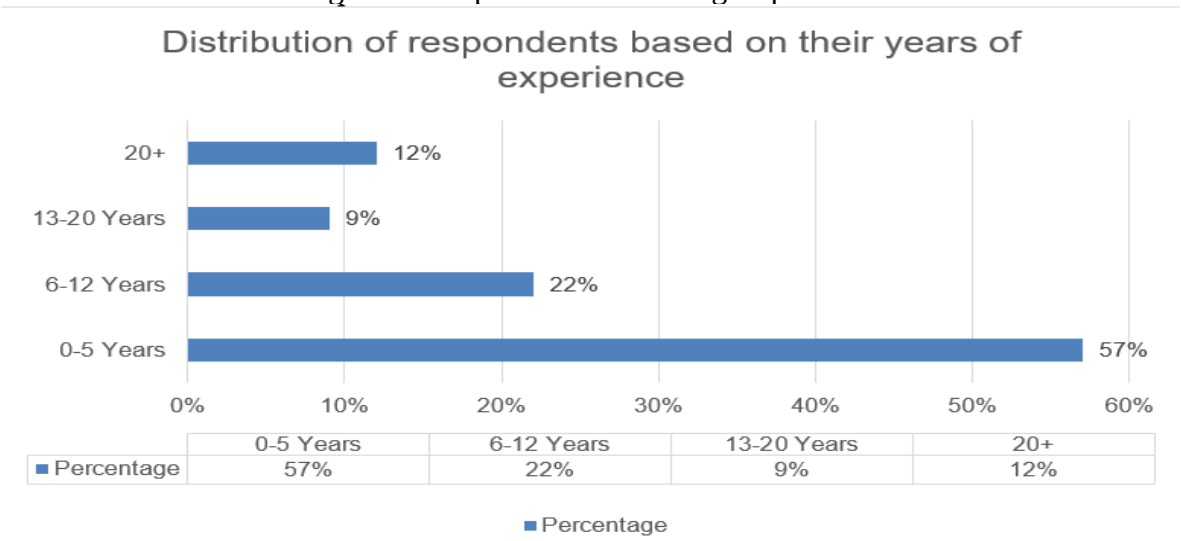
As presented in Figure 3, most teachers are between 20 and 29 years old, with 34 respondents (52.3%). This is followed by 22 respondents (33.8%) falling within the 30-39 age bracket. Only 7 (10.8%) and 2 (3.1%) respondents fall in the 40-49 age group and the 50- and older age group.

Figure 3: Age Distribution of the Respondents



In terms of professional experience, the data indicates that over half of surveyed teachers are relatively new to the profession, falling within the range of 0-5 years of teaching experience, with 37 (56.9%) respondents fitting into this category. Following this group, 14 respondents (21.5%) fall within the 6-12 teaching experience bracket. Six respondents (9.2%) have 13-20 years of experience, and eight (12.3%) have more than 20 years of teaching experience. These two last groups, despite being fewer in number compared to the first two groups of respondents, their perspectives provide valuable insight regarding the integration of tablets into the educational setting because they have experience teaching both before and after the integration of tablets into the primary education.

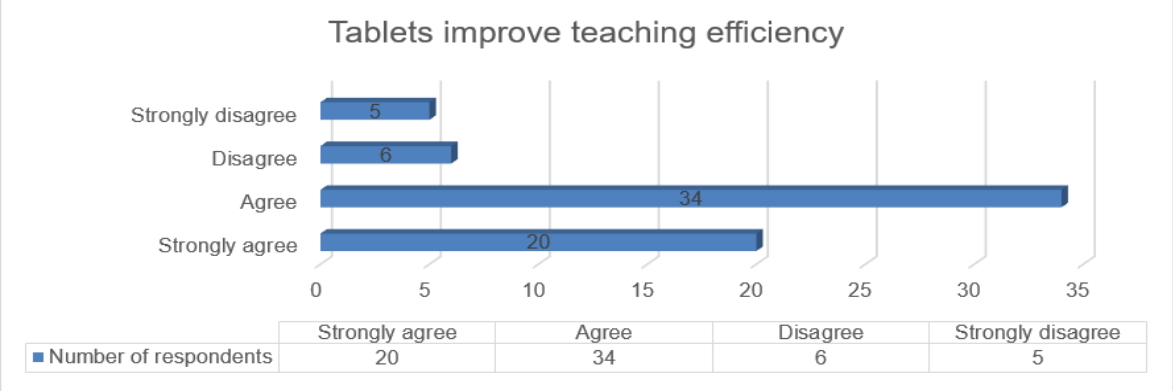
Figure 4: Respondents' Teaching Experience



Perceived Usefulness of Tablets

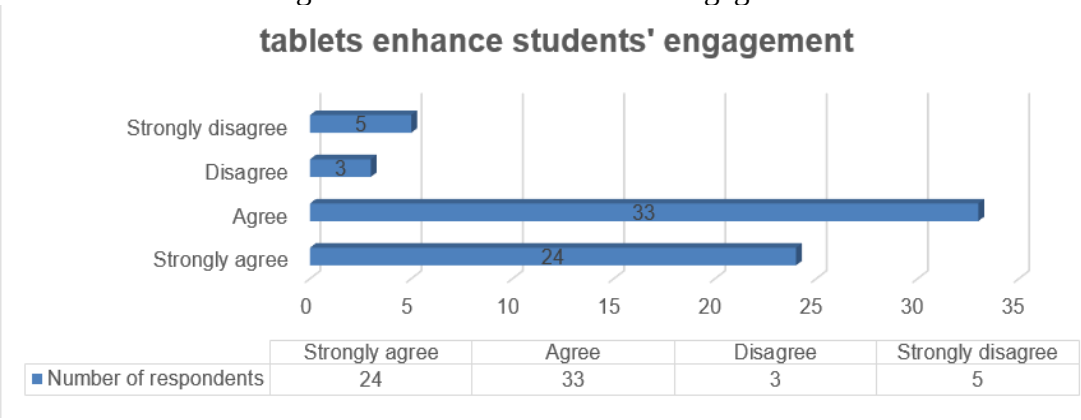
The data indicates that most teachers find tablets to be valuable tools to improve teaching effectiveness. 20 respondents (30.8%) strongly agreed, and 34 (52.3%) agreed that tablets are useful and practical in the classroom. Six respondents (9.2%) disagreed, and only five respondents (7.7%) strongly disagreed with the statement, "Tablets are useful tools to improve teaching and learning."

Figure 5: Usefulness of Tablets in Improving Teaching and Learning



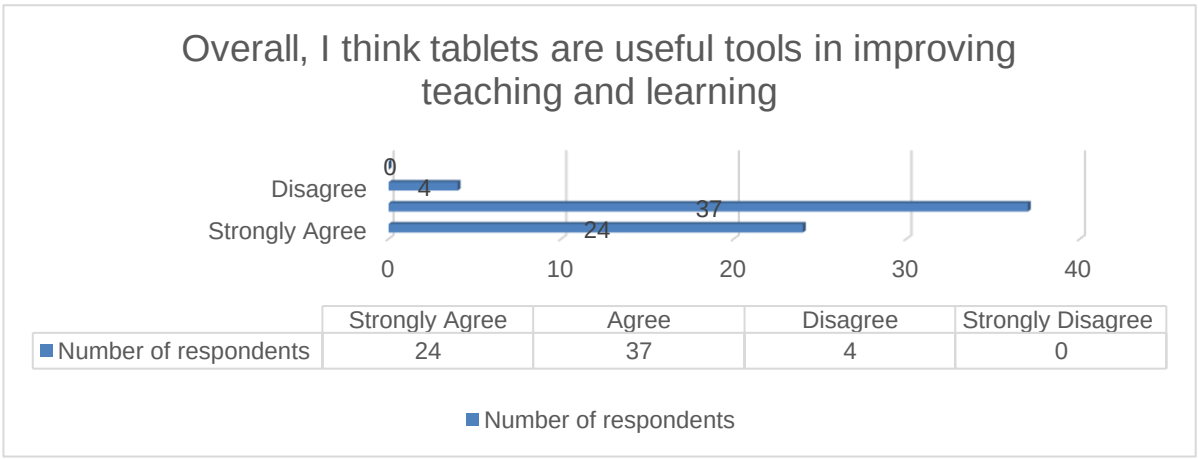
Similarly, most teachers believe that tablets enhance pupils' engagement, with 57 teachers (87.7%) agreeing with this statement. And a minority of 8 respondents (12.3 %) disagree with the statement. " Tablets enhance students' engagement."

Figure 6: Tablets and Students Engagement



To get a broader picture of teachers' perceptions regarding the usefulness of tablets, we asked them about their overall usefulness in improving teaching and learning. Respectively 24 respondents (36.9%) and 37 respondents (56.9%) strongly agreed or agreed on tablets' usefulness in enhancing teaching and learning, while only 4 respondents (6.1%) disagreed, and no respondent expressed strong disagreement.

Figure 7: Overall Perception on Tablets Usefulness

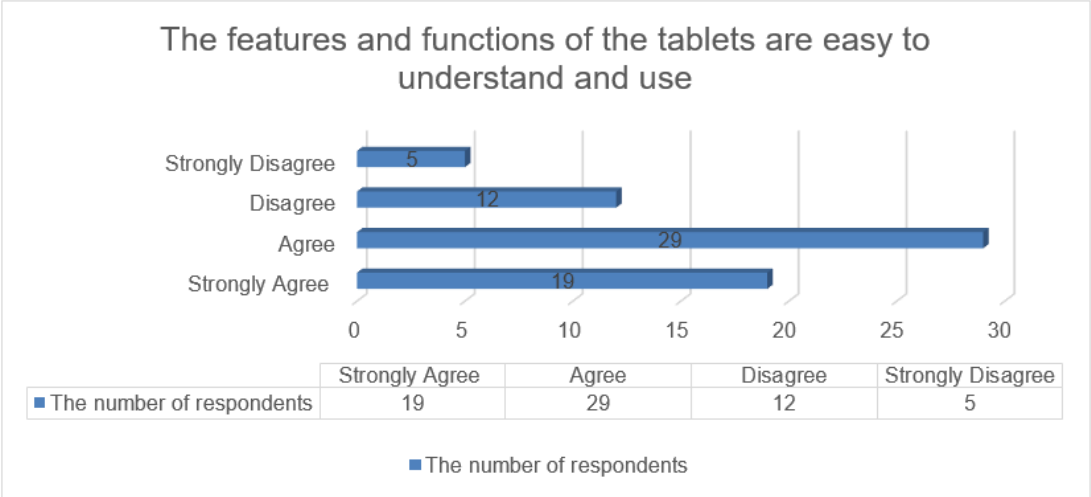


Ease of Use of Tablets

According to the TAM, similar to the perceived usefulness (PU) analyzed in the previous category, the user's perceived ease of use (PEU) of a technological device determines greatly their behavioral intention to use it. Following our survey, most respondents acknowledged the tablet's ease of use, finding its features and functions easy to understand and use.

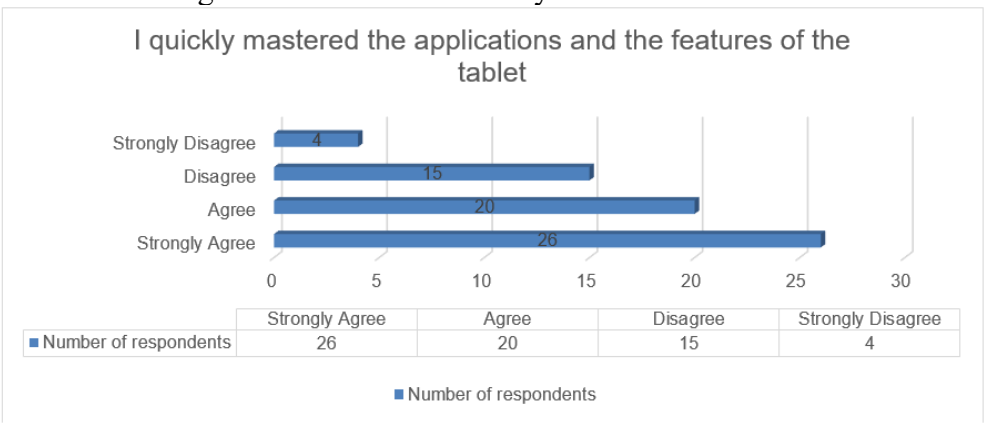
Respectively, 19 teachers (29.2%) and 29 teachers (44.6%) strongly agreed or agreed on the user-friendliness of tablets. On the other hand, 12 teachers (18.5%) expressed disagreement, and 5 of them (7.7%) strongly disagreed.

Figure 8: Easiness of the Tablets' Functions and Features



In line with the acknowledged ease of use of tablets, the majority of respondents said that they quickly mastered the applications and the features of the tablets, with respectively 26 respondents (40.0%) strongly agreeing and 20 (30.8%) agreeing. Nevertheless, a notable 15 respondents (23.1%) disagreed, while only 4 (6.2%) expressed strong disagreement regarding the statement, "I quickly mastered the applications and the features of the tablet."

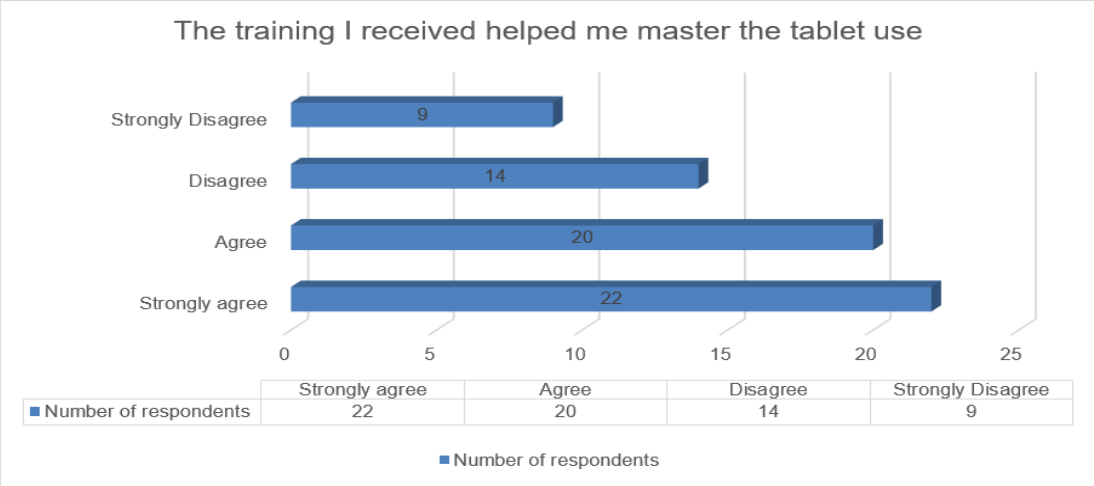
Figure 9: Ease of the Mastery of Tablets' Features



When teachers were asked about the role the in-service training on tablet use in the classroom has played in facilitating their mastery of the device, 22 respondents (33.8%) strongly agreed on the effectiveness of the received training, and 20 respondents (30.8%) agreed. In

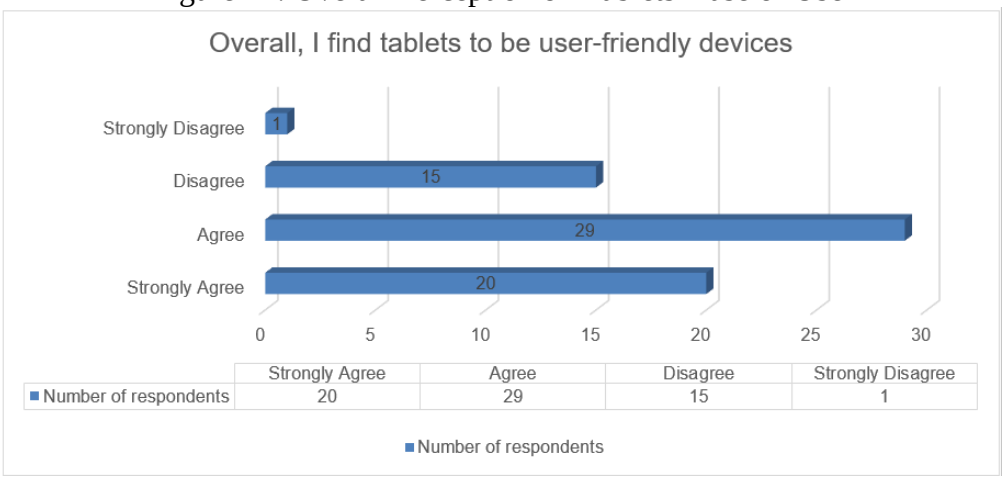
comparison, 14 respondents (21.5%) and 9 respondents (13.8) disagreed or strongly disagreed regarding the effectiveness of the training on tablet use in the classroom.

Figure 10: Effectiveness of the Trainings in Mastering the Tablets Use



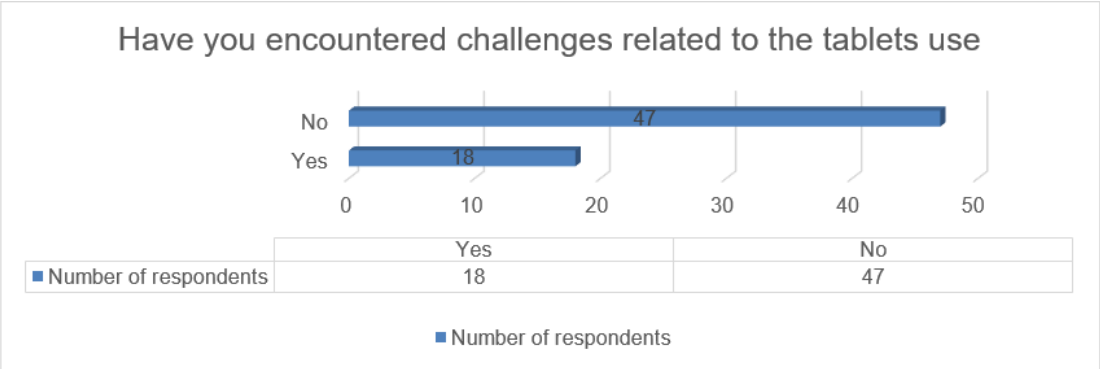
Overall, 20 respondents (30.8%) and 29 respondents (44.6%) strongly agree or disagree regarding the ease of use of tablets, although 15 respondents (23.1%) disagree and one person (1.5%) strongly disagrees.

Figure 11: Overall Perception on Tablets' Ease of Use



To inquire about the potential challenges teachers, encounter when using tablets in the classroom, we asked respondents whether they have encountered any challenges. 47 respondents (72.3%) did not encounter challenges with the tablets, while 18 respondents (27.7%) reported encountering some kind of difficulties and challenges related to the tablet. The question allowed respondents who answered YES to explain the nature of the challenges they encountered.

Figure 12: Challenges Encountered in Using Tablets



The challenges suggested by the respondents are listed below.

1. **Insufficient Electrical Outlets for Charging**
   Several teachers mentioned the inadequate number of electrical outlets available for charging the tablets. This issue often leads to students sharing a single tablet, which is an inefficient learning arrangement. One teacher noted:

   > The difficulties we encounter are often due to the lack of sufficient power outlets for charging the tablets, which sometimes forces us to work with one tablet shared between two students. This is not very effective and complicates our task.

2. **Large Class Sizes and Limited Individual Attention**
   Teachers managing large classes, sometimes with up to 50 students, reported difficulties in providing individualized feedback and monitoring each student's progress with the tablets. One teacher observed:

   > Due to the large number of students in the class, it is difficult to check each student's work and provide the necessary feedback.

3. **Distraction by Unintended Applications**
   Another concern raised by teachers was the distraction caused by unintended applications on the tablets, which led some students to deviate from their assigned tasks. One respondent explained:

   > Students tend to play with other applications instead of focusing on the ones we've assigned.

   Additionally, some students, who had little to no experience with tablets outside of school, struggled even with basic tasks, such as turning the device on. As one teacher shared:

   > Some students who have never used a tablet outside the classroom have difficulty even turning it on.

4. **Fragility of Tablets**
   The fragility of the tablets was another point of concern. Teachers expressed worries that young students might break the devices due to their inexperience. One teacher explained:

   > Since tablets are fragile tools, I am always concerned that they may break. They are new to these devices, and at only six years old, they do not yet know how to properly handle them, especially during the first few months of their first year.

5. **Difficulty in Mastering Installed Programs**
   Another challenge identified by teachers was the difficulty students faced in mastering the programs installed on the tablets. One respondent noted:

   > Mastering the programs installed on the tablets has been a challenge.

6. **Limited Time for Tablet Use**
   Several teachers expressed concern about the limited time allocated for tablet use within the curriculum. In some cases, applications such as XO seemed to cause confusion among students. One teacher remarked:

   > The time allocated for tablet use is limited. Some applications, like XO, create confusion among the students.

7. **Insufficient Tablets for All Students**
   In some classrooms, the number of available tablets was insufficient to ensure that each student had one. This led to students sharing tablets, further complicating the learning process. One teacher shared:

   > There are not enough tablets for the students, so we have to work with one tablet shared between two students.

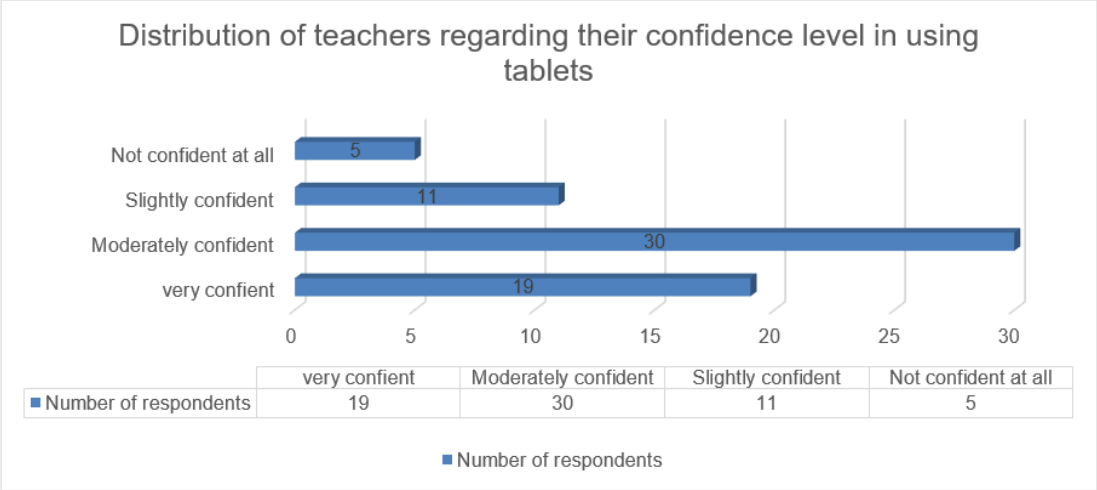
8. **Classroom Management Issues**
   The introduction of tablets into the classroom also created challenges in classroom management. Teachers reported that students often became overly excited and noisy when the tablets were distributed. One teacher noted:

   > With the use of tablets, classroom management becomes difficult, as students become very noisy as soon as the tablets are distributed.

Teacher Self-Efficacy in Using Tablets

When asked about their confidence level regarding using tablets for educational purposes, a large majority of 30 respondents (46.2%) reported feeling moderately confident, while 19 respondents (29.2%) reported feeling very confident. On the other hand, 11 respondents (16.9%) reported feeling only slightly confident, and 5 teachers (7.7%) acknowledged their lack of confidence regarding tablet use in the classroom, reporting feeling not confident at all.

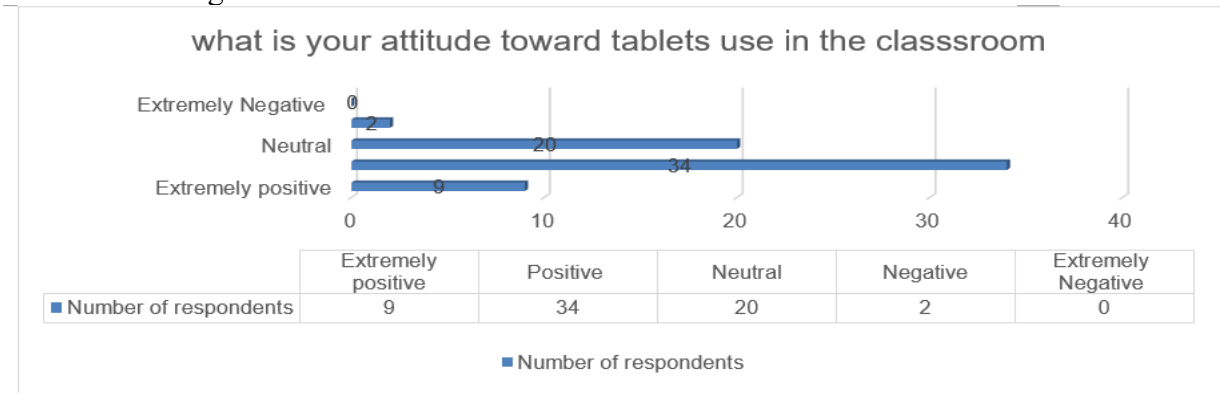
Figure 13: Teachers' Confidence Level in Using Tablets



Teacher Attitudes Toward Tablet Use

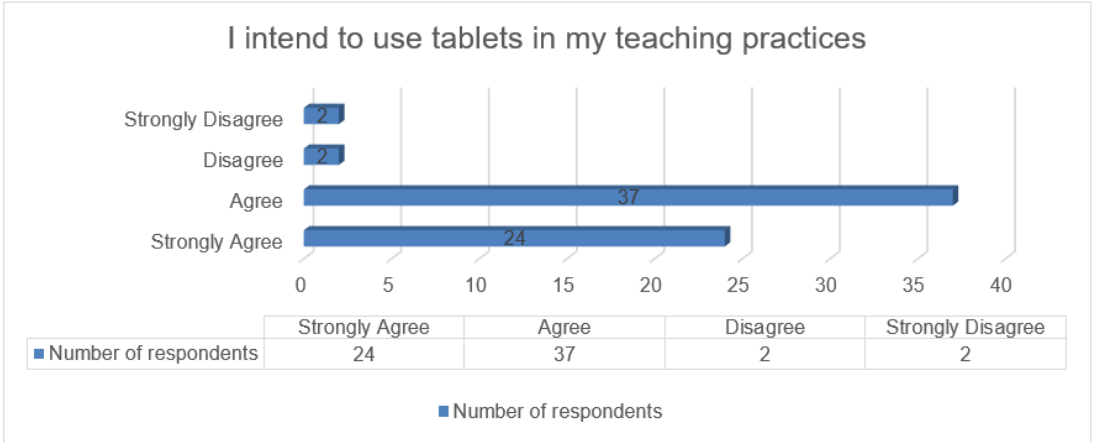
Regarding the attitude of teachers toward tablets, results show a predominantly positive overall attitude toward tablet use. 9 teachers (13.8) reported having an extremely positive attitude toward tablets, and 34 of them (52.3%) expressed a positive attitude. In contrast, 20 respondents (30.8%) remain neutral, only 2 respondents (3.1%) have a negative perception, and no respondent expressed an extremely negative attitude.

Figure 14: Teachers' Attitude Toward Tablet Use in the Classroom



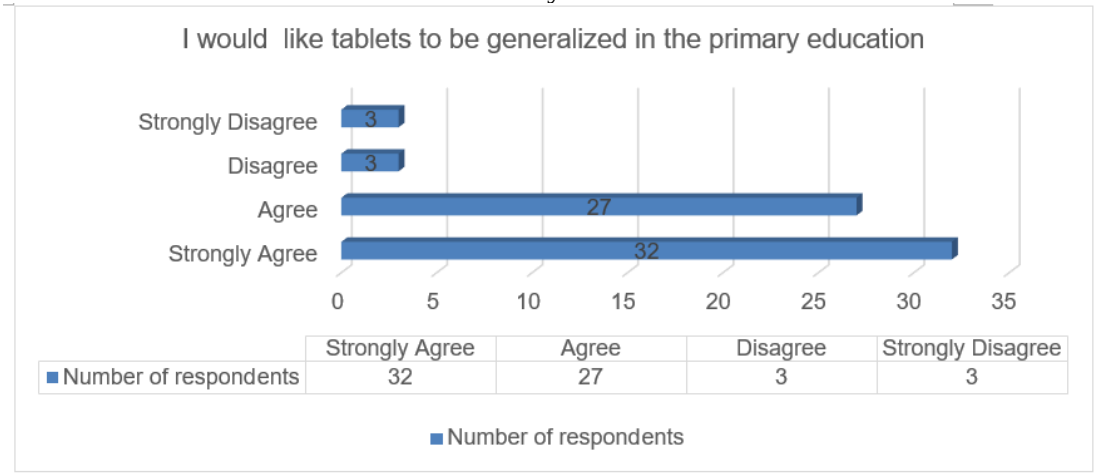
Next, teachers were asked about their behavioral intention to use tablets in their future teaching practices; 24 of them (36.9%) expressed a strong willingness to use these devices by strongly agreeing with the statement below. 37 respondents (56.9%) agreed, while 4 respondents expressed disagreement or strongly disagreed, with 2 respondents falling into each scale.

Figure 15: Teachers' Intentions to Use Tablets in Their Teaching Practices



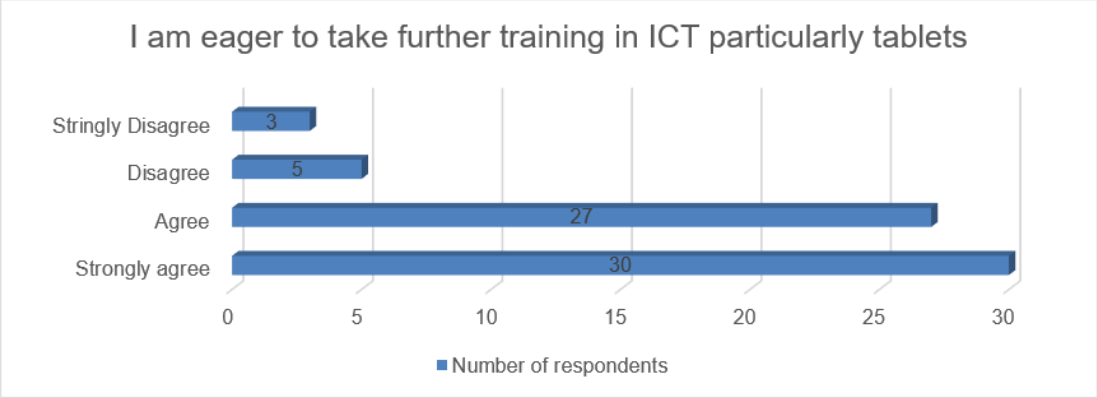
Given that, as of January 2024, tablets are used in only the first three grades of Djiboutian elementary education (grades 1-3), we asked teachers if they would like these devices to be generalized across all elementary education levels (Ali, 2024). Most respondents would like them to be generalized, with 32 strongly agreeing with the below statement and 27 teachers (41.5%) agreeing. Only 6 respondents, with respectively 3 disagreeing and 3 strongly disagreeing, would not like tablets to be generalized across elementary levels.

Figure 16: Teachers' Opinion About the Potential Generalization of Tablets in the Primary Education



To gain a greater understanding of respondents' behavioral intention toward tablet use, we asked them about their willingness to undergo further training on the use of these devices. 30 respondents (46.2%) expressed a strong willingness for further training by strongly agreeing with the statement below, while 27 respondents (41.5%) agreed. On the other hand, 5 respondents disagreed, and 3 of them strongly disagreed.

Figure 17: Teachers' Willingness to Take ICT Training Particularly Tablets



Conclusion

This study explored the perception of Djiboutian elementary school teachers on using tablets in primary education. The findings suggest that while teachers see tablet as useful tools that are user-friendly and therefore have a mostly positive perception towards it, there are several challenges that limit their effective use in the classroom.

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From Hiroshima to Hawaii: Deepening Study Abroad Experiences Through a Historical and Intercultural Education Course

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Official Conference Proceedings

Abstract
Hawaii is a popular destination for Japanese students to learn English, but they often face challenges in achieving full immersion because of the prevalence of the Japanese influence. Moreover, historical ties between Japan and Hawaii are often overlooked in study abroad contexts. To address these gaps, university in Hiroshima, in collaboration with a Honolulu-based partner institution, developed a course that explored the challenges faced by Japanese immigrants and their contributions to Hawaiian society. The course engaged students with historical and intercultural dynamics through lectures, guest speaker sessions, interactive discussions, reflective activities, and capstone research projects. A reflexive thematic analysis of students' weekly reflections identified four major themes: (1) learning and discovery, (2) personal and cultural connections, (3) critical analysis of historical narratives, and (4) application and integration. The results showed significant thematic progression in the students' reflections throughout the course. Using Hiroshima-Hawaii as an example, this study suggests the potential to enrich study abroad experiences by combining historical and intercultural education with reflective practices in a pre-departure course.

Keywords: Study Abroad, Pre-departure Course, Historical and Intercultural Education

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Introduction

The increasing globalization of higher education has underscored the need for innovative approaches to study abroad programs that go beyond basic language learning and cultural exposure. Hawaii, known for its rich multicultural heritage and historical significance, is a popular destination for Japanese university students seeking to learn English. Despite the popularity of Hawaii as a study abroad destination, many Japanese students face unique challenges that hinder their ability to achieve full linguistic and cultural immersion. One key factor is the presence of strong Japanese influences in Hawaii, which can create a sense of comfort that counteracts the depth of immersion and "foreignness" needed for transformative learning experiences.

Moreover, while the historical ties between Japan and Hawaii, marked by Japanese immigration and the profound contributions of Japanese Americans to contemporary Hawaiian society, form a deep cultural connection, these elements are often underexplored in conventional study abroad contexts. This oversight limits students' opportunities to develop a holistic understanding of the historical and intercultural dynamics shaping both societies.

To bridge these gaps, Hiroshima Shudo University, in collaboration with a Honolulu-based institution, developed an innovative course in 2023 that integrates historical and intercultural education as part of the curriculum of the Department of Global Politics. The course was designed to enrich students' knowledge and enhance their critical thinking, intercultural competence, and ability to make personal connections with historical narratives. Using a multifaceted pedagogical approach that includes lectures, guest speakers, discussions, and research projects, the course seeks to provide students with a structured, yet reflective, environment conducive to meaningful learning.

The purpose of this study is to evaluate course design and delivery by examining how students' historical and intercultural understanding of a potential study abroad destination (Hawaii) develops, as characterized by qualitative analyses of their weekly reflections submitted throughout the course, and to draw pedagogical implications to underscore the value of incorporating historical context alongside reflective practices in intercultural education, offer a model for enhancing study abroad experiences, and inform future curriculum development to support students' growth as globally competent individuals.

Background and Literature Review

Historical Ties Between Hiroshima and Hawaii

The historical relationship between Japan and Hawaii has been marked by significant migration and cultural exchanges. Beginning in the late 19th century, waves of Japanese immigrants arrived in Hawaii and contributed immensely to the development of Hawaiian society, particularly in the sugar plantation industry. In the 1880s, approximately 29,000 government-sponsored immigrants (*kanyaku imin*) arrived, of whom more than 11,000 (38.2 percent) were from Hiroshima (City of Hiroshima, 2020). These immigrants and their descendants have left a lasting legacy, enriching Hawaii's cultural tapestry and fostering deep-rooted connections that resonate even today. Okamura (2014) highlighted the role of Japanese immigrants in shaping modern Hawaiian society, contributing to various cultural, economic, and political aspects. Hiroshima and Hawaii also shared a sense of postwar reconciliation and peacebuilding efforts, as manifested in the 2023 sister park agreement

between the Hiroshima Peace Memorial Park and the Pearl Harbor National Memorial. Since 1959, Hiroshima and Honolulu have maintained a sister city relationship to promote peace and cultural exchange. Despite these multiple connections, conventional study abroad programs often overlook nuanced histories that could deepen students' understanding of both their own heritage and the host culture.

The Importance of Intercultural Education

Intercultural education has gained traction as an essential component of higher education, particularly in the context of study abroad programs. Byram (1997) emphasized that fostering intercultural competence, defined as the ability to navigate and engage effectively with cultures different from one's own, requires an intentional educational design. Integrating intercultural learning within a historical context allows students to observe and actively engage in cultural exchanges, thereby promoting in-depth learning. Holliday (2018) reinforced this idea by illustrating the importance of critically engaging with intercultural narratives to understand global interactions. Courses that integrate intercultural content with reflective practice enable students to develop empathy, critical thinking, and the ability to analyze complex social and historical dynamics. This holistic approach is essential for students to thrive in an interconnected world.

The Role of Reflective Practice in Education

Reflective practice has long been recognized as a powerful tool in educational settings. Dewey's (1933) foundational theories of reflection emphasized that engaging in reflective thinking allows learners to process their experiences, gain insights, and apply this learning to new contexts. Kolb (1984) expanded on this by linking experiential learning to reflection and advocated for the integration of reflective activities in education to deepen students' understanding. In study abroad programs, reflective journaling and similar practices enable students to track their evolving thoughts, emotions, and learning, facilitating a shift from surface-level to deeper critical reflection (Takei, 2024b). Ryan and Ryan (2012) demonstrated that structured reflection can help students synthesize experiences, leading to greater intercultural competence and personal growth. Mezirow (1991) further emphasized that reflective practices can foster transformative learning, in which students critically reevaluate their assumptions and apply new perspectives.

Reflexive Thematic Analysis in Educational Research

Reflexive Thematic Analysis (RTA) has emerged as a robust qualitative approach for studying reflective journals and other narrative data in educational research. Braun and Clarke (2006, 2019, 2021) explained that thematic analysis allows researchers to identify, analyze, and report patterns within data. RTA has been employed in educational research to explore reflective practices. Baker (2021) used RTA to analyze teaching philosophy statements over time. This approach identified changes in educators' thoughts and opinions about teaching and learning in higher education, thereby informing them about aspects of their continued professional development.

Integrating Historical Context and Reflective Practice

The intersection of historical education and reflective practice in intercultural settings holds significant promise for enhancing study abroad programs. While students may gain

superficial understanding through lectures and discussions, reflective practice allows them to internalize what they have learned, connect it to their personal experiences, and apply it in meaningful ways. Bennett (1993) supported this by asserting that intercultural competence develops through gradual engagement and reflection. The literature suggests that when students are encouraged to reflect on historical events and analyze them within an intercultural framework, they are more likely to develop the critical thinking skills and intercultural competence required for global citizenship. This integration can deepen their appreciation of the history that they are studying and foster a deeper connection with the host culture.

In summary, existing research supports the value of combining historical education, intercultural learning, and reflective practice in study abroad programs. This integration can create a rich learning environment that informs students, transforms their understanding, and fosters academic and personal growth. This study contributes to this body of knowledge by examining how a course developed at a Japanese university uses these elements to enhance students' experiences and insights.

Course Design and Pedagogical Approach

The course was developed because of a recently established partnership with a Honolulu-based institution. It has been carefully designed to integrate both historical and intercultural education to enrich students' future study abroad experiences in Hawaii. It is intended primarily as a pre-departure preparation course for a study abroad program in Honolulu but can also serve as a follow-up course upon return or as a stand-alone course. The inaugural session of the course was offered in Fall 2023 with 24 students enrolled, and the second session was offered in Fall 2024 with 20 students enrolled. This section outlines the course structure and student activities that collectively fostered a deeper understanding of the historical and cultural dynamics between Hiroshima and Hawaii.

Course Structure

The course was structured to provide a comprehensive educational experience spanning a semester, including lectures, interactive discussions, and research. Since this is not a history course that builds historical knowledge incrementally, the textbook chosen for the course contains two bilingual stories, "Grandpa, Tell Me the Story" and "A Letter from Grandma in Hawaii," both written primarily for children by a Hiroshima-based licensed interpreter guide whose work questions the connection between Hiroshima and Hawaii. The stories are fictional but closely based on interviews conducted with 26 Niseis as part of her grant-funded research (Unezaki, 2020).

Guest speaker sessions were at the core of the course. One guest speaker was the storywriter mentioned above, who gave lectures on the history of Japanese immigration to Hawaii, the socioeconomic contributions of Japanese Americans, and the historical significance of Hiroshima and Hawaii's legacy in peacebuilding, and more importantly, answered students' queries as they read the two stories and challenged them with questions such as why they think many immigrants were from Hiroshima and what they would do in these situations to stimulate group discussion. The other guest speaker was from the University of Hawai‘i at Mānoa, who gave a remote lecture entitled "Japanese and Okinawans in Hawai‘i: A Brief Political History," with his Yonsei identity and expertise in ethnic studies, near the end of the semester to round out the course.

These opportunities provided first-hand accounts and unique perspectives that enriched students' learning experience with their expertise; this direct engagement with experts allowed students to go beyond textbook knowledge and gain a nuanced understanding of the material. In addition, optional on-campus screening of documentaries complemented the course. The screenings featured "Go for Broke! - Memories of Hawaii Japanese Niseis" in 2023 and "Okagesama de - Hawaii Nikkei Women's Trajectory" in 2024. On both occasions, film director Hiroyuki Matsumoto, who has been passionately committed to preserving history, gave a talk.

Interactive group discussions were an integral part of the course, encouraging students to articulate their thoughts, challenge assumptions, and engage with diverse perspectives. These discussions were structured around guided questions that encouraged students to think critically about the intersection of historical and cultural contexts. Students were asked to compare and contrast historical narratives and discuss the varying interpretations and impacts of these narratives on contemporary Hawaiian and Japanese societies.

Student Activities

This course emphasizes reflective practice as a key component of the learning process. Students were required to submit weekly reflective comments documenting their thoughts, emotional reactions, and new insights gained during lectures, discussions, and guest presentations. These comments were summarized weekly and presented in the following class with feedback from the teacher. This reflection activity was designed to track students' evolving understanding, help them connect theoretical knowledge to personal experiences, and make them aware of how their reflections change over time.

To deepen their understanding, students participated in capstone research projects that required independent investigation into specific topics of their choice related to the course themes at the end of the semester. These projects encouraged students to explore historical events and cultural phenomena in greater depth. By conducting their own research, the students developed analytical skills and the ability to approach topics from multiple perspectives. As a tangible outcome, each student made a one-page contribution to the printed course booklet.

Integrative Pedagogical Goals

The overarching goal of the course was to foster critical intercultural competence among students by intertwining historical contexts with personal and collective reflections. Drawing on experiential learning theories (Kolb, 1984), the course aimed to move beyond traditional methods of teaching history and culture by creating an environment in which students can actively engage, think critically, and reflect on how these lessons apply to their intercultural journeys. This holistic approach aligned with the principles of transformative learning (Mezirow, 1991) and encouraged students to reevaluate their prior assumptions and embrace new perspectives as part of their study abroad experience.

In summary, the course design and delivery combined lectures, expert interactions, research projects, and reflective practices to create a rich, multifaceted learning environment. By focusing on the intersection of historical education and intercultural learning, the course aimed to engage students in a process that informs and transforms their understanding,

fostering the development of intercultural competence and a deeper appreciation of the history shared between Hiroshima and Hawaii.

Research Method

This study used reflexive thematic analysis (RTA) as the primary research method to examine complex qualitative data and explore the progression of students' intercultural and historical understanding. Weekly reflections submitted online by students throughout the course were analyzed to identify recurring themes and track cognitive and emotional changes over time. RTA allows for a structured examination of reflections, enabling the categorization of key ideas and patterns in personal narratives that emerge throughout the students' learning journey.

Takei (2024a) presented preliminary findings based on the 2023 course, which indicated a significant increase in students' understanding of shared history; students expressed an initial lack of knowledge but showed a growing interest in learning more about these connections. To substantiate and elaborate on these findings, this study used two datasets: reflection comments submitted in the 2023 course and those submitted in the 2024 course. The 2023 dataset contained 255 entries with 35,926 characters in Japanese. The 2024 dataset contained 243 entries with 63,983 characters. As a result of greater teacher encouragement in the second year, students in the 2024 course tended to write more substantial and concrete comments. Before the study, all participating students were provided with detailed information about the research objectives and procedures. Written informed consent was obtained from each student to ensure voluntary participation and ethical compliance throughout the research process without affecting their course evaluation.

Following the RTA guidelines, the process begins with initial coding, which segments the data into meaningful units and labels each unit, followed by theme development and refinement to capture significant patterns related to the research objectives.

Key Findings

An analysis of student reflections through the RTA revealed four key themes that underscored the students' transformative journeys throughout the course. These four themes, which include (1) learning and discovery, (2) personal and cultural connections, (3) critical analysis of historical narratives, and (4) application and integration, illustrate the progression from initial engagement to deep intercultural and historical reflection. This section describes the themes identified, along with relevant student comments in English (translated by the author from the original Japanese), and characterizes the weekly theme progression.

Theme 1: Learning and Discovery

This theme captures moments when students realize their lack of knowledge, recognize new information or gain insight into historical or cultural contexts, often followed by eagerness and curiosity to learn more.

Many students expressed surprise at the depth of the historical connections between Hiroshima and Hawaii, particularly regarding the significant impact of Japanese immigration on Hawaiian society. Their reflections often highlighted students' newfound appreciation of the contributions of Japanese Americans to Hawaii's cultural and social development. This

theme demonstrated the students' journey from basic awareness to more comprehensive learning, where historical facts became more than just content; they became stories of resilience and community.

One student wrote, "The lecture on the history of Japanese immigration to Hawaii was eye-opening. I didn't know that the Hiroshima dialect influenced the Japanese spoken in Hawaii."

Another student noted,

> I was surprised at how little I knew about Hawaii's history. For example, I learned that the migration of Japanese workers to Hawaii began during the Meiji era, which gave me a new perspective on the history of the Japanese diaspora.

This theme emerged throughout the course of the study. Students frequently mentioned gaining new knowledge, discovering surprising facts and deepening their understanding. The early weeks focused on introductory learning, whereas the later weeks demonstrated more sophisticated reflections on historical and cultural topics. Ultimately, the learning and discovery process led to a shift in the purpose of potential future visits to Hawaii.

Theme 2: Personal and Cultural Connections

This theme reflects how students relate to a topic personally or culturally, often identifying commonalities or sharing histories. Some students reflected on their family backgrounds and discovered connections with the experiences of Japanese immigrants and shared cultural values. Students' reflections indicated an increased sense of empathy and understanding of their cultural heritage, which translated into deeper engagement with the course material.

For instance, one student wrote, "It was surprising to learn about the gender roles that were evident and confusing to Nisei children in Japanese schools in Hawaii, which made me question traditional Japanese values."

Another student noted, "Hearing stories about Hawaiians with roots in Hiroshima made me feel connected to the topic on a personal level, and it gave me a chance to talk to my grandfather whose cousin emigrated to Hawaii."

Students often expressed personal or cultural connections in their reflections, particularly in the early and middle weeks. These connections highlighted the resonance of the course content with their experiences, identities, and personal and family backgrounds. This theme emerged consistently, demonstrating how the course fostered a sense of relevance and relationship with the material.

Theme 3: Critical Analysis of Historical Narratives

This theme focuses on students critically examining historical events, questioning perspectives, and analyzing the broader implications of the narratives discussed in class. The reflections show that students began to question dominant historical narratives and explore alternative perspectives. This theme demonstrates that students shifted from passive learning to active analysis and evaluation of the biases and implications of their historical narratives.

One student remarked, *"*I found it intriguing how the portrayal of Japanese immigrants in Hawaii changed over time. It made me question how history is written and whose stories are told."

Another student stated, "I began to question the dominant narrative that portrays Hawaii as a tropical paradise, especially when I learned about the struggles of Japanese sugar plantation workers."

This theme became more prominent in the middle and later weeks. Students increasingly engaged in the complexity of historical events, critiqued existing narratives, and discussed the implications of multiple perspectives. This progression suggests a deepening of critical thinking skills as students engaged in historical analysis.

Theme 4: Application and Integration

The final theme represents how the students connected their learning to broader intercultural and personal contexts. Students reflected on how to apply the knowledge gained in their future academic and professional lives and their roles as global citizens. This theme illustrates a deeper level of understanding of how historical knowledge is integrated into students' worldviews, shaping their perspectives on intercultural interactions and global coexistence. Students expressed their intention to carry forward what they have learned by becoming more active in intercultural dialogue and promoting community inclusivity.

One student wrote, "I was inspired to think about how the lessons of resilience from Hiroshima and Hawaii can be applied to current global issues like migration."

Another student noted, "Discussing Hawaii's diverse cultural heritage inspired me to think about how we can promote a multicultural, harmonious society in Japan."

This theme emerged gradually, appearing primarily in the later weeks. This reflects the students' efforts to apply their learning to broader contexts, integrate knowledge across topics, and consider its practical implications. This progression indicates an increasing ability to synthesize and meaningfully use learning.

Throughout the course, students progressed from initial curiosity and limited knowledge to a deeper understanding and meaningful application of their knowledge about the historical connections between Hiroshima and Hawaii. Early reflections focused on discovery, with students expressing surprise at the new information and forming personal and cultural connections. As the course advanced, they critically analyzed historical narratives, questioned assumptions, and engaged with multiple perspectives. Connections deepened as the students related the material to their lives, fostering cultural empathy and awareness. Ultimately, students integrated their learning into broader contexts and demonstrated a willingness to apply their insights to academic, personal, and societal challenges, demonstrating their growth as intercultural learners.

Discussion

The analysis revealed a well-structured progression of student engagement, understanding, and application, which highlighted the transformative potential of the course. The themes of learning and discovery, personal and cultural connections, critical analysis of historical

narratives, and application and integration show that the students moved from initial curiosity and superficial understanding to deeper reflection and meaningful application of knowledge. This underscores the effectiveness of course design in fostering intercultural learning and critical thinking skills. The pedagogical implications of a Hawaii pre-departure course for Hiroshima students can be summarized as follows.

(1) Building Foundational Knowledge

The first step of the course is to provide structured opportunities for students to explore the history and cultural connections between Hawaii and their home regions. Providing a historical context and introducing key themes early can help students enter the study abroad experience with a solid foundation.

(2) Fostering Personal and Cultural Connections

The course can create opportunities for students to reflect on their personal connections with Hawaii and explore shared cultural elements. Activities such as group discussions, personal storytelling, and interactions with (guest) individuals with Hawaiian-related experiences can foster empathy and cultural awareness.

(3) Enhancing Critical Thinking

The emphasis on critical analysis of historical narratives suggests that the pre-departure curriculum should include activities that challenge students to question their assumptions, examine multiple perspectives, and understand the complexity of historical events. This can help students engage more meaningfully with the cultural and historical landscapes they will encounter abroad.

(4) Promoting Application and Integration

Encouraging students to consider how to apply their learning in future academic or professional contexts can increase their motivation and engagement. This could include reflective journals, scenario-based discussions, or projects that link course content to broader societal challenges.

(5) Structured Reflection and Progression

Incorporating regular reflection assignments aligned with the four themes identified in this study can help students track their progress and deepen their insights. These guided reflections can help students to monitor their progress.

By integrating these pedagogical elements, a pre-departure study course in Hawaii or abroad can effectively prepare students to maximize their learning, foster cultural empathy, and engage critically with their experiences abroad. A course designed to promote intercultural competence should integrate foundational knowledge, reflection, and practical applications. Students gain a deeper understanding of diversity by exploring historical and cultural contexts such as Hawaii's multicultural heritage and its ties to Japan. Activities such as personal storytelling, peer discussions, and critical analysis can foster empathy, interpersonal skills, and thoughtful engagement with cultural differences and similarities. Reflective

journaling and scenario-based exercises help students internalize their learning and apply intercultural skills in real-world contexts.

Studying abroad in Hawaii offers transformative benefits by immersing students in multicultural environments of historical and cultural significance. Students develop cultural empathy and critical thinking by engaging in Hawaii's unique narratives, including its historical ties with Japan and role in global history. This program promotes personal and interpersonal growth by encouraging meaningful connections and enhancing intercultural communication skills. Additionally, students have the opportunity to integrate classroom learning with real-world experiences, preparing them to thrive in a diverse multicultural society. These experiences enrich students personally, strengthen their academic and career pathways, and equip them with global-citizenship competencies.

Conclusion

This study highlights the critical role of pre-departure courses in preparing students for study abroad experiences, using the example of Hiroshima students studying abroad in Hawaii. This course provides a unique context for fostering foundational knowledge, empathy, critical thinking, and intercultural competence by exploring the historical and cultural connections between Hiroshima and Hawaii. The analysis of student reflections revealed key themes of learning and discovery, personal and cultural connections, critical analysis of historical narratives, and the application and integration of knowledge, demonstrating the potential of such courses in cultivating intercultural awareness and readiness.

However, this study is limited to the pre-departure phase and does not assess the impact of the course on students' actual experiences in Hawaii. While reflections suggest significant learning and personal growth, the lack of post-study abroad evaluations makes it difficult to determine how effectively the course prepares students for the realities of studying in Hawaii. Future research should include longitudinal studies to evaluate how pre-departure preparation influences students' intercultural competence, adaptability, and overall study abroad experience and progress upon return.

Despite these limitations, this study provides valuable insights for designing pre-departure courses that capitalize on unique historical and cultural connections, such as those between Hiroshima and Hawaii. Building on these findings, educators can enhance pre-departure programs to ensure that students are well-equipped to navigate and benefit from the transformative experiences of studying abroad. This approach not only supports individual student growth but also contributes to fostering global citizenship and intercultural understanding.

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Analyzing the Effectiveness of Teaching Games for Understanding (TGFU) Approach in Traditional Games in Solomon Islands: Enhancing Gross Motor Skills

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Abstract
The Teaching Games for Understanding (TGFU) approach is widely utilized in physical education, particularly in sports and games. Developed by Bunker and Thorp (1982), this model emphasizes game situations, tactics, and decision-making. Recently, researchers have adapted game-based models to focus on decision-making and skill execution. This study applied the TGFU approach, integrated with traditional games, to improve students' gross motor skills. A total of 52 students participated and were randomly assigned to experimental and control groups. The traditional games selected for this study involved psychomotor activities like movement, leaping, and jumping. A pre-test and post-test design was used, with the experimental group receiving TGFU-based lessons and the control group participating in conventional PE lessons. Two traditional games were used for the pre- and post-tests, while four intervention lessons were delivered using the TGFU approach. These lessons emphasized skill execution techniques and explosive movements, drawing content from the national PE syllabus, including games, athletics, and running sub-strands. The results, analysed using a paired t-test, demonstrated that the TGFU approach had a significant positive impact on gross motor skills compared to conventional PE lessons.

Keywords: Traditional Games, Gross Motor Skills, Teaching Games for Understanding and Convention Learning

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Introduction

Physical education plays a vital role in the school curriculum by helping students develop skills and beliefs through integrated physical activities that are essential for their daily lives (Siedentop, 2002). Without proficiency in these fundamental motor skills, students may struggle to acquire broader games and movement skills, making such proficiency critical for maintaining an active lifestyle. In the 21st century, physical education has evolved to meet modern societal needs, emphasizing the development of active, social, and creative learners (Dyson & Casey, 2012). Schools now aim to enhance students' abilities, interests, and motivation for holistic development (Bessa et al., 2021).

However, the integration of 21st-century teaching methods, such as the Teaching Games for Understanding (TGFU) approach, seeks to address these challenges. This approach emphasizes developing socially active and creative learners while enhancing their abilities, interests, and motivation to engage in physical education. By focusing on learning through play, TGFU combines the technical and tactical aspects of games, enabling students to gain a deeper understanding of both the game and its processes.

This study aims to incorporate traditional games into the physical education curriculum using the Teaching Games for Understanding (TGFU) approach. It focuses on finding innovative and creative ways to integrate traditional games into physical education, fostering motor skills development for learning to students. Specifically, the research examines how the TGFU approach can enhance the gross motor of 6th-grade students in the Solomon Islands. To achieve this, the study will address the following key questions.

The practical significance of this research lies in applying the Teaching Games for Understanding (TGFU) approach to traditional games to enhance students' gross motor and social skills in the Solomon Islands. Key points include:

- *Addressing Ineffective Traditional Game Teaching*: The study highlights the shortcomings of conventional lesson delivery, which often overlooks the deeper value of traditional games. Additionally, many teachers lack the conceptual understanding to adapt TGFU in their teaching methods. This research aims to fill that gap by offering strategies to effectively incorporate traditional games into physical education using the TGFU model.
- *Fostering Critical Knowledge*: TGFU encourages students to acquire critical knowledge related to problem-solving, skill mastery, and game strategy. By enhancing cognitive processes required for psychomotor skills, the model helps students perform skills effectively while understanding the broader context of the game. This approach supports the development of both gross motor and social skills.

Literature Review

The TGFU model focuses on a tactical approach to teaching games, integrating decision-making, problem-solving, and skill development within game situations. TGFU encourages breaking down or modifying games to suit learners' needs. Light highlighted that modification emphasizes specific tactical aspects of games. The Tactical Games approach provides a structured environment for technical, tactical, and fitness training during game practice (Watson et al., 2011). This approach enhances players' decision-making and critical thinking skills.

Pill (2013) introduced the Game Sense approach, which promotes cognitive development through play, using modified games to enhance skill acquisition. Metzler (2017) suggested that game practices involve skill drills and instructional strategies to teach both individuals and teams decision-making in game contexts. Both the Tactical Games and Game Sense models align with TGFU in their focus on teaching through games and using sampling and game structure exaggerations to guide learning. However, Play Practice pedagogy encourages diverse instructional strategies without emphasizing the development of "thinking players" through guided discovery, a key feature of TGFU and Tactical Games (Light, 2014). Mitchell et al. (2020) emphasized that it involves exploring game rules, discovering tactical and technical aspects, and addressing game-related challenges.

The term "motor" refers to the biological and mechanical aspects that facilitate movement. He further defined motoric abilities as the outward capability to perform body movements in various directions (flexibility). These movements are driven by mechanical factors, such as contracting large muscles to perform actions like walking, running, and jumping. However, Cattuzzo et al. (2016) argued that motor skills are not innate but learned over time, requiring the body to adjust to specific movements during games. Movement patterns in games can improve dexterity, speed, strength, flexibility, and hand-eye coordination.

Prawitasari (2015) highlighted the role of traditional games in fostering unity and preserving cultural heritage, while Aziz and Wan Ramli (1994) also noted their cost-effectiveness, often utilizing recycled materials from the local environment. Herrera Velásquez et al. (2018) pointed out that policies from educational institutions and local governments support traditional games, encouraging intercultural dialogue and sustainability. Abbas & Rajab (2015) highlighted how traditional knowledge resists Western cultural influences, guiding daily practices with local wisdom.

Sample of Study

This study involved a total population sample of 52 students, ensuring that the same participants completed both the pre-tests and post-tests to maintain reliability. This requirement was successfully met. The research focused on 6th-grade students from the East Constituency region of Malaita Province in the Solomon Islands. Three schools were randomly selected within a specific ward in the region to serve as the sample population for the study.

Table 1: Distribution of Participants by Gender

Distribution of participants by Gender		
Participant	**Students**	**Percentage**
Male	27	51.9
Female	25	48.1
Total	52	100

Instrument

The Test of Gross Motor Development, Second Edition (TGMD-2) profile, designed by Ulrich, D.A. (2000), was used as a key instrument to evaluate gross motor skills. This

standardized tool has been widely validated in previous studies. The assessment focused on locomotor skills, including three specific performance items: running, horizontal jumping, and leaping.

Result and Analysis

Table 2: Statistic Description for Gross Motor Skills

Pre-performance Outcome (Gross Motor Skills)							
	No	P-value	Mean	Variance	Std deviation	Skewness	Kurtosis
Expr. Pre-test	30	0.590	33.777	16.133	4.016	-0.423	0.561
Cont. Gr. Pre-Test	22		34.318	13.318	3.677	0.061	-0.276
Post-performance Outcome for Gross Motor Skills							
Exp. Gr. Post-test	30	0.010	36.766	9.633	3.103	-0.033	-0.069
Cont. Post-Test	22		33.272	20.779	4.558	-0.37	-0.006

Table 2 shows that the p-value for the pre-test of both groups is 0.590, which is greater than the alpha level of 0.05, indicating no significant difference between the groups. However, the post-test reveals a significant difference, with a p-value of 0.010, which is less than the alpha level of 0.05, highlighting a notable difference between the groups in the second post-test.

Statistical analysis of the pre-test data for both the control and experimental groups, as shown in Table 1, indicates improvements in both groups' gross motor skills performance. However, when applying the T-test model for gross motor skills, the control group outperformed the experimental group with a mean score of 34.318 in the pre-test, compared to the experimental group's mean of 33.777. The standard deviation for the experimental group was 4.016, while the control group had a standard deviation of 3.677. Despite the experimental group achieving a higher score, the control group's scores were more consistent and closer to the mean. The skewness for the experimental group was -0.423, and the kurtosis was 0.561, while the control group had a skewness of 0.061 and a kurtosis of -0.276, suggesting that the control group had lower scores compared to the experimental group.

Table 3: Paired Samples t-Test

Measure 1		Measure 2	t	df	p	Cohen's d	SE Cohen's d
Pre-Test	-	Post Test	-2.269	51	0.028	-0.315	0.148

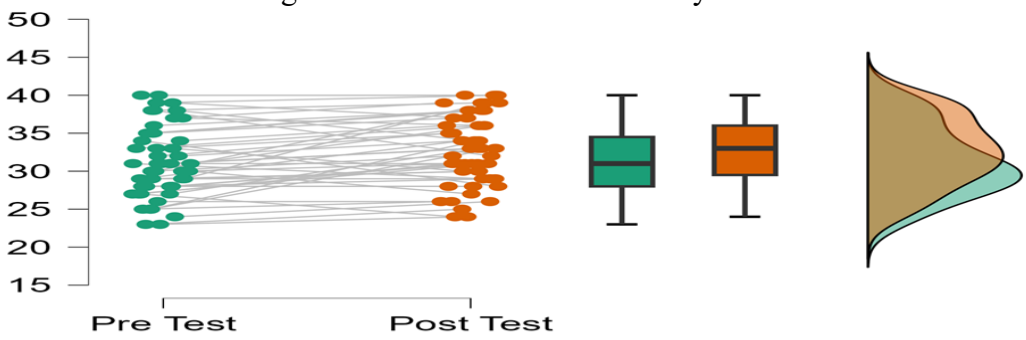
Note. Student's t-Test.

Table 4: Test of Normality (Shapiro-Wilk)

			W
Pre-test	-	Post-test	0.984

Note. Significant results suggest a deviation from normality.

Figure 1: Gross Motor Skills Analysis



The Paired sample T test, table 3 shows the p value of 0.028 less that alpha 0.05 indicated an impact on the intervention on students' gross motor skills.

Table 5: Gross Motor Skills Category

	Pre-test				Post-test			
	Experimental		Control		Experimental		Control	
GMS Category	M	SD	M	SD	M	SD	M	SD
Locomotor	17.5	2.2	17.7	1.4	18.2	2.0	17.2	2.5
Object control	16.2	2.7	16.5	2.6	18.5	1.6	16	2.3

Table 5, presented two categories for gross motor skills: locomotor and object control. In the pre-test, the control group had a higher mean of 17.7 for locomotor skills compared to the experimental group, which scored 17.5. However, the experimental group had a higher standard deviation of 2.2, while the control group had a standard deviation of 1.4, indicating greater variability in the experimental group's scores. For object control in the pre-test, the control group had a mean of 26.5 with a standard deviation of 2.6, while the experimental group had a mean of 16.2 and a standard deviation of 2.7, suggesting that the experimental group maintained relatively high values compared to the control group.

After the intervention, the post-test results showed a slight increase in the experimental group's mean for locomotor skills to 18.2, while the control group's mean decreased to 17.2. Similarly, for object control, the experimental group had a mean of 16.2 with a standard deviation of 2.7, while the control group had a mean of 16.5 and a standard deviation of 2.6. The post-test results indicated a slight decrease in the control group's mean from 16.5 to 16, while the experimental group saw a modest improvement of 13.9%. Several factors may have contributed to the decrease observed in the control group.

Discussion

Sutapa et al. (2021) reinforce the findings of this study by emphasizing the role of modified play activities and the integration of TGFU through traditional games in improving children's gross motor skills. This approach encourages critical thinking, problem-solving, and a deeper understanding of play. Within the context of traditional games and learning through play, the concept of individuality is essential. By incorporating this principle, learners can identify challenges, reflect on them, and critically apply their skills, shifting the focus from conventional methods to a more student-centred approach. The results presented p value 0.082 and indicate that the intervention influenced students in varied but effective ways, significantly enhancing their gross motor skills. The TGFU intervention fostered highly competitive skill applications through six traditional game skill tests. Consequently, the findings demonstrate a clear positive impact on students' gross motor skill development, as reflected in T test analysis.

Additionally, Table 16 reveals an increase in mean values for both experimental and control groups, signifying a positive effect on gross motor skills across both cohorts. A more in-depth analysis of skill performance in the experimental group highlights a 90% improvement across six skill tests from pre-test to post-test. In comparison, the control group exhibited a 60% improvement across the same skill tests, further validating the influence of TGFU on students' motor skill development.

Conclusion

This study provides valuable insights into strategies that ensure physical education meets its intended objectives. It advocates for a more technical and tactical approach by integrating modern games with traditional games in a learner-centered framework. Transitioning from a teacher-centered model to a student-centered approach enhances learning outcomes, particularly in skill performance. This study emphasizes discovery learning, reflection, and question-based engagement, where students actively participate in identifying problems—whether in knowledge or skill execution—within physical education through traditional games.

Based on the findings, the study draws the following conclusions:

Both teaching approaches used in the intervention positively influenced students' gross motor skills. However, the TGFU approach had a significantly greater impact on skill performance compared to conventional teaching methods. Given this, it is recommended that physical education in the Solomon Islands adopt the TGFU strategy to enhance student learning. The TGFU model not only broadens and deepens students' skill application but also proves to be more effective in fostering motivation and engagement in traditional games. This approach allows students to develop skills by breaking down and modifying games, making it highly suitable for traditional games.

Implication

Expanding the understanding of integrating both the TGFU approach teaching methods is essential for enhancing and sustaining physical education. Traditional games play a crucial role in students' physical, social, and cultural development within the country. The findings of this study indicate that while the TGFU approach effectively motivates students to engage

in physical education, its implementation in traditional games further enhances student participation and motor skill development.

Therefore, this study recommends future research to explore a more comprehensive integration of both TGFU and traditional approaches. Future studies should adopt appropriate research designs and methodologies that effectively support students' learning of game knowledge and strategies. Contextualizing these approaches to suit specific games or activities will be beneficial. Additionally, this study acknowledges the value of conventional learning and traditional teaching methods, as they have been shown to positively impact students' physical and social development.

Limitation

While this study provides valuable insights, several limitations should be considered for future research on a similar topic.

Firstly, the sample size was restricted to only two schools from rural areas within a single district, which may have influenced the overall findings. A broader sample across multiple regions would yield more comprehensive results. Additionally, the number of lessons administered was limited to only eight—four per group—whereas a greater number of lessons could have provided deeper insights into student learning outcomes.

Secondly, this study primarily focused on physical and skill-based abilities, which were assessed outside the lesson rather than during class sessions. Conducting assessments during outdoor gameplay rather than in a controlled classroom environment may have impacted the accuracy of skill evaluation. Another significant challenge encountered was student absenteeism. Some students who participated in the intervention were absent during the game tests and interviews, making it difficult to fully capture their perspectives on traditional games.

Furthermore, the research design focused primarily on non-cognitive aspects such as motivation and skill performance, which may not have been sufficient to fully explore other essential learning factors. A major limitation was the shortage of trained physical education teachers, which affected the depth and accuracy of interview responses.

Recommendation

This study recommends integrating critical concepts of physical education teaching into teacher training programs and incorporating them into the national curriculum. By equipping future physical education teachers with effective teaching methodologies, this approach addresses major challenges currently faced in PE instruction. Introducing a comprehensive sports pedagogy alongside critical teaching strategies will help mitigate existing difficulties in physical education learning.

Teacher training institutions should apply these methods in PE courses for both pre-service and in-service teachers. Specifically, adopting the TGFU approach will enhance the quality of PE instruction at the elementary school level. Furthermore, repositioning physical education as a core subject within the curriculum could significantly contribute to achieving its intended educational goals. Collaboration between the Ministry of Education and Human

Resource Development and teacher training institutions is essential to bridge the gap between theoretical knowledge and its practical implementation in schools.

Beyond recommending the integration of traditional games into the curriculum, this study also encourages PE curriculum developers to include a stronger emphasis on traditional games in the syllabus. This will help preserve cultural values while ensuring sustainable and meaningful learning experiences in physical education.

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The Sustainable University of the Future: Interdisciplinary Imaginaries of Learning Spaces and Curricula in Egypt

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Abstract
Although Education for Sustainable Development (ESD) has received much attention as a concept that aims at developing citizens who live sustainably on Earth; research concerning international governance and policy was focused on developed nations rather than developing ones. This study presents the outcome of a series of multi-stakeholder workshops conducted within an interdisciplinary research project involving administrators, senior faculty, students, and staff while merging architecture and education to envision learning space and curricula. The aim of merging these two fields is to envision the future of learning spaces and curricula in the sustainable development campuses in Egypt. The workshops identified the prevailing education and sustainability megatrends most relevant to Egypt that directly apply to envisioning sustainable educational futures. Subsequently, multiple groups of student participants developed possible future learning scenarios and designed learning spaces and possible employable technologies to realize these future modes of teaching and learning. Analysis of the teams' outcomes revealed the emphasis on interdisciplinarity and the dismantling of silos between academic disciplines as a strategy to respond to the identified megatrends. The groups uniquely addressed this interdisciplinarity theme through technology, Artificial Intelligence (AI), and Extended Reality (XR) technologies integrated with architectural design imaginaries, transcending traditional spatial and temporal boundaries. The findings of this study included designed interdisciplinary courses and reimagined learning spaces from architectural and technological points of view. The study also provides expected challenges and limitations about the future of ESD and sustainable campuses in developing nations.

Keywords: Interdisciplinarity, Megatrends, Education for Sustainable Development, Future Learning Scenarios, Learning Spaces

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Introduction

The United Nations (UN) Agenda 2030, established in 2015, and its 17 Sustainable Development Goals (SDGs) confirmed that higher education institutions (HEIs) should offer programs that implement and teach sustainable development (SD) across all disciplines (Cottafava et al., 2022). The whole-institution approach (WIA) and the whole-sector approach (WSA) are needed to accelerate sustainable practices in higher education (Kohl et al., 2021). While the future of sustainability in education has been examined in developed nations, much less research has focused on developing and underdeveloped nations, which have considerably different challenges, realities, and potentials. This knowledge gap created a substantial hurdle for HEIs in Egypt and other developing countries in promoting sustainability in education, leading to the misallocation of resources and unrealized potential. Moreover, most efforts to promote sustainability in education have focused on curriculum, spaces, tools, or operations in a siloed approach, leaving the possibility of synergies unexplored (Leal Filho et al., 2019).

In response, a research project titled "Sustainable Development Campus: Envisioning the Futures of Learning Spaces and Curricula for AUC and Egypt" was initiated at the American University in Cairo (AUC), aiming to answer the following central question: "How can we define the future of higher education for sustainable development in Egypt, in 2030 and 2050?" To do so, the research developed further questions, including "What curriculum and educational spaces are needed to deliver these visions?" and "What daily teaching and learning practices and learning environments are needed in class and outside for realizing these visions?"

A series of multi-stakeholder workshops were conducted at AUC to answer these questions, integrating undergraduate students from the Architecture (ARCH) and Educational Studies (EDUC) departments. The first workshop asked the participants to prioritize the most relevant megatrends in ESD in Egypt and how this can be reflected in future learning scenarios in HEIs. The second workshop focused on imagining future learning scenarios in AUC specifically and designing learning spaces that meet the future needs of ESD. Finally, a third workshop was organized where groups of students, the future leaders of education, presented their visions of future learning spaces and curricula at AUC.

In this paper, we present the results of analyzing the student groups' outcomes from the second and third workshops. We aim to present various interventions for HEI in developing countries with an emphasis on the concept of interdisciplinarity. These interventions envision future learning scenarios, learning spaces, and curricula that serve educational needs. Importantly, these interventions are theoretical concepts and practical solutions that can be implemented in real educational settings. The literature presented in the discussion field includes studies concerning similar results to the group outcomes. Literature included studies from different universities applying interdisciplinarity as well as the use of AI, VR, and XR in HEI.

Methodology

The student workshop was conducted in collaboration between the Architecture and Educational Studies departments. Undergraduate architecture students, working with graduate educational studies students, formed five groups. These students were not just participants but active contributors to the research, tasked with developing detailed proposals envisioning

future curricula and learning spaces that can accomplish an ideal future around 2050, where AUC is a local and regional leader in sustainable education. Their role was crucial in exploring and integrating established megatrends, focusing on the concept of interdisciplinarity, and visualizing innovative learning spaces that can adopt the proposed future teaching-learning activities.

The five groups were required to attend two weekly follow-up sessions via Zoom, during which they received feedback by presenting their progress work to the research group. The outcome was presented in a third Zoom meeting to two lead faculty members from the architecture and educational studies departments and supporting research assistants. The student deliverables comprised a 10-slide PowerPoint presentation, a Word document, and an A1 storyboard in PDF format. The researchers gathered all the submittals and analyzed and compared all the proposals to reach the conclusion presented in this paper. Table 1 provides a summary of the submitted proposals.

Table 1: Group Titles, Ideas & Connection With Megatrends

Group No.	Group Title	Overarching Idea	Main Drivers/ Megatrends
A	Learning Pods	Personalizing learning through the integration of separate AI-equipped pods that are reconfigurable	• Flexible learning modalities • Personalized learning • Artificial Intelligence & Machine Learning
B	AI student Companion	Using AI as an assistant to students throughout all stages of university	• Artificial Intelligence & Machine Learning • Partnerships
C	Application Based Learning	Combining professional practice with the education phase bridging the gap between both	• Artificial Intelligence & Machine Learning • Lifelong learning • Personalized learning
D	Core Curriculum Activation	Enhancing the core curriculum to overlap and complement any primary program curricula	• Collaborative Learning • Partnerships
E	Immersive Learning	Integrating immersive Learning to simulate real-world scenarios by removing the boundaries between the university and the community	• Artificial Intelligence & Machine Learning • Flexible learning modalities • Efficiency

Results

The group outcome analysis results are presented and compared based on this paper's two areas of focus: the learning scenarios and the learning space design. In addition, the key themes repeated among different groups are highlighted.

Learning Scenario

The proposed learning scenarios have posed outlines of potential HEI course curricula that not only adapt to the future but also encourage interdisciplinarity and the blending of innovative learning tools and collaborations, as well as the creative use of the architecture around them. The proposed course curricula include integrating core courses into the different disciplines to unite multiple fields and join forces to tackle global challenges like climate change. External entities can sponsor such courses to merge theory with practice. Other curricula revolve around flexibility and letting an AI assistant choose the courses and subjects for every student based on performance. The following section will mainly explore two primary proposed curricula applying interdisciplinary education from groups C and E.

"Integrated Architectural Futures" Course (Group C)

Group C suggested a course titled "Integrated Architectural Futures," which transcends traditional boundaries while fostering a dynamic learning environment where everyone—students, educators, and industry professionals—becomes both a teacher and a learner. The course emphasizes interdisciplinary collaboration, real-world partnerships, and cutting-edge technology. "Integrated Architectural Futures" graduates emerge as adaptable, forward-thinking architects who blend theory, practice, and technology seamlessly. They are equipped to shape the built environment, foster sustainable communities, and lead architectural innovation. Some key features this course offers include holistic learning spaces where physical and virtual learning spaces are utilized. Reflecting interdisciplinarity in the curriculum, students work with practitioners as part of the program and collaborate with existing firms, working on real-life projects and gaining internship opportunities. The course heavily relies on advanced technology such as VR, AR, and holograms, which can be a service that the university provides or a support tool as a benefit from the aforementioned collaborations.

This proposal achieved interdisciplinarity by merging theory with practice. Linking architecture firms with realized projects, experts, and teaching professors will bridge the employability skills gap in HEI, creating real-world partnerships. As a result, graduates of this course are capable of connecting theoretical knowledge with practical applications. In this case, technology would facilitate interdisciplinarity with the aid of modern advanced visualization tools. Moreover, flexible learning settings as students choose between physical and virtual environments would create a more adaptable learning experience.

"Green Chemistry and Sustainability Issues in Egypt" Course (Group E)

Group E proposed an undergraduate lecture course in Green Chemistry and Sustainability focused on environmental issues in Egypt. This course will be taught to a multidisciplinary group of science and non-science majors. It will introduce students to green chemistry and sustainability topics while immersing them in using the scientific literature. Students will use an immersive learning approach to simulate real-life situations in different communities in Egypt, aiming to propose and implement solutions. Immersive learning will allow students to interact and communicate with professionals in real-time anywhere in the world, giving students endless possibilities to learn at any time.

The concept of interdisciplinarity is slightly different in this course than in the previous course. This course combines various disciplines in the curriculum, including chemistry and

sociology, creating a blend of expertise. Not only is the curriculum a result of a multi-discipline merge, but it also invites students of different fields to take that course, which means that the curriculum has sufficient flexibility and is accessible enough to accommodate students from various academic backgrounds.

One interesting theme repeatedly mentioned in the proposed future learning scenarios is the notion of interchangeability between the different roles of students and teachers. Many of the designed curricula played freely with the roles of students, where in some cases, they are the learners, and in other cases, they take on the role of the teacher. The proposals did not assume the function of a traditional lecture-based style or teacher-centered methods but rather explored how these responsibilities can interchange and what that means for the future of education, which was a very interesting finding.

Learning Space Design

The range of learning space designs created during the workshop is remarkable. It opened doors to many creative and non-traditional approaches and questioned the limits of architecture. Each group generally designed a learning space that serves the proposed learning scenario and curricula. Although each group had a vision of interdisciplinary learning that impacted their learning space design, three distinctive themes emerged from analyzing all proposals: central cores, flexible and modular spaces, and AI and technology-embedded spaces. Drawing from the workshop outcomes, this section will delve deeper into these three themes.

Central Cores

Groups D and E designed very similar learning spaces focusing on the relationship between the spaces more so than the design of one space in particular. They proposed a central core in the middle with specialized or independent work areas, lecture halls, or labs surrounding it (Fig. 1). The central core encompasses the required equipment for an immersive experience, including VR, AR, and XR (Extended Reality) (Fig. 2). The goal behind this design is for the spaces to foster connections and networks between different fields and disciplines and between different people as well. This would allow students to connect with entities and organizations outside HEI, removing the boundary between the educational institution and the community while also breaking the limits of time and space.

Figure 1: Central Core Design - Group D

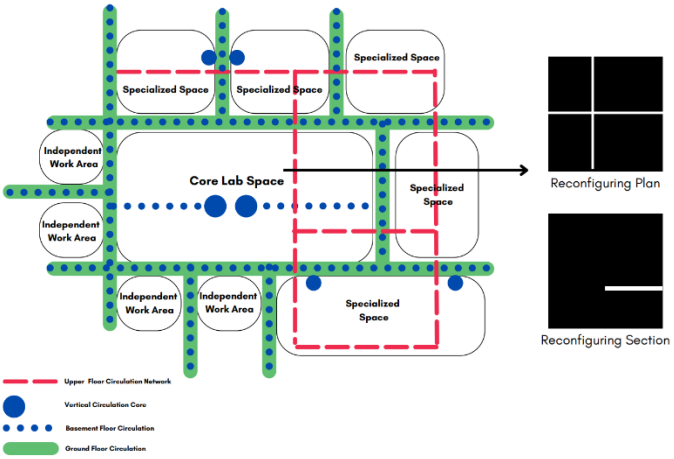
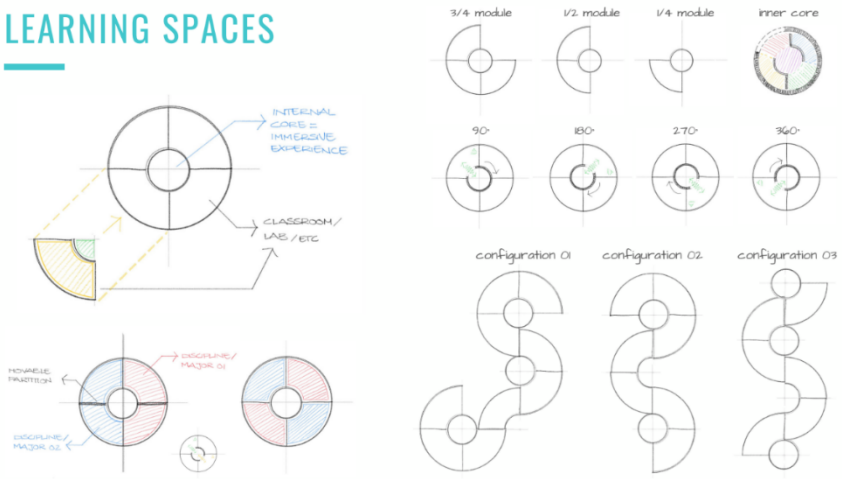


Figure 2: Central Core Design - Group E



Flexibility & Modular Spaces

Complementing the central core design, Groups D and E have also opted for modular and changeable design, which is dynamic in contrast to the static central core. With an architecturally flexible setting, this module can be configured spatially and changed to create multiple layouts in plan and section. Housing either small or large groups of students, the modules can be puzzled together to create one big space to accommodate whichever size is needed, or it can be split into contained zones for concentrated activities.

Group A's proposal explored flexibility and modularity to the maximum, defying the traditions of architecture. The learning space is visualized as a pod, a singular space for individual students that can be utilized differently as shown in Figures 3 and 4. Equipped with advanced technologies, the pod is qualified to support students in their studies and beyond. These pods are flexible and can be adapted to multiple settings, including at home and on campus. Students can join external activities from their own pod and access software remotely. The pods can be reconfigured to be separate to serve the individual or joined to create a pod assembly as shown in Figure 4.

Figure 3: Pod Module – Group A

Figure 4: Pod Module – Group A

AI & Technology Embedded Spaces

As evidenced in Table 1, most of the groups chose to incorporate technology in their design. Integrating VR, AR, XR, and built-in AI systems was a prominent and recurring theme. The goal was for such technologies to open doors, dissolve physical architectural boundaries, and create dynamic, interactive, and inclusive learning spaces.

For example, Group C proposed using AR/VR rooms where students can conduct lab experiments that would otherwise be inaccessible (Fig. 5). This approach enhances students' learning experience and provides them with hands-on opportunities. Group A suggested having AI assistants on standby to guide students whenever they face difficulties or to support those with special needs, thus providing them with personalized assistance based on need and necessity. Additionally, Group E explored the use of extended reality to virtually transport students to different locations where they can interact with other peers to exchange knowledge and experiences (Fig. 6). This not only allows for collaborative learning but also broadens the understanding of global contexts.

Figure 5: AR/VR Room – Group C

Figure 6: Extended Reality- Group E

As a recapitulation, the learning space design proposals demonstrate an understanding of future architectural spaces as flexible, adjustable, and modular with AI capabilities straying away from the traditional direction of learning space design of a static wall-confined room. They introduce the idea of having mobile spaces that can be transported from the student's home to campus and elsewhere without losing the available software, programs, and benefits that the campus provides. The designs also focus more on designation and creating small spaces with one concentrated activity and purpose. Students switch between stations depending on need and function. Additionally, advanced technology and AI systems have become an inseparable part of architecture to give a new purpose to traditional architecture. Throughout student groups' discussions, it is worthwhile mentioning that the role of architecture went beyond designing physical spaces to creating a learning experience that utilized VR and AI to break boundaries between the outside world (real-life collaboration, internships, etc.) and the inside (classrooms).

In each of the three displayed themes, interdisciplinarity is represented in multiple ways. An interdisciplinary connection is established between various fields and disciplines by creating central cores that house technological tools and equipment. This core acts as a hub where students from different backgrounds can interact and exchange ideas. The concept of designing flexible and modular spaces does not necessarily represent interdisciplinarity but instead facilitates it. Depending on the field, discipline, and need, these spaces can be configured to accommodate different user groups, students, and majors, paving the way for interdisciplinary potential. Lastly, the intersection of architectural design with digital technology allows interdisciplinary play between the internal learning environments and external firms and companies.

Discussion

The workshop outcomes highlight the role of interdisciplinarity in teaching and learning and the architecture of HEIs. Interdisciplinarity is a broad term that can be translated in many ways. One way to achieve interdisciplinarity was by integrating multiple disciplines, aiding in understanding global challenges that are affected by various disciplines. The approach used by the groups can be described through the Interdisciplinary Concept Model that introduced several steps in the design process of an interdisciplinary curriculum, which starts from selecting a core theme or topic and then making associations between disciplines (Ashby & Exter, 2018).

Moreover, the groups acknowledged the need to address different conditions when designing and implementing interdisciplinary courses. A study described that interdisciplinary higher education would require a set of subskills and conditions, such as knowledge of disciplinary paradigms and communication skills (Spelt et al., 2009). A study conducted in the UK aimed to develop a best practice model to facilitate interdisciplinarity in HEI; and highlighted the importance of a collaborative culture of shared values and ownership among faculty and students (Power & Handley, 2017). Moreover, the same study highlighted the need for physical space to facilitate interdisciplinary thinking (Power & Handley, 2017). This was reflected in the groups' outcomes as the role of architecture designing learning spaces is crucial to facilitate interdisciplinarity. According to Affordance theory, the design of the physical environment of learning spaces directs and impacts the pedagogies and activities inside (Reinius et al., 2021). The group's outcomes included common design features such as a central core that serves as a hub integrating students from different disciplines. A similar concept of a central gathering area called "Agora" was applied in a Finnish school that was architecturally designed to have flexible learning spaces (FLS) (Reinius et al., 2021). Among our group outcomes was envisioning this central core as an immersive learning room to serve different disciplines. The architectural design element goes beyond designing physical spaces utilizing immersive technologies such as AR, VR, and XR, which are equipped with AI, breaking the boundaries of time and space and aiding collaborations between HEIs and external entities in the community. An exciting project is the "Skope" learning environment, which includes an AR and a VR visualization tool where students of architecture, engineering, and construction (AEC) can design sustainable buildings by walking through key spaces of the building (Vassigh et al., 2018).

Embedding AI systems to facilitate the integration of interdisciplinarity was raised in all groups' outcomes. One of the groups emphasized the role of AI in assisting in personalized and adaptive learning through AI assistants. The integration of AI can generate personalized curricula for every student and suggest firms for potential collaborations encouraging experiential learning. One study discusses the role of AI in personalized learning specifically in learner profiling, adaptive content delivery, and real-time feedback (Barrera Castro et al., 2024).

While there is much research on AI integration in education across different fronts, the impact of AI on interdisciplinarity is a topic that would require further research. The outcomes from the workshop generally concluded that AI has great potential to develop interdisciplinary learning and teaching and improve the learning space design without exactly mentioning how it is going to do so. A study showed that AI assists interdisciplinarity as it helps overcome challenges such as epistemic divides between disciplines through search engines, recommendation engines, and automated content analysis (Baum, 2020).

In addition, some groups suggested more collaboration between HEIs and firms/companies, creating a connection between theory and practice as a means to interdisciplinarity. A study proposed a more comprehensive approach to this collaboration known as the "closed cycle collaboration process" where companies raise their sustainability needs, and universities respond with solutions that companies study their feasibility till final solutions are reached (Orecchini et al., 2012). This approach to collaboration would complement interdisciplinarity towards the implementation of ESD programs in HEIs through fostering real-life partnerships, adding to the student's learning experience, and closing the gap between education and the labor market. Complementing theory with practice allows students to witness the implementation of the theory learned in real-life projects, allowing them to earn a

new and essential set of skills. This notion is commonly known as experiential learning. Experiential learning and real-life partnerships "enhance[s] the learner's creativity and critical thinking through reflection and participation in situational contexts." (Alarcón, 2021), which allows students to put gained knowledge into action. This opens many doors for collaborative work where both entities (educational institutions and practice firms) benefit from one another. Students gain new experiences and test their knowledge while practitioners/professionals use the student's creativity and innovation (Toro & Arguis, 2015).

Furthermore, interdisciplinarity redefines the teaching curricula, allowing for adaptive study and personalized self-paced learning. While building the teaching curricula, students can be granted the flexibility to pick and choose the disciplines they want to study and construct their interdisciplinary curriculum. According to the US Department of Education, personalized adaptive learning is where educational objectives, approaches, and content are chosen based on the student's needs (Peng et al., 2019). Learning is perceived as more meaningful and relevant because their interest drives it. Students become more motivated to study and explore the benefits of an interdisciplinary curriculum. Moreover, interdisciplinarity also prevents fragmentation and compartmentalization in teaching curricula and forces students and teachers to have a global view of the world (Santos et al., 2017) and to tackle global and social challenges (Falcus et al., 2019). It also restrains students from having a purely theoretical background in a specific discipline. Instead, it motivates them to explore the implementation of these theories in practice and obtain a new set of skills.

However, it is also essential to mention the challenges of interdisciplinarity to be able to work around them. As beneficial as it is, interdisciplinary education can often be described as superficial as it takes the learner's attention from one discipline and disperses it to many others simultaneously (Cooke et al., 2020). This results in students learning "a bit of everything" and not specializing in one particular field, which can lead to another challenge, namely career risks (Cooke et al., 2020).

Throughout the conducted workshop, participants showed great belief that interdisciplinarity is showing a lot of promise in the future of learning spaces and curricula in Egypt and developing nations. Several considerations were taken when proposing solutions; in learning space design Group E proposed the central core to be an immersive learning room to be shared considering its high cost. Moreover, groups discussed the challenges that would face the implementation of interdisciplinarity in HEIs in Egypt and developing nations. Among those challenges was the resistance to change by faculty members who will need a new mindset and culture that supports collaboration which is the cornerstone of interdisciplinarity. A study conducted in Egypt revealed that the majority of students merely have any prior knowledge about ESD; this raises a great challenge to HEIs to create awareness about ESD before its implementation (Ramzy & Wahieb, 2012).

Conclusion

In this paper, outcomes of the student workshop were analyzed to create a vision of the sustainable university of the future, focusing on the interdisciplinary imaginaries of learning spaces and curricula in Egypt. The outcomes and interventions proposed for future learning scenarios, learning spaces, and curricula moved beyond theoretical realms to explore practical solutions that can be implemented in natural educational settings. Interventions included using artificial intelligence (AI) and extended reality (ER) technologies, which facilitated the implementation of interdisciplinarity by offering flexible learning modalities.

The analysis of the outcomes shows that interdisciplinarity in education can be interpreted in various ways, ranging from merging between two or more disciplines to going beyond the HEI realm and fusing theory with practice. The workshop also determined that the architecture of the learning space and AI are inevitable parts of interdisciplinarity as they promote and enable a more holistic use of interdisciplinarity where students connect across time and space. Though an exciting finding, very little research has been done on the impact of HEIs' architecture and whether or not it aids in introducing interdisciplinary education to Egypt. The correlation between interdisciplinarity and AI is also yet to be explored.

Nevertheless, weighing the benefits of interdisciplinarity against its drawbacks, this concept is undoubtedly a valid step for the future university as it carries personalized learning, experiential learning, and dynamic learning spaces that are boundaryless and embedded AI systems. Although the implementation of interdisciplinarity in Egypt and underdeveloped nations seems to be challenging in terms of resources, awareness, and culture; yet huge opportunities arise for HEIs in these countries as strive to improve educational quality at relatively affordable fees for international students.

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Ethics Approval

The Institutional Review Board at the American University in Cairo has reviewed and approved this work.

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Empowering Future Instructional Designers: Ethical AI Integration for Inclusive Learning

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Abstract
This work-in-progress study examines a graduate-level instructional design course focused on ethical AI integration, addressing critical gaps in AI education through practical application. Utilizing a backwards design approach, the online course integrated hands-on AI tools practice with ethical considerations in instructional design. Data collection will begin in March 2025. Initial student reflections suggest a potential transformation from basic AI tool usage to sophisticated prompt engineering and the ability to leverage a variety of generative AI tools in the instructional design process. This research aims to contribute practical insights for developing AI-integrated instructional design curricula and preparing future instructional designers for ethical AI implementation.

Keywords: Artificial Intelligence, Instructional Design, Higher Education, Ethics, Teacher Education

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Introduction

The increasing integration of artificial intelligence (AI) into educational practices has created a corresponding need to prepare instructional designers for effective and ethical AI implementation (Zawacki-Richter et al., 2019). While existing research explores technical aspects and policy considerations of AI in education, practical guidance for instructional designers incorporating these tools into their practice remains limited. This study, currently underway, addresses this gap by examining the development and implementation of a graduate-level course at the University of Alabama, focusing on practical skill development and ethical considerations related to AI (Holmes et al., 2022). The goal is to equip future instructional designers with a strong understanding and skill base to effectively and ethically utilize AI tools in their practice, a crucial step in ensuring their workforce readiness (McNeill, 2025).

Literature Review

Current literature acknowledges the transformative potential of AI in education but lacks concrete frameworks for implementation in instructional design contexts. The rapid evolution of AI tools, particularly generative AI, has created both opportunities and challenges for educational practitioners (McNeill, 2025). This course aims to address these challenges, focusing on AI's role in instructional design, exploring its benefits and limitations, and emphasizing practical skills such as prompt engineering. To ensure relevance and efficacy, a backwards design, student-centered approach was adopted, aligning with best practices in instructional design (Wiggins & McTighe, 2005).

Course Design and Content

The course design utilized a backwards design approach, integrating hands-on practice with multiple AI tools while emphasizing ethical considerations and real-world applications. The first course sections ran from May 2024 to July 2024 and the course was repeated in the next semester, August 2024-December 2024. The online course included several synchronous Zoom sessions, peer review, and opportunities for discussion.

The course covered the following topics:

- Introduction to Gen AI
- Ethical Considerations
- Prompting Fundamentals
- Learning Objectives and Outlines
- Assessments and Rubrics
- Authoring and Evaluating Course Content
- Generating AI Images
- Simulations and VR Integrations

Methodology

This study employs a mixed-methods approach to examine the experiences of 55 graduate students enrolled in an eight-module course on AI integration in instructional design. Data collection, which will begin in February 2025, will include post-course surveys and qualitative analysis of student reflections. A focus group with eight students is planned to provide deeper insights into the course's impact.

Anticipated Results

Analysis of anticipated student reflections is expected to reveal key themes related to AI literacy, skill development, and implementation challenges. Based on preliminary observations, students may demonstrate a transformation in their understanding and application of AI tools throughout the course. One student noted, "This course has already proven to be invaluable to my work...I used AI extensively for idea generation, content, assessment development, discussion forum prompts, and rubrics." This reflects the practical application of course concepts in real-world scenarios. Another key element of the course was ethics case studies, prompting discussion and analysis among students when making technology-related decisions.

The development of effective prompting strategies was central to the course, guided by the RESPECT framework (Role, End Goal, Specifics, Context, Enumeration, Constraints, Tone) (McNeill, 2024).

Theoretical Framework

The design of this course was informed by emerging theoretical frameworks for AI integration in instructional design contexts. Drawing from the modified Unified Theory of Acceptance and Use of Technology (UTAUT) model (Dwivedi et al., 2019), the course structure acknowledges that effective AI implementation depends on multiple interconnected factors: performance expectancy, effort expectancy, social influence, facilitating conditions, attitude, and behavioral intention. Each module was designed to address these components, with particular emphasis on building performance expectancy through hands-on activities and improving attitude through ethical case studies.

Recent research suggests that instructional designers' adoption of AI tools is significantly influenced by perceived usefulness and ease of use (Weng & Chiu, 2023), which aligns with the course's focus on practical application and structured skill development. The RESPECT (Role, End Goal, Specifics, Context, Enumeration, Constraints, Tone) framework for prompt engineering (McNeill, 2024) introduced in the course directly responds to the identified need for systematic approaches to generative AI interaction, addressing a gap identified in multiple studies regarding effective prompt engineering practices (Lo, 2023).

Methods

The mixed-methods approach planned for this study is well-aligned with current research methodologies in AI education. Similar studies examining AI integration in instructional design have employed both quantitative measures to assess skill development and qualitative analysis to capture nuanced perspectives on ethical implementation (Yogesh et al., 2023). Our planned focus group methodology parallels approaches used in studies of instructional designers' AI adoption patterns, where rich qualitative data has proven valuable for understanding contextual factors affecting implementation (Gupta et al., 2023).

The post-course survey instruments are being designed to capture not only technical skill acquisition but also changes in attitudes toward AI, addressing what Bozkurt (2023) identifies as the critical need to understand both the technical and affective dimensions of AI adoption in educational contexts. This holistic assessment approach acknowledges that effective AI literacy encompasses both practical skills and critical perspectives.

Practical Applications

Early student reflections from the course reveal patterns consistent with broader research on instructional designers' experiences with AI tools. Similar to findings from studies of practicing instructional designers (documented in the research literature), students have identified time savings, ideation assistance, and content development support as primary benefits of AI integration. The progression from basic usage to more sophisticated prompt engineering mirrors the adoption patterns identified in studies of professional instructional designers, where expertise develops through iterative experimentation with increasingly complex applications (Gibson, 2023).

One notable aspect of the course design is its emphasis on transparency and ethical considerations, responding directly to concerns identified in the literature regarding AI's potential limitations. By requiring students to critically evaluate AI outputs and implement verification processes, the course addresses what Khalil and Er (2023) identify as essential practices for responsible AI implementation. As one student noted, maintaining human oversight while leveraging AI capabilities represents the optimal approach to instructional design in the AI era.

Preliminary Results

Preliminary analysis of student engagement with the course modules suggests particular enthusiasm for prompt engineering techniques and ethical case studies. This finding aligns with research indicating that instructional designers prioritize maintaining control over AI outputs while maximizing efficiency benefits (Lim et al., 2023). Students' reflections on practical applications reveal a progression from viewing AI as a simple content generator to recognizing its potential as a collaborative tool throughout the instructional design process.

Challenges identified by students—particularly regarding verification of AI-generated content and maintaining pedagogical quality—mirror those reported by practicing instructional designers. This suggests that the course is effectively preparing students for real-world AI implementation challenges they will encounter in professional contexts. The iterative refinement of prompting strategies throughout the course appears to be addressing what research has identified as a critical skill gap among instructional design professionals (Lo, 2023).

As this research progresses, we anticipate that the longitudinal data will contribute valuable insights on effective pedagogical approaches for developing AI literacy among instructional design students, addressing a significant gap in the current literature on AI in education, which tends to focus more on technical implementation than on capacity building for educational professionals.

Limitations and Future Research

This study's primary limitations include its geographic scope within a single institution and the need for longitudinal data to assess long-term impact. Additionally, the researchers hope to determine the correlation between the RESPECT framework and student success using AI. As one student stated, "Prior to my use of AI, I would need many hours of brainstorming and thought development...but AI tools have expedited that process immensely."

Future research questions include:

- How does the integration of AI-assisted course design impact students' ability to create inclusive learning experiences?
- To what extent does hands-on AI experience influence students' attitudes towards and proficiency in using AI for educational purposes?
- What are the key challenges and opportunities identified by students in applying AI-generated content in ID practice?

Conclusion

This ongoing research seeks to provide practical insights for developing AI-integrated instructional design curricula while maintaining emphasis on ethical implementation. The anticipated findings are expected to support the importance of hands-on experience with AI tools balanced with critical consideration of their appropriate use in educational contexts. As AI continues to evolve, preparing instructional designers to effectively and ethically leverage these tools becomes increasingly crucial for the future of instructional design practice.

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Bridging the AI Gap: Micro-videos for Transforming Faculty Teaching

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Abstract
This work-in-progress study presents an innovative approach to faculty AI literacy through targeted micro-learning videos. The initiative addresses the growing need for practical AI training in higher education through a library of 110 two-minute videos designed to make AI integration accessible and manageable. Recent data shows that while 65% of students believe AI training should be integrated into coursework and 62% of employers value AI knowledge, only 40% of faculty are familiar with AI tools. This project aims to bridge this gap through bite-sized, on-demand learning experiences. The study employs a mixed-methods approach to evaluate the effectiveness of micro-learning interventions in developing faculty AI literacy and implementation skills. Initial pilot feedback indicates reduced preparation time, enhanced personalization of learning experiences, and increased confidence in AI tool usage among faculty participants.

Keywords: Artificial Intelligence, Faculty Development, Micro-learning, Higher Education, Educational Technology

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Introduction

The integration of artificial intelligence (AI) tools in higher education presents both opportunities and challenges for faculty development. AI's potential to transform teaching and learning is significant, yet its successful implementation hinges on faculty readiness and willingness to adopt these new technologies. Recent data from Inside Higher Education (2024) reveals a significant disconnect between stakeholder expectations and faculty readiness: while 65% of students believe AI training should be integrated into coursework and 62% of employers value AI knowledge in graduates, only 40% of faculty report familiarity with AI tools. More concerning, 42% of faculty currently prohibit AI use in their classrooms, highlighting an urgent need for accessible professional development solutions.

Several factors contribute to this hesitancy and lack of preparedness. Faculty members often face information overload, struggling to keep pace with the rapidly evolving landscape of AI tools and applications (Zawacki-Richter et al., 2019). Time constraints, technical knowledge gaps, infrastructure limitations, and cost considerations further exacerbate the challenges of AI integration in higher education. As noted by McNeill (2025), many faculty members express concerns about the ethical implications of AI, including issues of plagiarism, data privacy, and algorithmic bias.

To address these challenges, this study examines an innovative approach: targeted micro-learning videos designed to make AI integration accessible and manageable for faculty across disciplines. The University of Alabama Teaching Academy developed an on-demand AI learning library that contains bite-sized courses to fit faculty's busy schedules. The goal is really AI literacy and how to use AI ethically and effectively in our courses. This initiative aims to provide faculty with the knowledge, skills, and confidence necessary to effectively leverage AI tools in their teaching practices, ultimately enhancing student learning outcomes and preparing graduates for the AI-driven workforce.

Literature Review

Microlearning, defined as short, focused learning units, has gained traction as an effective strategy for professional development, particularly in rapidly changing fields like AI (Hug, 2007). The principles of microlearning align well with the needs of busy faculty members who require flexible and accessible learning opportunities. Microlearning, particularly within personalized learning environments, offers opportunities to adapt learning to individual needs, potentially enhancing knowledge retention, engagement, and application of new skills (Brusilovsky et al., 2018).

Recent research highlights the potential of AI in various aspects of higher education. For example, AI-powered writing assistants can provide draft feedback and suggestions to help students improve writing skills, especially in large classes. In art history, AI can be used to generate images and analyze art and historical context. In world languages, AI can be very valuable in translating language and assisting students in learning and communication. In a biology class, AI can power lab report analysis and streamline grading and feedback.

Psychology classes can use data analysis automation to enhance the processing and interpretation of research. Computer science can use code review automation to help identify and address issues in student assignments more efficiently. Furthermore, the ethical considerations surrounding AI in education have become a focal point of discussion.

Ensuring fairness, transparency, and accountability in AI applications is crucial to prevent bias and promote equitable learning opportunities for all students (Holmes et al., 2022).

Methodology

This research employs a mixed methods design to examine the effectiveness of micro-learning interventions in developing faculty AI literacy and implementation skills. The intervention consists of 110 two-minute videos organized into seven distinct learning tracks covering foundational concepts, practical applications, and ethical considerations. Each video focuses on immediate, practical application while maintaining flexibility through 24/7 access and self-paced learning. The seven learning tracks are: AI History & Foundations, Basics of Using AI, Instructor Support, Classroom Activities, AI for Creating Assessments & Rubrics, AI for Grading & Feedback, and Teaching Students about AI. There's no set way to approach any of the learning tracks. You can skip around. You can start anywhere you like.

The study will recruit 100 faculty participants for a four-week intervention period, with data collection planned from February to August 2025. A subset of 20 participants will engage in focus group discussions to provide deeper insights into the intervention's impact. Data collection methods include pre/post surveys measuring knowledge, attitudes, and self-efficacy; platform usage analytics; focus group interviews; and a six-month follow-up assessment to evaluate long-term impact and sustainability.

The pre and post faculty surveys will include knowledge, attitude changes and improvements in self-efficacy. Platform usage will be analyzed to assess if the platform is effective in the focus group. In depth feedback and insights will be collected based on our survey results. The six-month follow-up assessment focuses on long-term impact and sustainability, implementation tracking, student learning outcomes, faculty adoption rates, and challenges encountered.

Implementation Strategy

The project follows a phased implementation approach, launching with 40 initial videos in December 2024 before expanding to the complete library in early 2025. The video content emphasizes real-world classroom examples across various disciplines, from English composition to computer science. Each learning track addresses specific faculty needs, from basic AI literacy to advanced applications in assessment and feedback.

The intervention design acknowledges the diverse needs of faculty members through multiple entry points and flexible learning pathways. Videos incorporate practical demonstrations of AI applications in large enrollment courses, including automated grading assistance, discussion monitoring, and personalized feedback at scale.

This approach aims to address common faculty concerns while showcasing the potential benefits of AI integration. The automated grading assistance can free up instructor time and ensure consistency, discussion monitoring and moderation can deploy algorithms to monitor those online discussions and moderate the content, personalized feedback at scale provide tailored feedback to students addressing individual needs and supporting their learning, and group project management can use AI to facilitate collaboration, decide on tasks and track projects for group projects, track project progress for group projects.

Preliminary Findings

Early feedback from faculty accessing the initial video content indicates several positive outcomes. Participants report reduced course preparation time, enhanced ability to create personalized learning experiences, and increased confidence in implementing AI tools. These preliminary results suggest the effectiveness of the micro-learning format in addressing faculty needs while accommodating busy schedules. Faculty who have reviewed initial videos have reported greater confidence in using AI tools and integrating tools in their professional and teaching practices.

Discussion and Future Directions

While initial results are promising, several considerations emerge for future development. The rapidly evolving nature of AI technology necessitates regular content updates and expansions. Additionally, varying levels of faculty readiness and potential resistance to AI adoption require careful attention to change management and support structures.

The research will continue through 2025-2026 with ongoing assessment and iteration based on faculty feedback. Future development will focus on expanding resources to address emerging needs, evaluating long-term impact, and developing additional support mechanisms for faculty implementation. Specifically, future research should investigate the impact of micro-learning videos on student learning outcomes and explore the potential for scaling up the intervention to reach a wider audience of faculty members.

This project contributes to the growing body of knowledge on effective faculty development strategies for AI integration in higher education. By providing accessible, practical, and engaging learning experiences, this initiative aims to empower faculty members to embrace AI as a tool for enhancing teaching and learning in the 21st century.

Conclusion

The AI Microlearning Video Initiative offers a promising approach to bridging the AI gap in higher education. By providing faculty with accessible and relevant training, this project has the potential to transform teaching practices and prepare students for the AI-driven workforce. The ongoing research and development efforts will continue to refine and expand the initiative, ensuring its long-term impact and sustainability.

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Fostering Intercultural Competence Through an Italian-Japanese Business Language Course

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Abstract
Developing intercultural competence is an important goal of world language courses. One of the curriculum designs to foster intercultural competence includes collaborative online international learning (COIL). Although the benefits of COIL have been documented, finding international partners can be a challenge. The present study addresses this issue by partnering students of two different languages, Italian and Japanese, at Emory University. We developed a business language course consisting of learners of Italian and Japanese to enhance students' intercultural competence through collaborative work. The class met twice a week, once together in English to discover the business culture of Italy and Japan, and another time separately to learn business language skills in Italian or Japanese. Language lessons employed a task-based language teaching (TBLT) pedagogical approach and community-engaged activities so that students could work on real-life tasks. Tasks in our course were centered around Business Night preparation and execution. Business Night is an event in which students engage with representatives from Italian and Japanese companies in the local community. Seven students of Italian and nine students of Japanese participated in the study. Students' learning reflective essays were the main data source which were analyzed qualitatively to identify emerging themes. Results showed that students gained intercultural competence through collaboration with students of the other language. Furthermore, students gained intercultural competence through observation of two faculty of different cultural backgrounds collaboratively teaching a course.

Keywords: COIL, Business Language Course, Intercultural Competence

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Introduction

In an era of increasing globalization, effective communication across cultural and linguistic boundaries is essential for success in international business. This paper examines the development and implementation of the course Business Communication in the Globalized World: The Case of Japan and Italy, co-designed and co-taught by the authors of this paper. Offered for the first time in Spring 2024, this course aims to help students develop essential business-related vocabulary, best practices in professional communication and etiquette, collaborative communication skills, and intercultural competence.

The course design integrates multiple instructional approaches, including lectures conducted in English, language-specific lessons in Italian or Japanese, task-based and community-engaged learning activities. Utilizing the Collaborative Online International Learning (COIL) framework, the course fosters collaboration and intercultural exchange, enabling students to engage meaningfully with global perspectives in business communication.

A key feature of the course is its community-engaged learning experience, in which students conceptualized, organized, and executed the Italian and Japanese Business Night. This event served as a conference and networking opportunity, allowing students to interact directly with local business professionals from Italy and Japan, thereby applying theoretical concepts in real-world settings.

The following section provides a literature review on three foundational concepts of our pedagogical approach: COIL, intercultural competence, and community-engaged learning.

Literature Review

The Collaborative Online International Learning (COIL) Framework and Its Implementation

The COIL pedagogical framework facilitates virtual intercultural collaboration between students and faculty from different institutions worldwide. By integrating online communication technologies into coursework, COIL provides students with meaningful global learning experiences fostering the development of intercultural competencies and cross-cultural communication skills (Guth & Helm, 2010). Through structured collaboration with peers from diverse cultural and linguistic backgrounds, students engage in project-based learning that enhances their ability to navigate professional interactions in an international business environment.

While COIL offers significant benefits for intercultural learning, its implementation presents several challenges. One of the most prominent difficulties is time zone coordination, which can hinder synchronous communication and require scheduling flexibility. Additionally, curriculum alignment between collaborating institutions can be complex as courses often have distinct learning objectives, academic calendars, and assessment methodologies. Another common challenge is partner engagement as maintaining motivation and active participation across institutions requires sustained facilitation and institutional support (O'Dowd, 2023).

To address these challenges, we adapted the COIL model to our needs by partnering an Italian course with a Japanese course within the same institution instead of finding an

international partner. This approach eliminated time zone constraints, as both courses were scheduled during regular class hours. Additionally, operating within the same institutional framework facilitated seamless curriculum alignment, allowing faculty to closely collaborate in designing shared objectives and activities. The in-person component further enhanced student engagement, fostering a more cohesive and interactive learning environment, while maintaining the intercultural and collaborative benefits of COIL.

Structured Implementation of COIL in Our Course

Our adaptation of COIL follows the four key stages outlined by the SUNY COIL Center, ensuring a structured and immersive learning experience:

(1) Icebreakers and Team Building – Students participated in interactive activities (i.e. self-introductions, games, storytelling) designed to develop a sense of community across language groups and increase engagement for effective collaboration.
(2) Comparative Discussion and Cultural Analysis – Students engaged in discussions comparing business communication practices in Italy and Japan. These discussions deepened their intercultural knowledge and facilitated critical reflection on cultural differences in professional settings.
(3) Collaborative Project Work and Problem-Solving – The project in question was the Business Night event. Working in teams, students applied their knowledge to real-world business challenges, engaging in joint event preparation that required cross-cultural communication and collaborative decision-making.
(4) Reflection and Conclusion – Students participated in debriefing discussions to reflect on their learning and what their peers learned, critically assessing their intercultural growth and considering the professional applications of their newly acquired skills.

This structured approach allowed students to progress through increasing levels of intercultural interaction, culminating in a transformative learning experience. By implementing COIL within a single institution, while maintaining its core principles of intercultural collaboration, we successfully mitigated logistical challenges while providing students with globalized business communication experiences.

Intercultural Competence

As previously mentioned, the central objective of this course is to develop intercultural competence. Intercultural competence refers to the ability to communicate and collaborate effectively with individuals from diverse cultural backgrounds in a manner that is respectful, inclusive, and equitable. It extends beyond merely recognizing cultural differences; it involves fostering shared points of reference and demonstrating adaptability in both language and communication. Hammer (2015) defines intercultural competence as “the capability to shift one’s cultural perspective and appropriately adapt behavior to cultural differences and commonalities” (p. 483). This dynamic skill set enables individuals to navigate cross-cultural interactions with sensitivity and awareness, essential for fostering meaningful global engagement.

Intercultural competence is a critical skill in today’s globalized business environment, where effective communication across cultural boundaries is essential for success. In the context of our course, which focuses on Italian and Japanese business communication, developing intercultural competence means equipping students with the ability to navigate professional interactions in culturally diverse settings. This involves not only linguistic proficiency but

also a deep understanding of cultural norms, values, and business etiquette. Both Italian and Japanese business cultures place a strong emphasis on interpersonal relationships, but they differ significantly in communication styles, decision-making processes, and professional etiquette. Teaching business communication in these two languages requires not only linguistic training but also an emphasis on intercultural competence to help students navigate these differences successfully.

Developing intercultural competence in the context of teaching Italian and Japanese for business communication is essential for preparing students to navigate the complexities of international business interactions. By integrating language learning with cultural awareness and professional etiquette, our course ensures that students are not only linguistically proficient but also culturally adept, fostering their ability to communicate effectively and build relationships in diverse business environments.

Community-Engaged Learning

We integrated a community-engaged component into the course to provide students with meaningful opportunities to apply their learning in real-world contexts. This experiential approach enhances their understanding of business communication in intercultural settings, strengthens critical thinking and problem-solving skills, and fosters a sense of responsibility. Moreover, community-engaged learning creates a dynamic educational environment where students move beyond theoretical discussions and actively participate in professional and social exchanges. Through direct interactions with Italian and Japanese business professionals, students develop a deeper appreciation for cultural nuances in business communication, etiquette, and negotiation styles. These experiences not only reinforce linguistic and professional competencies but also cultivate adaptability and intercultural sensitivity—critical skills for success in today's global economy.

Furthermore, community engagement encourages students to recognize the reciprocal nature of learning. While they gain valuable professional insights from industry experts, they also contribute fresh perspectives, demonstrating how academic knowledge can be applied in diverse, real-world scenarios. As Hartfield-Méndez (2013) asserts, "community-engaged learning can better prepare students for their future careers and their development as global citizens," by actively participating in structured experiential learning, students become more culturally aware, socially responsible, and better equipped to navigate professional environments that require collaboration across linguistic and cultural boundaries.

Methodology

During the semester, we conducted action research to further our understanding of the value of our innovative course design that incorporated a modified COIL method and community-engaged learning activities into business language courses.

Research Questions

Our exploratory qualitative study was guided by the following two research questions.

(1) Can we produce COIL benefits such as fostering intercultural competence by combining two groups of students of different languages, instead of combining students from different institutions in two countries?

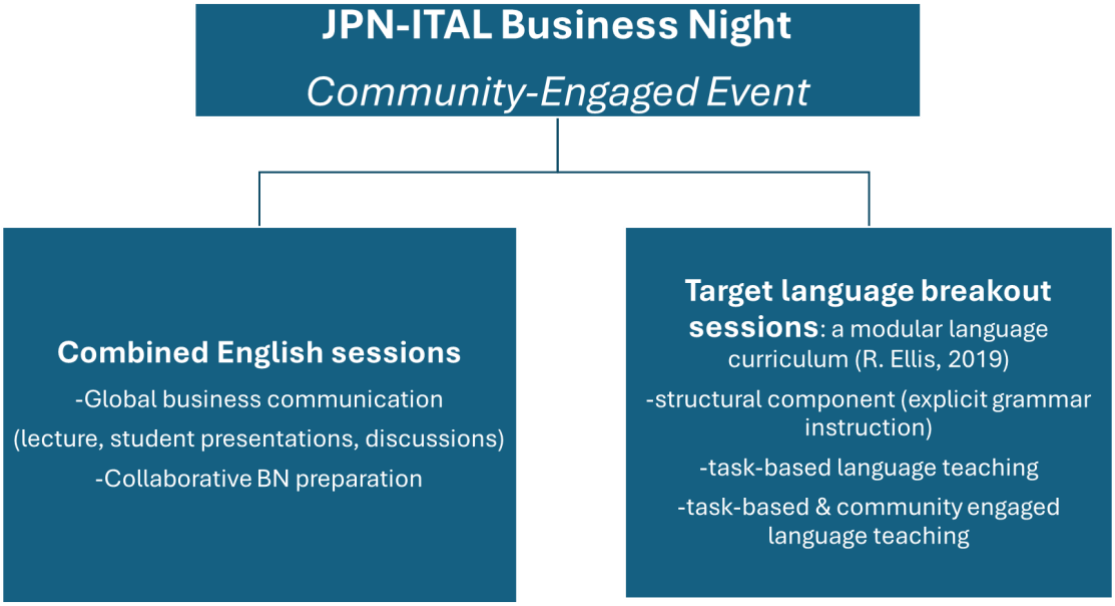
(2) Through community-engaged learning, do students perceive improvements in their language skills or increased confidence in using the target language?

Course Design

Figure 1 below summarizes our course design, which incorporated community-engaged learning, task-based language teaching, and a COIL-like method in order to foster intercultural competence and second language development.

The class met twice a week, once together in English to discover the business culture of Italy and Japan, and another time separately to learn business language skills in Italian or Japanese. For our language classes, we created a modular curriculum following the work of Rod Ellis (2019). The curriculum was based on creating real world needs for students through community-engaged tasks, culminating with the main attraction of the course the "Business Night" event, a business networking event that brings together Italian and Japanese businesspeople, and students. Our language lessons employed a task-based language teaching (TBLT) pedagogical approach with a structural component to give grammar instruction related to business Japanese or Italian.

Figure 1: Course Design



Participants

Our study lasted for one semester. Seven undergraduate students of Italian and nine undergraduate students of Japanese participated in this study. Table 1 shown below presents the demographic information of our students. The majority, 11 out of 16 participants, were domestic students. Among them, there were two Japanese heritage speakers and five Italian heritage speakers. Students' proficiency levels ranged from intermediate to advanced. In the Japanese group, participants had completed second-, third-, or fourth-year Japanese courses, while the Italian group included students who had completed first-, second-, third-, or fourth-year Italian courses. Additionally, four students had previously studied abroad in Japan or Italy for a few months.

Table 1: Student Demographic Information Table

Participant ID	Target language	Domestic/ international	Heritage	Courses completed
AF	Japanese	domestic	JPN	402
AP	Italian	domestic	N/A	102
BC	Japanese	domestic	N/A	302
CN	Italian	international	N/A	470
JC	Italian	domestic	ITAL	301
JM	Japanese	domestic	JPN	301
MC	Japanese	domestic	N/A	402
MK	Japanese	domestic	N/A	301
MW	Italian	domestic	ITAL	470
NE	Italian	international	ITAL	470
PV	Japanese	domestic	N/A	202
RS	Japanese	international	N/A	402
RSH	Italian	international	ITAL	302
SD	Italian	domestic	ITAL	201
TL	Japanese	domestic	N/A	302
WJ	Japanese	international	N/A	402

Data Analysis

Our main data source was students' reflective essay of what they learned in this course. We conducted a qualitative content analysis using the software called NVivo to capture themes that emerged from the essays.

Results and Discussion

Our study was guided by two research questions which we answered by qualitatively analyzing students' reflective essays.

Research Question 1 asked: *Can we produce COIL benefits, such as fostering intercultural competence, by combining two groups of students of different languages instead of combining students from different institutions in two countries?*

The findings suggest an affirmative answer. Instructor collaboration emerged as a significant factor in modeling intercultural communication. For instance, one Japanese language student reflected:

> I think what provided the best learning about intercultural communication and business was not from the textbook … or the business night speakers, but from seeing the two of you develop your working relationship and get more and more comfortable teaching together. Y'all exemplified both the differences that can exist at the beginning and how to work through those things. I find that genuinely very impressive, and even though it does not particularly pertain to business, it does take a lot of effort, and I think I would be wise to take some of the observations I made in class into future pursuits that have an intercultural focus. (Japanese student)

This reflection underscores the potential to teach students the skills necessary for collaborating with individuals from different cultural backgrounds without requiring engagement with someone residing abroad. By observing the instructors navigate and reconcile cultural differences in real time, students gained practical insights into intercultural competence that extended beyond theoretical knowledge.

These findings suggest that collaboration between faculty members within the same institution can effectively create opportunities for students to develop intercultural communication skills. Such intra-institutional collaborations provide a viable alternative to traditional COIL models that rely on partnerships across borders. This approach has the added benefit of circumventing logistical challenges associated with international collaborations, such as time zone differences and scheduling conflicts, while still fostering meaningful intercultural learning experiences.

Students also experienced meaningful intercultural competence development through their collaboration with peers and community business professionals. For example, a Japanese language student reflected, "[...], while we had been taught that Italians often carry a more relaxed, flexible attitude toward punctuality compared to the Japanese's stringent organization, watching the Business Night drag on ten or twenty minutes beyond the scheduled time was shocking" (Japanese student).

Collaborating with students from another language course provided valuable opportunities to understand what it means to work with individuals from different cultural backgrounds. Many Japanese language students found it challenging to collaborate with Italian students, particularly in situations where punctuality was important. While discussions about cultural differences in punctuality between Japanese and Italian cultures were met with open-mindedness, students' reactions shifted when they encountered these differences firsthand during a collaborative event. This finding aligns with existing COIL studies, which emphasize the importance of experiential collaboration in fostering intercultural competence.

Similarly, a comment from an Italian language student highlights the value of working with peers from another language course in developing intercultural competence, "[…] The juxtaposition of these two distinct cultures enabled me to identify commonalities, appreciate differences, and develop a heightened sense of cultural sensitivity" (Italian student).

We also had an unexpected finding in this study. Interestingly, we observed that many students, despite being American, displayed behaviors aligned with the cultural norms of Japan or Italy during their interactions. Based on these observations, we conclude that collaboration between students from two different language classes within the same institution can provide intercultural competence learning opportunities comparable to those offered by COIL.

Research Question 2 asked: *Through community-engaged learning, do students perceive improvements in their language skills or increased confidence in using the target language?*

The findings indicate that the answer is yes.

One Japanese language student reflected on the value of interacting with a local Japanese business professional, stating, "There were many challenges that arose from these interactions, but getting out of my comfort zone was essential to grow my communication skills."

Another Japanese language student noted that combining practice with classmates and interactions with local Japanese business professionals significantly contributed to the development of their language skills. A student wrote, "We were able to learn and practice the use of business Japanese with classmates as well as invited guests which greatly helped my ability to listen to and use Japanese in a formal way."

The differing experiences between these students appear to be influenced by their proficiency levels. Lower-proficiency learners likely benefited from the gradual progression of practicing with classmates before engaging with real business professionals. In contrast, higher-proficiency students found that the direct challenge of communicating independently with Japanese business professionals was a key factor in their language development.

Similarly, many Italian language students felt that their interactions with local Italian business professionals significantly contributed to their language development. For example, one student wrote:

> I do have to say that the interactions I had with the Italian businesspeople (both in person and over email) were *incredibly* useful to learning the formal way of speaking.

> I believe this practical side is a strong point of the course, that should be emphasized and expanded in future versions of it.

We also found that students perceived language development through both spoken and written interactions with local Italian or Japanese business professionals. Another comment from a Japanese language student highlights the importance of written communication in acquiring business Japanese skills:

> The assignment of composing business emails in Japanese to company professionals provided invaluable practical application of *keigo* (honorific and humble polite forms) concepts from our textbook. Though not as spontaneous as verbal communication, this exercise encouraged deliberate thought and precision in expression, serving as an essential initial step toward fluency.

The excerpts presented here are representative of the feedback we received from our students. Overall, students highly valued the real-life tasks of communicating with local business professionals in their target languages, recognizing these interactions as meaningful opportunities for language learning and skill development.

In summary, the findings from Research Question 1 affirm that combining students from different language courses within the same institution can effectively foster intercultural competence, similar to traditional COIL experiences. Students gained valuable insights not only through structured discussions but also by observing and experiencing cultural differences in collaboration, such as varying approaches to punctuality. Additionally, instructor collaboration served as a powerful model of intercultural communication, demonstrating how cultural differences can be navigated in professional and academic settings. An unexpected yet significant outcome was the observation that many students, despite being American, exhibited behaviors aligned with the cultural norms of the language they were studying, further reinforcing the depth of their intercultural engagement. These findings suggest that intra-institutional collaborations offer a meaningful and accessible alternative to the COIL model, equipping students with the skills necessary for cross-cultural communication and collaboration in diverse professional and social contexts.

The findings from Research Question 2 confirm that community-engaged learning significantly enhances students' perceptions of language learning by providing authentic, real-world communication experiences. Students recognized the value of both spoken and written interactions with local business professionals, which allowed them to develop formal language skills and gain confidence in using their target language in professional settings. The varying experiences of lower- and higher-proficiency students highlight the importance of scaffolding these interactions to support different learning needs. Moreover, students appreciated the opportunity to apply textbook knowledge in meaningful contexts, reinforcing the practical benefits of experiential learning. These results align with Hartfield-Méndez' (2013) insights on the role of community engagement in language acquisition, emphasizing that direct interaction with native speakers fosters linguistic competence and cultural awareness in ways that traditional classroom instruction alone cannot achieve.

Conclusion

In conclusion, this case study addressed two research questions: the first examined the impact of collaboration between two different target language classes on the development of

intercultural competence, while the second investigated the impact of community-engaged learning on learners' perceptions of their language learning. The findings indicated affirmative answers to both questions.

The significance of this study lies in its innovative approach to fostering intercultural competence through collaboration between two different target language classes within the same institution, which is a practice that has received limited attention in existing research. While we recognize the value of COIL and international online collaboration, we believe our curriculum design offers a more practical alternative for certain educational contexts. Unlike COIL courses, our approach eliminates challenges such as time zone differences and the difficulty of finding equally committed international partners.

In addition to cross-language collaboration, our course incorporated community-engaged learning, enabling students to interact with local Japanese or Italian business professionals. This component provided students with opportunities to engage in real-life tasks in a business context, which they perceived as enhancing their language learning experience.

It is important to note that the findings of this qualitative case study are not generalizable. However, we believe the results are transferable to similar contexts where instructors are originally from the countries of the target culture. Further studies would be needed to understand if similar results can be obtained in a context in which instructors are not originally from the target culture. We hope this study inspires world language educators to collaborate with colleagues teaching different languages within the same institution to promote intercultural development in their courses.

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From Classroom to Community: Empowering Community Health Leaders

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Abstract
The Department of Family & Community Health Sciences (Rutgers Cooperative Extension) Internship Program played a crucial role in supporting the Healthy Corner Store Initiative (HCSI), which aims to transform New Jersey corner stores—often the primary food source in underserved areas—into providers of healthier food options. So far, graduate and undergraduate interns have accumulated over 1,039.54 hours of work with Rutgers faculty and staff, receiving training and mentorship in research methods and ethics while engaging in community participatory research. In partnership with the non-profit organization The Food Trust, they built rapport with community members, installed promotional materials, supported nutrition education programs, and effectively conducted environmental analyses of corner stores across the state. Preliminary data analysis highlights the need for ongoing support and strategic interventions. Building maintenance was generally satisfactory, with 60% of buildings well-maintained and 55% free from graffiti; however, only 25% of stores featured pedestrian walk signals and marked crosswalks. All stores offered fruits and vegetables, and 84% had healthy snacks available, yet only 13% provided fresh vegetable packages. Unhealthy foods were visible from the entrance in 95% of stores. The promotional efforts for healthy eating were mixed: 50% of stores displayed healthy promotional materials, while only 20% featured photos promoting healthy eating inside. Produce bins were visible at the front entrance in 50% of stores, and SNAP/EBT cross-promotion could be found in 25%. HCSI interns will continue throughout the 2024-2025 academic school year.

Keywords: Cooperative Extension, Students, Community Participatory Research, Food Access

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Introduction

In historically underresourced communities throughout New Jersey, corner stores often serve as the primary food source for residents. This makes them perfect locations for interventions that may improve community nutrition and health outcomes. Research indicates that small grocery and corner stores significantly impact customer purchasing habits, particularly in low-income urban areas (Caspi et al., 2017). Additionally, retail-based interventions can effectively enhance the purchasing and consuming healthier foods by combining environmental changes with community involvement (Karpyn et al., 2020). In partnership with the community organization, The Food Trust, The Department of Family & Community Health Sciences (FCHS) at Rutgers Cooperative Extension (RCE) developed the Healthy Corner Store Initiative (HCSI) internship program to address these community needs while offering valuable experiential learning opportunities for students. Research finds that faculty and student collaborations in community-engaged research improve student learning outcomes and project sustainability (Eyler & Garza, 2019). This approach aligns with best practices in service learning, highlighting the importance of connecting academic coursework with real-world community engagement (Salam et al., 2019).

Institutional Context and Program Framework

Cooperative Extension Context

The Department of Family and Community Health Sciences (FCHS) internship program exemplifies the foundational mission of Cooperative Extension: bringing evidence-based knowledge to communities to address critical public needs. As part of Rutgers Cooperative Extension, FCHS operates at the intersection of research, education, and community engagement. These three pillars have defined Extension's work since its establishment through the Smith-Lever Act 1914. The program's structure mirrors Cooperative Extension's commitment to the land-grant university mission through its three integrated branches: 4H Youth Development, Agriculture and Natural Resources, and Family and Community Health Sciences. The FCHS focus on community food systems, chronic disease prevention, food literacy, school nutrition, and wellness initiatives directly advance Extension's contemporary role in addressing public health challenges through research-based interventions and education. During 2023-2024, 52 students contributed over 16,460 RCE internship hours while engaging in research and community outreach.

The Food Trust Partnership

The Food Trust is an essential partner for the Healthy Corner Store Initiative, providing a multifaceted approach, including direct community education through the Heart Smarts program, which offers practical nutrition guidance, critical infrastructure support for implementing healthy food initiatives, and marketing materials and support. Within just one year of implementing the program's initiatives, the Medina Food Market in Camden, New Jersey, increased their sales by $24,000. This example demonstrates the potential for meaningful change when strategic interventions are carefully designed and implemented.

Program Innovations

Comprehensive Environmental Assessment Framework. The HCSI Internship Program developed a sophisticated three-concept environmental assessment approach beyond

traditional store evaluations. Using components of previously validated surveys, including Retail SLAQ, NEMS-GG, MAPS-mini, and the Corner Store Environment Assessment, an extensive survey was developed on REDCap software. The interior store environment portion focuses on variables such as product placement strategies, how promotional materials are positioned, and the overall layout and navigability of the store space. The exterior store environment evaluation considers broader contextual elements, including the physical condition of the building, the surrounding approach environment, and critical safety features that impact customer experience. Finally, the "grab-and-go" analysis concentrates on the critical first five feet of customer interaction. These environmental analyses may illustrate how store layout and product positioning can nudge consumers toward healthier food selections.

Structured Intern Development Model. The HCSI program goes beyond standard research approaches by deeply integrating community input and participatory principles, making it a unique opportunity for applied learning. Interns play a crucial role in this research process, engaging in tasks challenging traditional academic experiences. The goal for FCHS and HCSI interns is to transform them from beginner researchers to experienced community health practitioners. First, interns are required to complete a Collaborative Institutional Training Initiative (CITI) training, ensuring that they understand the fundamental principles of ethical community-based research. Next, they develop and test data collection instruments aligned with research questions for feasibility and reliability. They are gradually entrusted with more advanced responsibilities, including refining and revising research instruments and data analysis. They are encouraged to add to community presentation skills through abstract and research poster development and conference presentations. This experience ensures a deep, meaningful engagement beyond the classroom.

Academic-Community Partnership Model. The partnership with the Food Trust is an excellent example of collaboration transcending traditional academic-community interactions. By joining this national organization, the researchers and interns gained access to evidence-based intervention strategies implemented across hundreds of sites. Systematic environmental assessments form the backbone of the research, allowing for a holistic examination of the factors influencing food access and environmental influences. The research design incorporated comprehensive quantitative and qualitative analyses that provide a nuanced understanding of community food environments. This approach aligns seamlessly with established community-based participatory research principles articulated by Minkler and Wallerstein (2015). By addressing both supply and demand-side factors, as highlighted by Dutko et al. (2018), the methodology offers a comprehensive strategy for understanding and improving community food systems.

Results and Impact

Student Engagement

HCSI Interns dedicated over 1,039 internship hours to this vital initiative, engaging in various activities that connected academic learning with real-world community impact. Their participation went beyond traditional internship experiences, covering essential areas such as store environmental assessments, community surveys, data collection and analysis, and direct program implementation and evaluation. Eight of the ten Fall 2024 interns are continuing into the Spring 2025 semester program, with an addition of six new undergraduate interns who will undergo training. In addition to adding team members, the program will promote two

graduate student members to Student Director roles, where they will further cultivate their leadership and professional development skills. This approach prepares them for public health careers and maintains Extension's tradition of developing community leaders who understand theoretical frameworks and practical implementation challenges.

Store Assessment Findings

Preliminary research demonstrated a challenging picture of food access: A chi-square analysis revealed that stores with unhealthy exterior environments were significantly associated with the availability of unhealthy food products (χ^2(1,N=20)=7.179, p=0.007). Only 13% of stores offered pre-packaged fresh produce, while 95% featured unhealthy foods at store entrances. Infrastructure challenges were equally apparent, with 75% of stores lacking adequate pedestrian access. Despite these challenges, 50% of stores displayed healthy promotional materials, and 20% featured images promoting healthy eating.

Community Impact

Working with FCHS and The Food Trust, the HCSI interns translated research insights into practical community initiatives, emerging as transformative change agents. They supported tailored healthy retail implementation plans for community corner stores, conducted over 20 corner store site visits, and implemented innovative food voucher programs. The interns' work extended beyond data collection, as they facilitated nutrition education programs at local schools and created direct, meaningful connections between store owners and community members. These experiences exemplify an effective model for academic-community collaboration, where interns gain hands-on experience while contributing to tangible food access improvements.

Future Directions

Geographic Expansion

The program's future strategic plan includes geographic expansion to extend the initiative's reach into Northern Jersey, enhancing its impact and understanding of regional variations in corner store environments. In addition, the HCSI program seeks to introduce new intern cohorts, ensuring a steady pipeline of engaged and trained community health researchers.

Research Agenda

Future research intends to assess the long-term impact of The Food Trust's interventions to understand sustained changes in community food environments. A key focus will be evaluating how the duration of partnerships influences corner store policy, system, and environmental changes, providing critical insights into the need for sustained community health initiatives and partnerships.

Program Enhancement

Future program efforts will refine the program's training protocols, ensuring the research design and educational experience remain responsive to emerging public health needs. The initiative is dedicated to continually strengthening community partnerships, recognizing that

the most effective interventions arise from genuine, collaborative relationships between academic institutions and communities.

Conclusion

The HCSI internship program demonstrates how academic institutions can meaningfully impact community food environments while providing valuable experiential learning opportunities to their students. Through training, mentorship, and practical experience, interns develop professional skills while contributing to important public health initiatives. The program's success in engaging stores and collecting baseline data establishes a foundation for future research examining the long-term effects of healthy store interventions.

The program's research and community engagement integration reflects Extension's longstanding commitment to bridging academic expertise with community needs. This model of academic-community collaboration continues to evolve, offering valuable insights for other institutions seeking to address complex public health challenges while developing future community health leaders.

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Comparative Study of Online and Classroom Teaching of an Engineering Course Using Active Learning Pedagogy

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Abstract
During the COVID-19 pandemic, online teaching and learning became an indispensable choice for instructors and students to continue their teaching and learning without interruption. After the COVID-19 pandemic, most students are very happy to resuming face to face teaching and learning in classroom, but some students still request to offer an online option to meet their various learning needs, which has triggered the author's further thinking about effectiveness and efficiency of these two course delivery modes to instructors' teaching and students' learning. In this paper, the author will use assessment data collected under these two course-delivery environments respectively for teaching Vibration Theory in mechanical engineering program at Saint Martin's University as a case to carry out a comparative study of online and classroom teaching using actively learning pedagogy. Based on the data collected, advantages and disadvantages of each delivery mode to effectiveness and efficiency of teaching and learning using actively learning pedagogy have been discussed from the learners' point of view as well as instructor's point of view. The comparative study and data analysis will help engineering educators to have a direct insight of pros and cons of online and classroom teaching when active learning pedagogy is used. Based on the results of this comparative study, a new hybrid course delivery mode has been proposed. The new mode combines the advantages and avoids the disadvantages of both online and classroom teaching to better support active learning pedagogy for delivery of engineering courses.

Keywords: Online Teaching, Face to Face Teaching, Active Learning, COVID-19, Vibrations

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Introduction

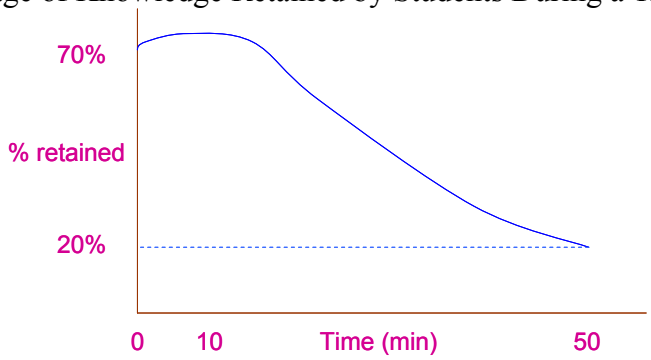
Active learning, which simply say is learning by doing, has been demonstrated as an effective teaching approach to engage students in learning process and accommodate their needs of various learning styles (Cho et al., 2021; Hernández-de-Menéndez et al., 2019). It is not only a process through which students must actively be involved in reading, writing, discussion, and problem-solving activities, but also a student-centered teaching approach (Felder & Felder, 2003). The approach involves students in all aspects of the learning process (Johnson & Johnson, 2008), and easily accommodates the students' own needs, abilities, learning styles, existing skills, and experiences (Bean & Melzer, 2021; Prince, 2004).

Before the COVID-19, the author had been using active learning pedagogy to develop lecture contents and design learning activities for delivering ME410 Vibration Theory to senior students in mechanical engineering program at Saint Martin's University (SMU). During the COVID-19 pandemic, online teaching and learning became an indispensable choice. Therefore, the author flipped the same lecture contents and learning activities of ME410 from face-to-face in-class room delivery into online delivery. Next, what will be discussed are ME 410 course information, comparative study of both face-to-face and online delivery modes, and a proposed new hybrid delivery mode.

Design of Active Learning Activities (ALA) for the Course ME 410

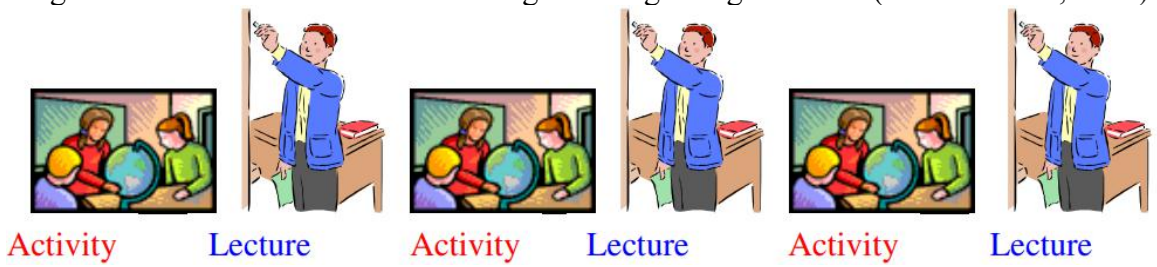
ME 410 Vibration Theory is a three-credit elective course offered to junior and senior students in the mechanical engineering program at SMU. It is a spin-off subject of dynamics and requires that students have a solid background in dynamics, differential equation theory, linear algebra, advanced engineering math such as Fourier series expansion and convolution integrals. From these prerequisites, it is obvious that ME 410 has a strong theoretical taste and requires intensive mathematical derivation. The instructor could not find an effective work around to these theoretical derivations because vibration concepts and methods are embedded into the derivation procedure. students may easily lose their learning interests at such extremely math-orientated derivation during traditional passive class lectures and further have difficulties to understand concepts and methods integrated in the derivation. On the other hand, the study (McKeachie, 2002) has shown that once a traditional fifty-minute lecture is finished and the students take a test on lecture contents immediately afterwards, their retention of the knowledge from the lecture can be illustrated by the curve shown in Figure 1. The figure indicates that retention of about 70% has been retained during the first fifteen minutes of the class lecture. The percentage of knowledge retention decreases after that and reduces to 20% level at end of the lecture To resolve learning interest issues and enhance learning effectiveness, active learning pedagogy has been integrated in teaching ME 410. The retention curve can be raised significantly after the first fifteen minutes of the lecture if active learning pedagogy is used (Duan & Ries, 2007).

Figure 1: Percentage of Knowledge Retained by Students During a Traditional Lecture



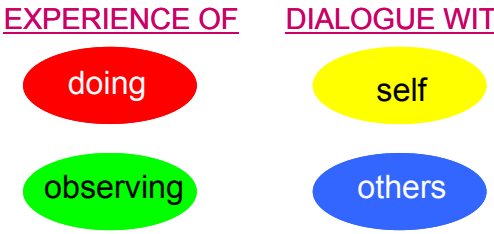
Thus, various active learning activities were designed in ME 410, such as in-class-teams, think-pair-share, in-class-writing-assignments, course projects with problem-based learning, etc., to facilitate learning needs of the students. Specifically, at the beginning of class, a two-minute learning activity was arranged for students to reflect on what they had learned from the previous class session and engage themselves in learning the current lecture contents. After warming up, the instructor lectured for about fifteen minutes. Another three-minute activity was given for students to work on the lecture contents. Then another two lectures were given about fifteen minutes and ten minutes respectively with a five-minute activity arranged between them. The students were required to participate in these activities and class discussions. The process is illustrated in Figure 2. In practice, the arrangement of lectures and activities were dynamic rather than identical for each class period.

Figure 2: Illustration of Active Learning Planning Design Process (Duan & Ries., 2007)



To integrate the course with activities that are woven around a well-established process and allow students to experience vibrations analysis themselves rather than just completely passively listen to how it is supposed to work, a basic model was used as illustrated in Figure 3 for design of the activities. The following are a few samples to show how active learning strategies were explored to carry out this integration.

Figure 3: A Model for Guiding Design of Active Learning Activities (Duan & Ries, 2007)



Students Actively Involved in Mathematical Derivation in a Group Setting

Rather than passively listening to the instructor delivering the entire mathematical derivations, students were involved in the derivations actively in group. Take the derivation of formulations for the steady-state response of the equation of motion for forced vibration of an undamped system under harmonic force as a simple example. After the equations of motion $m\ddot{x} + kx = F_0 \cos\omega t$ (m: mass of an object, k: stiffness of spring, x: state variables, F_0: magnitude of excitation force, and ω: frequency of the excitation force) was set up, the following activities were carried out:

Instructor: Assuming the particular-solution is $x_p(t) = X\cos\omega t$. Three students work in a group and substitute $x_p(t)$ into the equation of motion. Then obtain equation for X. You have about three minutes to work on it.

Students: Work in group to obtain the equation for X

Instructor: Check the results with a few groups and ask two groups to give their results to Class

Activities of Think-Pair Share

During the activities, the instructor gave requirements. Students thought of answers individually, formed pairs to produce joint answers, and then shared answers with class. Take introduction to vibrations as a simple example. A think-pair share activity was arranged as follow:

Instructor: Please think about two examples each of the bad and good effects of vibrations individually first, then find a partner to exchange your results, and share your joint answers with class.

Students: Pair-think share and present answers to class.

Course Project Integrated With Problem-Based Learning Techniques

Two or three students formed a project team and worked together throughout the entire semester. Each team was asked to write a proposal and problem statement. They had to create hypotheses to initiate the modeling process, and derive and solve equations of motion to apply what they learned in class. The topic of the project was selected by each project team. The topic would be senior design project, national competition, or a real-world problem of interest to all team members to model, simulate, and analyze. Figure 4 shows some samples of selected team projects. The project was divided into three phases. Basic requirements of each phase are listed in Table 1 below.

Figure 4: Selected Project Titles From ME 410

Minute Paper Activity

The instructor asked students to anonymously write down (1) the main point(s) of the lecture, and (2) the muddies point(s) of the lecture, then collect papers, look through the responses to check understanding, and begin the next lecture by addressing common questions from the minute papers.

Table 1: Three Phases for Selected Team Project

	Phase I	Phase II	Phase III
Requirements	1. Pick up a vibration device or system to model and analysis 2. Write project proposal 3. Form preliminary vibration system model and explain how to carry out analysis	1.Set up equations of motion 2. Solution of equation of motion 3. Explain your results modeling->equations of motion-> solution -> interpretation of results	1.Possible Matlab computer simulation & analysis 2. Per simulation data, revise the system parameters if necessary 3. Carry out simulation again 4. Interpretation of results
Presentations & evaluation	1.Proposal/presentation 2. Phase I grading	1. Progress report presentation 2. Phase II grading	1.Final report & presentation 2. Final project evaluation

Activities of In-Class Writing Assignment

The students were asked to write what they knew about a topic before the instructor delivered a lecture on it to help them subsequently connect new ideas to what they already knew. Sometimes the students were asked to generate a list of questions they had about the topic or a list of practical applications of new materials.

Flipping In-Classroom Lectures and Activities Above Online Virtually

During the COVID-19, the lectures and learning activities mentioned above were flipped for online delivery. Zoom and Moodle were two key platforms used for online delivery of ME410. Zoom was selected for synchronous live lectures and active learning activities and was key course flip platform. Moodle was used as course communication platform for assignment, assessment, and asynchronous delivery of pre-recorded lectures. Microsoft Note

was chosen as lecture note writing blackboard. The online technical system is like that used in the previous application (Duan & Bassett, 2011).

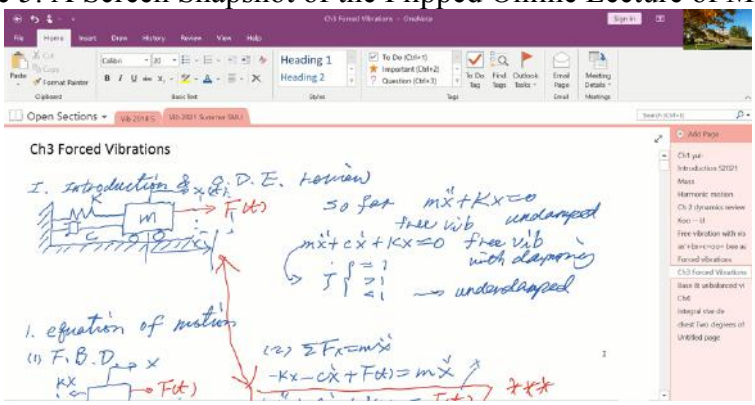
Several functions of Zoom were used, such as Breakout Room, Chat, Broadcast, Share, Audio & Video (A/V) etc., to flip the lectures and active learning activities in Zoom environment. In-classroom lectures could be supported by A/V and share of Zoom functions. Table 2 shows a correlation between ALA and Zoom functions for flip the learning activities.

Table 2: Correlation of ALA Supported by Zoom Functions

ALA	Math derivation	Think pair	Course project presentation	Minute paper	In-class writing
Zoom functions	Breakout room; broadcast; A/V; share; chat	Breakout room; broadcast; A/V; share, raise hand	A/V; share; chat; raise hand	Chat	Chat

For example, the activity of mathematical derivation in group was accommodated via breakout room for forming group, broadcast for instructor's announcement, A/V and share for each group to share their results, and chat for each group chatting with the instructor. Figure 5 shows a screen snapshot of the flipped Zoom lecture. After the course was delivered online virtually, the same assessment tool used in classroom teaching was utilized to gather learning experience feedback from the students. Based on data collected from both in-classroom and online teaching modes, discussion focus next will turn into comparative study and analysis of students' learning and the instructor's teaching experiences under these two environments.

Figure 5: A Screen Snapshot of the Flipped Online Lecture of ME 410



The Course Assessment and Comparative Study of Learning and Teaching Effectiveness

Homework problems, computing assignments, quizzes and exams were used to assess students' learning and the effectiveness of teaching ME 410 Vibrations Theory under two delivery modes using active learning pedagogy. In addition, an anonymous student survey was conducted to obtain evaluation for teaching and learning. Table 3 below shows the students' summative feedback on questions used to assess their learning experiences, and sample feedback of student engagement in the course is present in Table 4. For convenience,

data of the hybrid delivery mode has been added into Table 3, which will be used for further discussion of the hybrid mode late on.

Table 3: Percentage of Student Responses to Summative Questions Under 3 Delivery Modes

Summative questions	**Delivery mode**	Excellent (5)	Very good (4)	Good (3)	Fair (2)	Poor (1)	Very poor (0)	Ave.
The course as a whole was:	In-class	25%	38%	37%				3.9
	Zoom	20%	60%	20%				4.0
	Hybrid	60%	20%	20%				4.4
The course content was:	In-class	25%	38%	37%				3.9
	Zoom	20%	60%	20%				4.0
	Hybrid	20%	60%	20%				4.0

Survey Result Discussion

Table 3 shows that there is no significant difference between in-class and online delivery modes for summative evaluations in terms of "the course as a whole was" and "the course content was" according to learning experience feedback from the students. However, for student engagement in the course, Table 4 indicates that in term of "The amount of effort you put into the course was" the student put much more effort into the course in online delivery mode than in-class delivery mode. The author chatted with the students enrolled in the online course. They felt it took more time for them to do homework in term of format and submission process under online mode than in-class mode. Because in-class delivery mode, they just turned in the hand-writing homework in class while for online delivery mode, they had to type the homework using software such as Word etc. or convert hand-writing homework into an E-document file format for submission in Moodle platform. Among the students in online class, a few students mentioned that online mode saved commuting time, which may explain why difference of average scores between in-class and Zoom is subtle rather than significant in term of "Your involvement in course (attend class, homework…)". A few students mentioned they occasionally encountered some difficulties associated with internet connections, speed, and sound quality of their devices. Generally, the students' learning experiences were equivalent between in-class and online delivery modes for all other areas, but in term of "use of class time was" in-class delivery was slightly efficient than online delivery as shown in Table 4.

Table 4: Percentage of Student Responses to Engagement Questions Under 3 Delivery Modes

Engagement questions	**Delivery mode**	Much higher (7)	(6)	(5)	(4)	(3)	(2)	Much lower (1)	Ave.
The amount of effort you put into the course was:	In-class	38%	12%	38%	12%				5.8
	Zoom	60%	20%		20%				6.2
	Hybrid		60%	40%					5.6
Your involvement in course (attend class, homework…) was:	In-class	38%	25%	25%	12%				5.9
	Zoom	40%	20%	20%	20%				5.8
	Hybrid		60%	20%	20%				5.4
Use of class time was	In-class	43%	29%	14%	14%				6.01
	Zoom	20%	40%	40%					5.8
	Hybrid	20%	60%	20%					6

Instructor's Comments of Teaching Experiences of ME410 Between In-Class and Online Modes

From the instructor's point of view, online delivery provided convenience for the instructor to accommodate students' learning needs easier than in-class delivery. For example, a student was able to attend class virtually when he/she had to stay home or was not able to attend the class in person. Paper was not needed because all student works were graded on computers, which saves resources and is environment friendly. However, the online delivery was not favorable for the instructor to keep eye contact with the students during lecturing, which lost a chance for the instructor to immediately know the facial responses of the students to the lecture contents or questions. As comparison with in-class delivery, online delivery also increased workload of the instructor due to extra time added for setup each class session and grading E-version of homework and returning them to the students.

The Proposed Hybrid Course Delivery Mode

After the Covid-19, most students were very happy to attend the class in person and have face to face lectures and activities in classroom, but there were situations in which some students asked to attend the class online when the class was offered in classroom. To accommodate needs of the students, ME410 has been offered in a hybrid mode. Zoom, Microsoft note, and Moodle have been utilized together in the hybrid mode. The lectures and learning activities carried out mainly in classroom with Zoom access virtually. The lectures have been recorded in Zoom and posted in Moodle for the students to watch in case anyone misses a class session. The author has been trying to keep advantages and avoid disadvantages of both in-class and online delivery in the hybrid mode for students' learning. In term of "the course as a whole was" the average score is higher in the hybrid mode than both in-class and online modes as indicated in Table 3.

Conclusion

The comparative study presented in this paper highlights the strengths and weaknesses of both online and classroom-based teaching methods, particularly in the context of active learning pedagogy for engineering courses. By analyzing assessment data from Vibration Theory courses at the author's University, the study provides valuable insights into how these two modes of delivery impact both teaching effectiveness and learning outcomes. The proposed hybrid model, which combines the benefits of online and face-to-face teaching while minimizing their respective drawbacks, offers a promising solution for enhancing active learning in engineering education. This approach can serve as a useful framework for educators looking to optimize their course delivery methods and better meet the diverse needs of students.

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The Impact of Financial Education at Home and School on Asset Formation Among Married Men and Women: A Comparison Between Japan and Norway

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Abstract
This study investigates how financial education at home and school influences the financial behavior of married men and women in terms of asset formation and management. The author commissioned a research company to conduct a web survey in December 2021, targeting 2,000 married individuals aged 35-55 in Japan and 600 in Norway. The results showed that Japanese couples had lower individual incomes and financial assets compared to Norwegian couples, and the total household financial assets were also lower. Regarding asset management, many Japanese respondents, both men and women, reported not engaging in asset management, while many Norwegian respondents reported managing assets together as a couple. The number of respondents who had received financial education at school or work was 3.7 times higher in Norway than in Japan, highlighting the lack of financial education opportunities in Japan. The presence or absence of financial education significantly affected income, awareness of the need for asset management, and life planning, supporting previous research. Furthermore, those with financial education experience had more frequent discussions about savings and stocks with their parents. Financial education experience may have promoted conversations about savings and investments between parents and children at home.

Keywords: Financial Education, Asset Formation, Household Financial Assets

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Introduction

Japan's "Lost 30 Years" refers to the period of economic stagnation following the burst of the bubble economy in the early 1990s (Murase, 2022). During this period, Japan experienced prolonged deflation and low economic growth rates, with many Japanese facing employment difficulties and stagnant wages.

Specifically, looking at the trends in Japanese financial assets, the "Public Opinion Survey on Household Financial Behavior 2023 (Survey of Households with Two or More Persons)" published by the Central Council for Financial Services Information collected responses from 5,000 households nationwide (households with heads aged 20-79 and at least two members). The average savings amount for households with financial assets was 17.58 million yen for households with two or more people, and the median savings amount, which is the savings amount of the household that is exactly in the middle when arranged in order of the smallest savings amount, was 7.15 million yen. Including households without financial assets, the average was 13.07 million yen, and the median was 3.3 million yen. The average can be significantly raised by a small number of high-asset households, giving an impression that is far from the reality of many households. To compensate for the shortcomings of the average, the median is also considered. The median is the financial asset amount of the household that is in the middle when the surveyed households are arranged in order of the smallest (or largest) amount of assets (The Central Council for Financial Services Information 2023). The median can be considered as a representation of the typical household. The average financial asset amount in 2023 is not significantly different from the figure 10 years ago. The median financial asset amount in 2023 was 7.15 million yen, down from the peak of 9 million yen in 2013 (The Central Council for Financial Services Information, 2013, 2023). This indicates that the number of households with low financial assets has increased over the past 10 years. Meanwhile, the consumer price index has steadily increased year by year.

In Norway, where gender equality is more advanced than in Japan, the average household financial assets have more than doubled in just over 10 years. The average household financial assets in Norway were 10.84 million yen in 2010, but the average value in 2022 was 24.43 million yen, more than doubling in just over 10 years (Statistics Norway, 2023). Since it is average, it is possible that a small number of wealthy households have raised the average, but when viewed over time, it has been increasing year by year, reaching the 20-million-yen range since 2020 (Statistics Norway, 2023). Like Japan, the consumer price index has been rising. In the case of Norway, 1 NOK (Norwegian Krone) is converted to thirteen yen based on the exchange rate at the time of the survey (December 2021).

In Japan, where the traditional division of labor between husband and wife remains strong, the assets built by the working husband are considered family property, and the husband's income is managed by the wife as family money. After the husband's death, the assets become the wives, so many wives did not see it as a problem. Under the gender-based division of labor, married women (wives) find it difficult to secure assets, suggesting a disparity in financial assets between husbands and wives.

In Japan, despite the continued rise in prices, the growth of household financial assets for households with two or more persons has stagnated. In this situation, savings for retirement, which will require significant medical and nursing care expenses, are insufficient. It is necessary for Japan to address the actual situation and problems of asset formation for both

husbands and wives, and to increase the financial assets of both husbands and wives to raise the total household financial assets.

While the median household financial assets in Japan have remained almost unchanged over the past 30 years, the average household financial assets in Norway have doubled over the past 10 years. What factors contribute to the wealth gap between Norway and Japan? One important factor to focus on is the impact of financial education at home and school.

Literature Review

There are numerous previous studies on the factors influencing asset accumulation. Factors that promote asset accumulation and management include educational background, annual income, amount of assets held, and financial literacy (The Central Council for Financial Services Information, 2019; Kitamura & Uchino, 2011; Lusardi & Mitchell, 2011; Lusardi et al., 2011; Okamoto & Komamura, 2018; Sekita, 2020; Shioji et al., 2013). All these factors tend to be lower for women than for men.

From the first survey on Japanese women and property, "Wife and Husband Property Survey" by the Tokyo Women's Foundation (1997), Mifune (1999) pointed out that if the total assets of a couple are considered as 100%, the wife's share is 29% and the husband's share is 71%, indicating a significant disparity in nominal assets between spouses. Despite the disparity in assets between spouses, the issue of the disparity in property between wives and husbands has not been addressed due to the "family jointness" consciousness, which considers the husband's assets as family property. From the same survey, Uemura (2004) revealed that wives could not form their own nominal assets due to a strong sense of sharing, where wives considered "the husband's property as their own" based on their contribution to household chores. Following this survey, from the Institute for Household Economy, in the "Survey on Family Life" (The Institute for Research on Household Economics, 2000), Mifune (2004) compared the nominal assets of wives by employment type and found that even in households where the wife was a full-time employee, the wife's nominal asset ratio was lower than the cumulative income ratio, household chore sharing ratio, and contribution to asset formation.

Since 1987, the number of dual-income households in Japan has surpassed the number of single-income households (mainly households where the husband works and the wife is a full-time housewife), and dual-income households are now the mainstream (Sano, 2023). Analysis of the recent "Survey on Household Finances and Attitudes of Dual-Income Couples" (2014) showed that the higher the household income of the couple, the higher the wife's own asset formation, and the wife's nominal financial assets were influenced by the household income of the couple (Suzuki, 2015). Shigekawa (2020) pointed out that Japan's separate property system attributes earned income to the earner, and there is no problem if both spouses can earn equally. However, under the gender-based division of labor, where the wife mainly works part-time or is a full-time housewife, the wife finds it difficult to secure assets.

In addition to the employment type of the couple, who holds the decision-making power in household finances is also important in creating the disparity in nominal assets between spouses. Pahl (1989) emphasized that asset formation between spouses is not only determined by who earns more but also by who "controls" the household money, i.e., the power dynamics between spouses. Grabka and colleagues (2015) analyzed the factors of the disparity in nominal assets between spouses from the German panel data (Wagner et al., 2007) of 7,200

couples and found that who makes the household financial decisions had the most significant impact on the disparity in financial assets between spouses.

In addition to the gender-based division of labor, the impact of financial literacy has also been pointed out. Kamiya (2018) reported that while men had higher financial knowledge than women, women had relatively higher correct answer rates for questions on "how to improve financial situations" and "household management," indicating that men, who have more opportunities to acquire financial knowledge through employment, and women, who often take on the role of daily household management and operation under the gender-based division of labor, build different financial literacy. Achieving gender equality in asset formation is also one of the biggest challenges in Norway. The Norway Reports (2020) stated that it is important for Norwegian women to receive appropriate support, encouragement, and training, and that women have a high ability to engage more deeply in investment activities and improve the profitability of assets.

Purpose and Subjects

This study targeted married men and women in Japan and Norway, where gender equality is more advanced, to investigate their own and their spouse's (partner's) income and financial assets, as well as their financial behavior (supported by the "Japan Center for Economic Research Grant" and the Grant-in-Aid for Young Scientists (Project Number 18K12924) (Principal Investigator: Junko Sano), and the "Murata Science Foundation Research Grant". Currently, the labor force participation rate of women in Norway is 69.5% (Statistics Norway, 2023) (54.2% in Japan, Ministry of Health, Labor and Welfare, 2022). Furthermore, Norway introduced a quota system for corporate executives in 1993 (requiring that the ratio of men and women on the board of directors be at least 40% each). As a result, Norway has a percentage of women in managerial positions at 41.5%, while in Japan, it is 12.6% (Ministry of Health, Labor and Welfare, 2022). On the other hand, in Japan, strategies have been continuously implemented to increase the labor productivity of male workers, with wives taking care of non-work-related matters, especially household chores, so that male workers can concentrate on their work. It is known that the current social security system still retains the remnants of "supporting the husband" (the "spousal deduction" in income tax and the "Category 3 insured person system," which allows wives to receive pensions without paying premiums, were established to evaluate the wife's "supporting the husband"). This study aimed to compare how gender-based division of labor and financial literacy affected asset formation between spouses.

Project Design/Methodology

A web survey on financial behavior and gender awareness was conducted. The survey, conducted in December 2021, targeted married men and women aged 30 to 55 (including common-law marriages, excluding divorced or widowed individuals) from across Japan and Norway who are currently working and forming assets. In Japan, women were divided into three groups: 334 full-time employees, 333 part-time employees, and 333 full-time stay-at-home spouses. To verify the difference in financial assets held in each spouse's name, only cases where responses were obtained for both the individual's and the spouse's financial assets were extracted. As a result, the analysis included 471 Japanese men, 469 Japanese women, 230 Norwegian men, and 189 Norwegian women. Descriptive statistics and t-tests were conducted for the analysis.

Main Results or Findings

Both male and female respondents in Norway had higher household income, wife's income, household financial assets, and wife's financial assets than those in Japan. Household financial assets were approximately 1.6 times higher for male respondents and 1.5 times higher for female respondents in Norway compared to Japan, which was consistent with national statistics. The wife's financial assets in Norway were approximately 9.73 million yen for male respondents and 8.84 million yen for female respondents, while in Japan, the wife's financial assets were approximately 4.83 million yen for male respondents and 5.46 million yen for female respondents. The higher income of wives in Norway, where dual-income households are standard and there are fewer full-time stay-at-home spouses, as well as the higher number of women in managerial positions, contributed to the higher household financial assets. However, the allocation of Japanese women into three equal groups of full-time employees, part-time employees, and full-time stay-at-home spouses also influenced the results. When comparing only dual-income households (with the wife as a full-time employee) in Norway and Japan, the wife's financial assets were 10.933 million yen for female respondents in Norway and 7.27 million yen for female respondents in Japan. For part-time employees in Japan, the wife's financial assets were 4.23 million yen, and for full-time stay-at-home spouses, the wife's financial assets were 4.87 million yen.

In Japan, the high "wife's household decision-making power" reduced the difference in financial assets between spouses. Decision-making regarding living expenses, savings plans, and asset management in Japan was "always the wife" or "mostly the wife" in 64.2% of cases for living expenses, 46.1% for savings plans, and 31.6% for asset management. In Norway, responses indicated that decisions were made "jointly" by both spouses in about half of the cases for all three categories. It was clear that in Japan, the wife mainly decided on the daily handling of money. This was similar to the results of the "7th National Family Trends Survey" (National Institute of Population and Social Security Research, 2023), where 62.3% of respondents said the wife decided on "household distribution and management," 22.8% said "together," and only 14.9% said "the husband" (Sano, 2023, 2024).

The proportion of those who agreed with the male breadwinner role, where men should support the family's economy, was predictably higher in Japan than in Norway. In Japan, there was a strong tendency to consider "the husband's income as family income" and to see the husband's breadwinner role as natural, with the wife taking on the role of household management. This led to the wife mainly making household decisions. Japanese wives seemed to feel less inconvenience in daily money management. In contrast, in Norway, the income and financial assets of spouses (partners) were managed jointly. One reason for the joint management of financial assets in Norway is the high proportion of common-law marriages. In this survey, all Japanese respondents were legally married, while in Norway, 72.5% were legally married (435 people), 13.5% were in common-law marriages (81 people), and 14% were cohabiting (84 people). Due to differences in the marriage system, it is believed that individuals manage their own income, share the costs necessary for living, and form assets with their remaining income.

Next, the breakdown of financial assets was examined. Respondents were asked to select all financial assets held in their name, including savings, trusts, stocks, investment trusts, bonds, securities derivatives, and others, or to indicate if they had none. Comparing Japan and Norway, Japanese couples' financial assets were heavily concentrated in savings. When asked about the breakdown of financial assets (multiple answers allowed), 88.6% of Japanese men

and 86% of Japanese women had savings, with the next most common asset being stocks, owned by 31.5% of Japanese men and 14.6% of Japanese women. In contrast, Norwegian men and women had a more diverse breakdown of financial assets. Norwegian men had 77.7% in savings, 49.3% in investment trusts, and 47% in stocks, while Norwegian women had 67.7% in savings, 33.7% in stock investments, and 32% in investment trusts. The preference for savings in Japan was prominent in the comparison between the two countries.

Regarding financial assets, respondents were asked, "Does your household manage assets through means other than savings or deposits?" The most common response among both Japanese men and women was "not managing assets," excluding savings. Particularly, 48% of Japanese women responded that they were not managing assets. In contrast, the response rate for not managing assets in Norway was 13.7% for men and 22.3% for women, with Norwegian women also being more reluctant to manage assets.

When asked why they were not managing assets, the most common response for both men and women in both countries was "because I don't want to lose money." Notably, the highest response among Japanese women was "securities investment is difficult." Why do so many Japanese women find securities investment difficult?

Next, the impact of education on asset formation and asset management in Japan and Norway was examined. Among respondents, 18.4% (out of 1,016) in Japan and 69.7% (out of 419) in Norway reported having opportunities for financial education at school or work. The response rate for financial education opportunities in Norway was about four times higher than in Japan.

Next, using a five-point scale, the impact of financial education opportunities on individual financial assets, annual income, financial literacy (1 point for two correct answers, 0 points otherwise), frequency of discussions with parents about savings (from very frequent, 5 points, to never, 0 points), frequency of discussions with parents about stocks, whether they think investment is necessary (from very necessary, 5 points, to not necessary at all, 0 points), and whether they have a life plan (from very much, 5 points, to not at all, 0 points) was examined. T-tests were conducted to confirm differences based on the presence or absence of financial education opportunities. In both countries, those with educational opportunities had higher average incomes and significantly higher frequencies of discussions with parents about savings and stocks. In Norway, those with financial education opportunities were significantly more likely to agree that stock investment is necessary. In both countries, especially in Japan, those with educational opportunities were more likely to have a life plan. The group with educational experience showed significantly higher values in all items except financial literacy in Japan.

Conclusion

The results showed that Japanese couples had lower individual incomes and financial assets compared to Norwegian couples, and the total household financial assets were also lower. Additionally, there was more support for gender-based division of labor in Japan than in Norway. In Norway, both spouses are typically full-time employees and manage money together, whereas in Japan, earning money is considered the husband's role, and managing money is the wife's role. Regarding asset management, many Japanese respondents, both men and women, reported not engaging in asset management, while many Norwegian respondents reported managing assets together as a couple. The most common reason for not managing

assets in both countries was the fear of losing money, but many Japanese women also cited the difficulty of asset management. The number of respondents who had received financial education at school or work was 3.7 times higher in Norway than in Japan, highlighting the lack of financial education opportunities in Japan. The presence or absence of financial education significantly affected income, awareness of the need for asset management, and life planning, supporting previous research. Furthermore, those with financial education experience had more frequent discussions about savings and stocks with their parents. Financial education experience may have promoted conversations about savings and investments between parents and children at home.

Discussion

In Japan, both men and women generally have lower financial assets in their names compared to Norway. Many Japanese are more reluctant to invest than Norwegians. Having financial education experience can increase conversations about savings and investments between parents and children, positively impacting asset formation and management. In the future, Japan needs to increase opportunities for financial education at schools and workplaces to the level of Norway, raise financial asset amounts, and actively engage in savings and asset management.

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Sampling the Need to Use and Study English Felt Daily by University Students in Japan

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Abstract
In the English as a Foreign Language (EFL) setting, the classroom has been the primary venue for language learning and has received significant attention for its influence on second language (L2) learners' motivation to study. However, this focus has often led to overlooking the role of L2 learning in learners' everyday lives outside of the classroom, including the motivation to study English. To address this gap, researchers have emphasized the importance of exploring out-of-class situations. One effective approach to overcoming this challenge is the experience sampling method (ESM), which randomly collects data on individuals' thoughts, emotions, and behaviors over time. This study used ESM to examine the factors influencing the perceived need to use and study English in L2 learners' everyday lives, focusing on variables such as gender and university majors. In total, 113 university students in Japan participated in the study and answered a questionnaire three times a day for one week. The results showed that academic majors had a stronger influence than gender on students' perceptions. English majors reported a consistently higher perceived need to use and study English, whereas non-English majors tended to feel the need to study English more than the need to use it. While English classes were the primary motivator for English majors, non-English majors were particularly influenced by the exam, peer and family interactions, and media. These findings highlight the importance of considering learners' academic and social contexts beyond the classroom, and provide insights for enhancing motivation in diverse settings.

Keywords: Experience Sampling Method (ESM), English Learning, Out-of-School Learning

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Introduction

Out-of-class learning plays a crucial role in the development of foreign/second (L2) language proficiency. This is particularly evident in the context of English as a foreign language (EFL), where opportunities for exposure to the target language are limited compared to English as a second language (ESL). Classrooms have traditionally served as primary venues for L2 learning in such environments. Reflecting on this reliance on classroom instruction, research has predominantly focused on understanding classroom-based motivation for L2 learning and identifying various influential factors (e.g., Dörnyei, 1994; Mercer & Dörnyei, 2020). However, this emphasis on classroom research has often overshadowed the exploration of out-of-class learning experiences. To address this gap, prior research has underscored the need to explore learning contexts beyond the classroom (e.g., Fukuda et al., 2019; Fukuda & Yoshida, 2013).

Moreover, in out-of-class contexts, it is crucial to examine how external factors shape learners' emotions, thoughts, and behaviors. These factors significantly affect L2 learners' learning processes and learning outcomes, thereby influencing the overall effectiveness of out-of-class learning. Investigating these factors can offer a more comprehensive understanding of L2 learning processes and bridge the gap between L2 learners' psychology and real-world language learning.

A particularly promising method for exploring these under-researched dimensions is the experience sampling method (ESM), which captures individuals' thoughts, emotions, and behaviors through random sampling over time. This study employed ESM to examine the factors influencing L2 learners' perceived need to use and study English in their everyday lives. By investigating these aspects, this study aims to deepen our understanding of how out-of-class experiences interact with classroom-based learning.

Literature Review

Research on Out-of-Class Learning

Several existing studies have assumed that out-of-class learning plays an important role in L2 acquisition. For example, Lai, Zhu, and Gong (2015) investigated the quality of out-of-class English learning among 82 middle school students in China. They found that diverse out-of-class activities addressing various language learning needs combined with in-class instruction that balanced attention to meaning and form were strongly associated with better English grades, higher confidence in language learning, and greater enjoyment. Further, Sundqvist (2011, as cited in Lai et al., 2015) explored the relationship between Swedish learners' time spent on out-of-class learning and their conversational proficiency. The results revealed a positive correlation of 0.31 between time spent on out-of-class learning and conversational proficiency, with a correlation of 0.36 with vocabulary knowledge. Additionally, the analysis showed that increased time spent on out-of-class learning was positively associated with learners' English self-efficacy.

Despite recognizing the importance of out-of-class learning environments, little attention has been paid to the fundamental question of when and how learners are motivated to engage in English learning in their daily lives. To deepen our understanding of Japanese English learners, it is essential to explore the core of their motivation, specifically the situations in which they feel the need to use and study English in their everyday lives.

One significant barrier to researching daily experiences related to target language is the methodological difficulty involved in capturing such phenomena. In the field of psychology, studying people's daily experiences (i.e., what they feel, think, and behave in the real world) has been a key focus of research. Among the various methods available, the interview method is the most common. While interviews successfully capture memorable events and experiences, retrospective methods such as these have notable limitations, including inaccuracies caused by reliance on participants' recollections of past events (Silvia & Cotter, 2021). One method for overcoming this pitfall is called the "experience sampling method" (ESM).

The Experience Sampling Method (ESM)

ESM is "a research procedure for studying what people do, feel, and think during their daily lives" (Larson & Csikszentmihalyi, 1983, p. 41; Larson & Csikszentmihalyi, 2014, p. 21). Silvia and Cotter (2021) identify three defining features of ESM.

1. People are assessed in their *natural environments*.
2. The events and experiences that people live are assessed in *real time*, capturing them close to when they occur.
3. People are *assessed intensively over time*, and the results can prove a large sample of emotions, thoughts, and actions.

A typical ESM procedure involves participants receiving a survey signal and subsequently answering questions about what they are doing, with whom, and in what situation. This procedure is repeated several times daily for a few days or weeks. In the early stages of ESM, paper and pencils or beepers were used. Nowadays, owing to technological advances and the prevalence of smartphones, email, short messaging services (SMS), and applications are accessed on smartphones.

ESM Research in Psychology and L2 Fields

In psychology fields, several studies have used ESM as a research tool to investigate various phenomena (e.g., Baumeister et al., 2019; Hofmann, Vohs, et al., 2012). For example, Hofmann, Baumeister, et al. (2012) investigated 205 German adults using beepers for one week to explore how often and how strongly people experience desires, to what extent their desires conflict with other goals, and how often and successfully people exercise self-control.

In the field of L2 research, ESM has rarely been used as a research tool. However, Hiver and Al-Hoorie (2020) and Arndt, Granfeldt, and Gullberg (2023a) have recently highlighted the suitability of this method for L2 research. An early example of ESM use in L2 research was introduced by Guilloteaux (2016), who examined the learning engagement levels (i.e., the simultaneous experience of concentration, interest, and enjoyment) of 224 high school students during English classes in Korea. Students received pager signals prompting them to produce a maximum of six responses during lessons. Guilloteaux's analysis of the students' mean scores revealed that most students were classified as having low engagement, with only 13% showing optimal engagement in lessons. She speculated that the prevalence of teacher-centered instructional practices could be a possible factor in such low engagement.

The number of studies employing ESM in the L2 field has been increasing. For example, Khajavy, MacIntyre, Taherian, and Ross (2021) focused on L2 willingness to communicate (WTC), and Arndt, Granfeldt, and Gullberg (2023b) studied language exposure and use. The

most relevant research conducted to date includes a series of studies by Taguchi. Taguchi (2022) investigated the felt need to use and study English alongside actual study behavior in the everyday lives of 24 Japanese students in Japan outside the academic semester. The study revealed that certain daily events and activities (e.g., watching English videos during leisure time and working part-time) contributed to some learners feeling the need to use and study English. Furthermore, some learners remained motivated to study English even during holiday periods, when there were no immediate English study situations at school. Another study by Taguchi (in press) examined the extent to which Japanese university students felt the need to use and study English in their everyday lives, the situations in which this need arose, the reasons for it, and the gap between the need to use and study English. This study found that ordinary daily activities triggered this need. Moreover, it identified factors that enhanced this need, such as heightened interest, immediate necessity, and future necessity. Conversely, it highlighted factors that diminished this need, including a perceived lack of ability and negative learning experiences.

Modifying Factors in Language Attitudes and Motivation

The studies mentioned above present a relatively straightforward picture of how one factor influences others in the realm of English learning. While the results outlined provide a reasonably accurate description of what has been under investigation, they do not suggest that the participants' responses were entirely uniform. Certain systematic variations can be identified within the general trends. There are several sources for these variations. For instance, Dörnyei, Csizér, and Németh (2006) examined whether Hungarian students' attitudinal and motivational variables were influenced by factors such as gender and the L2 they were studying at school. Their findings revealed a consistent trend, in which girls scored significantly higher than boys on attitudinal/motivational measures. Similarly, instructional differences played a notable role, with students actively involved in learning an L2 exhibiting higher levels of motivation for the target language than those who were not studying it. Furthermore, Ngo, Spooner-Lane, and Mergler (2017) compared English majors and non-English majors in Vietnam, focusing on their motivation to learn English. They found that English majors were more intrinsically motivated and felt less obligated to learn English than non-English majors.

These studies highlighted important trends and provided a foundation for understanding motivational differences in various contexts. However, a closer examination of these variations is necessary to gain deeper insight into out-of-class learning. These findings raise questions about how different factors influence learners' motivation, or, more fundamentally, the need to use and study English. Based on these results, the following research questions were addressed:

RQ1: Which factors contribute to the perception of the need to use and study English in daily life?

RQ2: Are there any differences between English majors and non-English majors in terms of their daily perception of the need to use and study English?

RQ3: What are the reasons for the perceived need to use and study English among English and non-English majors?

Method

Participants

A total of 113 students (28 males; 85 females) participated in this study, primarily from universities in central Japan, with the majority enrolled at a single university. The participants were 58 first-year, 44 second-year, and 11 third-year students. They studied English and/or English-related subjects. Their majors covered a wide range of disciplines, including humanities, social sciences, and natural sciences. Among them, 30 majored in English-related fields, while 83 in non-English-related fields. Most participants (102 students) thought that English would be necessary after graduation.

Research Instruments

This study uses two types of research instruments. Questionnaires were used to collect data, and ESM software was used to deliver the questionnaires.

Questionnaires. This study used two questionnaire types. The first focused on participants' experiences related to perceived English use and study. The following six items were originally designed by Taguchi (in press).

Q1:What were you doing for the last 90 minutes before responding to this survey? Please select main activities among 14 activities (e.g., working part-time, attending a class at university, doing club activities, etc.).

Q2:To what extent did you feel **the need to use English (reading, listening, speaking, or writing)** in the last 90 minutes before responding to this survey? Choose one number which is applicable to you from 0 (Never felt it at all) to 5 (Felt it very strongly).

Q3:Please specify reasons for it as concretely as possible.

Q4:To what extent did you feel **the need to study English (reading, listening, speaking, or writing)** in the last 90 minutes before responding to this survey? Choose one number which is applicable to you from 0 (Never felt it at all) to 5 (Felt it very strongly).

Q5:Please specify reasons for it as concretely as possible.

Q6:Did you study English in the last 90 minutes before responding to this survey? Choose one number which is applicable to you from 0 (Didn't study at all) to 5 (Studied quite a lot).

The second questionnaire type contained 13 questions about the participants' backgrounds, including their gender, academic majors, year at university, degree of necessity for English after graduation, and English proficiency.

All questions and instructions in both questionnaires were written in Japanese to ensure that the participants fully understood the surveys.

ESM software. The present study employed ESM software called "Exkuma" (https://exkuma.com/), which was specifically developed by an ESM expert for use in Japanese language environments. This software used LINE, a freeware communication application available for electronic devices such as smartphones, tablets, and PCs, to send respondents a link to Exkuma.

Data Collection Procedures

The participants were recruited through classroom announcements and word-of-mouth. Data were collected during the semesters in 2022. The survey was distributed via LINE, with signals sent to participants at three randomly chosen times per day between 9:00 am and 10:00 pm, ensuring a minimum interval of two hours between each signal. Participants were instructed to complete the survey within 90 min of receiving the signal. If the survey was not completed within 60 min, a reminder was sent. The survey period lasted for one week. In the background questionnaire, participants were asked to answer all questions after the ESM survey. Participants were compensated based on the number of times they answered.

The overall response rate was 86%, with participants completing the survey an average of 18 times out of 21 received signals. Given that the general response rate for ESM research typically ranges from 70% to 80% (Hektner et al., 2007), the response rate observed in the present study was notably high.

Data Analysis Procedure

All data were analyzed using Microsoft Excel and IBM SPSS version 29. For RQ1, to compare the means of the two groups of learners' attributes, independent samples *t*-tests were performed. For RQ2, to compare the means of English and non-English majors in terms of their two types of felt needs on a daily basis, independent samples *t*-tests were conducted, and to examine the differences between the two types within the same participants, paired samples *t*-tests were carried out. Furthermore, to indicate the effect sizes of the mean differences, Cohen's *d* was reported, with thresholds of 0.20, 0.50, and 0.80 or higher indicating small, medium, and large effects, respectively (Cohen, 1988). For RQ3, participants' responses were coded and similar comments were categorized into subcategories, which were then grouped into broader categories. Throughout this process, responses related to Q1 were consulted as required.

Findings and Discussion

Factor Contributing to the Perception of the Need to Use and Study English in Daily Life (RQ1)

RQ1 examined the factors influencing the perception of the need to use and study English in daily life. Table 1 presents the results of *t*-tests comparing gender (boys and girls) and academic majors (English and non-English majors). Note that English proficiency was not included here as the groups created based on English abilities were almost the same as the groupings of academic majors.

Table 1: Summaries of *t*-Test Analyses of the Perceived Need to Use and Study

		Q2: Felt need to use		*Q4: Felt need to study*	
	n	*M*	*SD*	*M*	*SD*
Gender					
Male	28	0.86	0.59	1.06	0.77
Female	85	0.73	0.59	0.89	0.67
df		111		111	
t		0.98		1.14	
d		0.21		0.25	
Major					
English	30	1.16	0.56	1.36	0.60
Non-English	80	0.62	0.54	0.78	0.66
df		111		111	
t		4.60***		4.25***	
d		0.98		0.90	

***$p < .001$ (2-tailed).

The analyses revealed no significant differences between male and female students. In contrast, a statistically significant difference was observed between English majors and non-English majors, with large effect sizes (*d*s = 0.90 & 0.98). These findings suggest that academic majors exert a stronger influence than gender on learners' perceptions of the need to use and study English in their daily lives.

These results can be interpreted as follows. Regarding gender differences, previous studies have frequently reported that female students tend to be more motivated to learn an L2 than their male counterparts (e.g., Dörnyei et al., 2006). However, this study found no significant differences between males and females. One possible reason lies in the assumption that learning Global English in Japan may neutralize gender-specific tendencies in terms of the felt need to use and study English in daily life. Regarding academic majors, the results of this study align with those of previous research (e.g., Ngo et al., 2017), suggesting that English majors are more likely to perceive the need to use and study English in their daily lives. This highlights the stronger influence of academic focus than other demographic factors such as gender on shaping learners' daily perceptions of the need to use and study English.

Given these findings, further analyses will focus on whether the students are English majors.

Differences Between Academic Majors in Terms of the Daily Perception of the Need to Use and Study English (RQ2)

RQ2 investigated the differences between English and non-English majors regarding their daily perceptions of the need to use and study English. Table 2 presents the results of the *t*-tests, revealing two key features.

Table 2: Differences Between English and Non-English Majors in Terms of the Daily Perception of the Need to Use and Study English

		Survey day						
Major		Day1	Day2	Day3	Day4	Day5	Day6	Day7
Q2: Felt need to use								
English	*M*	1.17	1.61	1.27	0.87	0.80	0.95	1.23
	SD	0.99	1.06	1.29	1.08	1.10	1.05	1.16
Non-English	*M*	0.81	0.55	0.65	0.62	0.55	0.53	0.71
	SD	0.94	0.85	0.96	1.01	0.88	0.85	1.10
	df	111	110	41.22	109	108	110	109
	t	1.79	5.43***	2.39*	1.15	1.23	2.19*	2.32*
	d	0.38	1.17	0.58	0.24	0.26	0.47	0.50
Q4: Felt need to study								
English	*M*	1.64	1.60	1.42	1.03	0.93	1.18	1.46
	SD	1.24	1.08	1.30	1.21	1.19	1.07	1.2
Non-English	*M*	1.03	0.71	0.84	0.79	0.70	0.66	0.79
	SD	1.13	0.95	1.15	1.15	0.95	1.00	1.15
	df	111	110	111	109	108	110	109
	t	2.46*	4.21***	2.31*	0.97	1.05	2.38*	2.66**
	d	0.52	0.91	0.49	0.21	0.23	0.51	0.57
Comparison of means between Q2 and Q4								
English	*df*	29	28	29	29	29	28	29
	t	3.06**	0.08	1.05	1.38	2.07*	2.45*	1.71
	d	0.56	0.01	0.19	0.25	0.38	0.46	0.31
Non-English	*df*	82	82	82	80	79	82	80
	t	2.56*	2.89**	2.64**	3.07**	3.04**	2.86**	1.64
	d	0.28	0.32	0.29	0.34	0.34	0.31	0.18

*p<.05 (2-tailed), **p<.01 (2-tailed), ***p<.001 (2-tailed).

First, statistically significant differences were observed between English and non-English majors on several days of the week. For the perceived need to use English, significant differences emerged on four days (i.e., Days 2, 3, 6, & 7), with medium to large effect sizes (*d*s = 0.47–1.17). Similarly, significant differences in the perceived need to study English were found on five days (i.e., Days 1, 2, 3, 6, & 7), indicating medium to large effect sizes (*d*s = 0.49–0.91). These findings indicate that English majors consistently perceive a greater need to use and study English throughout the week, suggesting greater engagement in language learning in their daily lives.

Second, the mean values for the perceived need to study English were generally higher than those for the perceived need to use English, regardless of the students' majors. To confirm that this result was statistically significant, paired samples *t*-tests were conducted. The analyses revealed significant differences for English majors on three days (i.e., Days 1, 5, & 6), with small to medium effect sizes (*d*s = 0.38–0.56). For non-English majors, significant differences were found on six days (i.e., Days 1–6), with small effect sizes (*d*s = 0.28–0.34). These results highlight that English majors tend to feel a similar level of need both to study and to use English, whereas non-English majors feel a stronger need to study than to use it.

Previous research on L2 motivation indicates that English majors are generally more motivated to study English than non-English majors (e.g., Ngo et al., 2017). Similar to RQ1,

our findings are consistent with these results. However, an intriguing observation is that learners, particularly non-English majors, often perceive a greater need to study English than to use it. While the need to use English is typically expected to motivate learners to study it, the findings suggest that, for some students, the perceived need to use English may demotivate them from studying it. Similarly, Taguchi (in press) reported that the felt need to use English could enhance or diminish learners' motivation to study, depending on the individual. This variation may be attributed to differences in the learners' academic majors, which will be further explored to address the third research question.

Reasons for the Need to Use and Study English Between English and Non-English Majors (RQ3)

RQ3 examined the reasons behind the differences in the perceived need to use and study English between English and non-English majors. Table 3 presents the results of comment analysis. To better understand these differences, we explored the characteristics specific to each group.

In the case of English majors, the dominant factor influencing their perceived need to use and study English was English classes (52% for Q3 and 49% for Q5). English classes refer to activities, topics discussed in class, and assignments that must be completed outside the classroom. Given that English majors typically take more English classes, it is natural for these classes to serve as a primary source of motivation for both using and studying English.

Table 3: Reasons for the Felt Need to Use and Study English Between English and Non-English Majors

	English class	Non-English class	English exam	Surrounding environment	Entertain-ment	Part-time	Self-study	Others
Q3: Reasons for the perceived need to use English								
English (n = 201)	105 (52%)	6 (3%)	7 (3%)	28 (14%)	19 (9%)	10 (5%)	17 (8%)	9 (4%)
Non-English (n = 361)	107 (30%)	24 (7%)	44 (12%)	95 (26%)	46 (13%)	20 (6%)	16 (4%)	9 (2%)
Q5: Reasons for the perceived need to study English								
English (n = 245)	120 (49%)	7 (3%)	13 (5%)	31 (13%)	21 (9%)	10 (4%)	16 (7%)	27 (11%)
Non-English (n = 422)	146 (35%)	20 (5%)	73 (17%)	89 (21%)	42 (10%)	20 (5%)	12 (3%)	20 (5%)

On the other hand, for non-English majors, while the main factor is still represented by English classes (30% for Q3 and 35% for Q5), other factors also played a notable role. Two of these factors are the English exam and surrounding environment (12% & 14% for Q3 and 26% & 21% for Q5, respectively). First, the English exam primarily refer to the TOEIC test, which almost all the students in this study are required to take at the end of the semester as part of their English class credit. Non-English majors often have low confidence in their English proficiency. This lack of confidence appears to heighten their awareness of the exam,

likely because of the pressure to achieve the minimum required score. This heightened awareness may stem from test anxiety (e.g., MacIntyre & Gardner, 1991), which could amplify their perception of the need to use and study English.

The second factor, surrounding environment, includes interactions with friends and family, encounters with non-Japanese people, and exposure to English media. This result is caused by two potential reasons. First, their lack of confidence in the English exam may have led them to talk about it with others, thereby increasing their awareness of English. Second, participation in this study may have heightened their sensitivity to English-related contexts.

Finally, it is worth noting that there was an increase from the felt need to use to the felt need to study. For English majors, the percentage of the "Others" category increased from 6% to 12%. Further analysis of this category suggested that some students sought to improve their English proficiency and seemed motivated to study English more actively. Conversely, for non-English majors, the percentages for English classes and the exam increased significantly from the felt need to use to the felt need to study (30%→35% and 12%→35%, respectively). Due to their limited English abilities, they seemed particularly compelled to study English in situations related to classes and the exam. These results reveal that, while the perceived needs to use and study English are closely connected, their relationship is not always straightforward—learners' awareness of the necessity of using English influences their felt need to study the language, sometimes increasing it and at other times decreasing it.

These findings suggest that immediate learning environments (e.g., English classes and exams) play a crucial role in making students feel the need to study English. Additionally, other stimuli, positive or negative, may enhance students' awareness of English learning. Such stimuli could encourage deliberate engagement in English learning even in the absence of opportunities for direct usage. Future research should explore how these additional stimuli interact with students' long-term motivation and actual English learning performance.

Conclusion

The present study explored differences in learners' perceptions of the need to use and study English in their daily lives, focusing on academic majors (i.e., English majors and non-English majors) and addressing three research questions (RQs). For RQ1, the findings demonstrated that students' academic majors had a stronger impact on their daily perceptions of the necessity of using and studying English than their gender. For RQ2, the results revealed that English majors consistently perceived a greater need to use and study English throughout the week, whereas non-English majors reported a stronger perceived need to study English than to use it. Regarding RQ3, English classes were identified as the primary motivators for English majors to use and study English. In contrast, for non-English majors, in addition to English classes, the English exam and environmental factors such as interactions with peers and family and exposure to English media played relatively stronger motivational roles.

Our findings provide valuable pedagogical insights. First, we found that English classes significantly influence students' daily perception of studying English, both during class and through assignments. Activities and assignments that provide an appropriate level of challenge are essential to maximize this impact. In addition, given that students daily encounter various stimuli that encourage English use and study, classroom activities should be designed to leverage real-world connections. For non-English majors, English exams are

important for raising awareness of the need to engage in the language; however, instruction should minimize undue pressure or anxiety.

Despite its contributions, this study had several limitations. Most of the participants were from a single university, which may have limited the generalizability of the findings. Future research using more diverse samples is recommended. Additionally, the scope of the questions used in this study was limited. Expanding the range of questions could provide deeper insight into learners' perceptions and experiences.

This study highlights a relatively underexplored area, namely learners' daily perceptions of their need to use and study English. By understanding students' real-life experiences of English use and study, educators can design better strategies to enhance their learning outcomes. The experience sampling approach is a promising method for capturing learners' real-time perceptions and behaviors. Further studies employing this method could provide more nuanced insights into the dynamic interplay between learners' environments and their motivation to use and study English.

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Trends in Data Utilization in Japanese High School IT Education: Analysis of 468 Presentations From 17 Zenkojoken National Conferences

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Official Conference Proceedings

Abstract
This paper examines how data utilization has emerged and evolved within Japanese high school Informatics education, based on an analysis of 468 presentations delivered at 17 annual conferences of the National High School Informatics Education Research Association (Zenkojoken). After reviewing the historical context of Informatics education in Japan, the study categorizes the presentations into five areas—Problem-solving in the Information Society, Communication and Information Design, Computers and Programming, Information Networks and Data Utilization, and Other Topics—reflecting the structure of the new high school curriculum guidelines. The primary focus is on the growing emphasis on data utilization skills, including data collection, analysis, and interpretation. Through a detailed examination of lesson plans, teaching strategies, and classroom outcomes, this paper highlights trends such as the increasing use of personal and local data to enhance student engagement and the incorporation of interdisciplinary approaches to amplify real-world relevance. The findings indicate that data literacy is not only becoming a vital skill set for students in a rapidly evolving digital society but also serving as a catalyst for innovative teaching practices. Implications for curriculum design and teacher training are discussed, and future perspectives for expanding data utilization activities in collaboration with other subject areas are outlined.

Keywords: Data Utilization, Informatics Education, High School Curriculum, Zenkojoken, Japan

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Introduction

Informatics education has progressively gained importance worldwide, as digital tools and technologies shape various aspects of daily life (Jones, 2023). In Japan, efforts to integrate Informatics into the high school curriculum have been driven by the national objective of developing citizens who can actively participate in a rapidly evolving information society (Ministry of Education, Culture, Sports, Science, and Technology [MEXT], 2018). Since 2003, Informatics has been a mandatory subject in Japanese high schools, aimed at cultivating essential computer skills, problem-solving abilities, and a deeper understanding of how technology can be leveraged to address societal challenges.

To support and advance this field, the National High School Informatics Education Research Association—commonly referred to as Zenkojoken—was established in 2008 (National High School Informatics Education Research Association [Zenkojoken], 2008-2024). Zenkojoken serves as a platform for educators, researchers, and policy makers to share best practices, teaching methodologies, and classroom innovations in Informatics education. Over the course of its 17 annual conferences, Zenkojoken has accumulated a substantial body of knowledge, as evidenced by the 468 presentations that form the basis of the study presented in this paper.

A noteworthy development in the recent revision of Japan's high school curriculum (implemented starting 2018) is the creation of two new subjects, Informatics I and Informatics II. These new courses revolve around four core fields: (1) Problem-solving in the Information Society, (2) Communication and Information Design, (3) Computers and Programming, and (4) Information Networks and Data Utilization. Together, these fields aim to ensure that all students are equipped with fundamental IT literacy, technical competencies, and the ability to apply these skills in creatively and socially beneficial ways.

Among these four core fields, the domain of "Information Networks and Data Utilization" stands out due to the rapid expansion of data-driven technologies in various industries (Domino Data Lab, 2023). With the increasing importance of data analysis, visualization, and informed decision-making, educators have recognized the need to cultivate "data literacy" as a critical component of 21st-century skills. The role of Zenkojoken conferences in disseminating effective teaching strategies within this area has grown considerably, particularly in the wake of widespread digital transformation and the availability of diverse data sets—from personal smartphone usage to broader societal trends.

This paper seeks to illuminate the trends in data utilization within Japanese high school IT education by systematically analyzing the content of 468 presentations from 17 Zenkojoken conferences. First, the historical context of Informatics education in Japan is presented. Next, the paper describes how these presentations were classified according to the five categories reflecting the core curriculum fields, with a special emphasis on the emerging category of "Data Utilization." Drawing upon this classification, the paper outlines the key instructional methods, classroom activities, and student outcomes that were identified in the presentations. Special attention is given to a case study of a high school lesson focusing on smartphone usage data, demonstrating how personal data can effectively engage students in learning.

Lastly, the paper explores the implications for future curriculum development and teacher training, arguing that data literacy and interdisciplinary connections can propel Informatics education forward in Japan and beyond. By examining how data utilization has been operationalized in classroom settings, this paper contributes to a growing body of literature

on best practices in Informatics education and offers insights for policy makers, practitioners, and researchers interested in fostering a data-literate generation.

Background of Informatics Education in Japan

Early Developments (2003 Onwards)

In 2003, Japan took a pioneering step by making Informatics education mandatory in high schools (MEXT, 2003). At that time, three subjects—Informatics A, Informatics B, and Informatics C—were introduced. Each of these subjects focused on a distinct dimension of Informatics, collectively seeking to ensure that students would graduate with:

(1) **Basic Computer Skills (Informatics A)**
Students learn fundamental skills such as word processing, spreadsheet manipulation, and essential networking knowledge. This subset of Informatics emphasizes foundational computer literacy for all students.

(2) **Algorithms and Logical Thinking (Informatics B)**
Students delve into problem-solving techniques with an emphasis on algorithmic thinking. Early programming exercises typically involve educational programming languages like Scratch, though some schools also incorporate Python or other text-based languages.

(3) **Real-World Applications (Informatics C)**
This subject encourages students to use IT tools to address and potentially solve real or simulated social and organizational problems. Activities may include analyzing data related to community issues, planning technology-based solutions, or designing web-based applications.

This tripartite structure laid the groundwork for subsequent reforms, as educators and policy makers continued to refine the curriculum to keep pace with technological advancements.

Role of Zenkojoken

Zenkojoken, the National High School Informatics Education Research Association, was launched in 2008, serving as a professional network for teachers seeking to improve and share effective methods in Informatics education. Over the years, Zenkojoken's annual conferences have become a cornerstone of professional development, featuring:

- Presentations of classroom-based research and best practices
- Workshops on emerging technologies and teaching tools
- Peer-reviewed sessions to maintain high-quality discussions

Throughout its evolution, Zenkojoken has maintained a teacher-driven focus, enabling educators to discuss the practical challenges they face in the classroom and collectively brainstorm solutions. Many teachers have credited Zenkojoken with helping them stay informed about curriculum changes and innovative approaches in the field.

Curriculum Revision and the Four Fields

In 2018, Japan's Ministry of Education, Culture, Sports, Science, and Technology (MEXT) revised the high school curriculum, resulting in two new Informatics subjects—Informatics I and Informatics II—that align more closely with the demands of a digital society. Central to these revisions is the division of content into four key fields:

(1) **Problem-Solving in the Information Society**
Emphasizes recognizing and defining social or personal problems, deciding which data are necessary for analysis, and using digital tools for solution development.
(2) **Communication and Information Design**
Focuses on effectively conveying information through thoughtful design, including the creation of infographics, data visualizations, or interactive media.
(3) **Computers and Programming**
Provides in-depth knowledge of how computers operate, including hardware and software fundamentals, as well as hands-on programming practice to develop logical thinking.
(4) **Information Networks and Data Utilization**
Teaches the architecture of networks and cultivates data literacy skills—gathering, analyzing, and making data-driven decisions, with a particular emphasis on connecting such skills to societal needs.

Within these fields, educators aim to strike a balance between theoretical knowledge and practical application, ensuring that students develop robust digital competencies along with critical thinking abilities. By framing the curriculum in this way, the new guidelines recognize the increasingly interdisciplinary nature of Informatics, which intersects fields like mathematics, social studies, and even the arts.

Methodology

Data Collection

The primary data for this study consist of 468 presentations delivered at the 17 annual Zenkojoken conferences. Each presentation was documented in a conference proceedings booklet or online repository provided by Zenkojoken. While the presentations varied in format—ranging from short oral reports to extended workshops—each contained descriptive information regarding the pedagogical approach, objectives, and outcomes of the teaching practices or research findings.

Data Classification

For this paper's analysis, each presentation was classified according to one of five categories:

1. Problem-solving in the Information Society
2. Communication and Information Design
3. Computers and Programming
4. Information Networks and Data Utilization
5. Other Topics

Two researchers—including the author—independently read through the abstracts or summaries, assigning each presentation to the category that most closely matched the primary content. Cases in which a single presentation overlapped multiple fields were initially categorized according to the presenters' stated main goal or emphasis, as well as the most frequently mentioned competencies or learning objectives. Presentations deemed difficult to categorize, or whose content was tangential to the four fields, were placed in the "Other Topics" category. Afterward, any discrepancies in classification were resolved through discussion until consensus was reached.

Analysis of "Data Utilization"

Within the "Information Networks and Data Utilization" category, a further layer of analysis was performed to capture the nuances of how data were being introduced and taught. Specifically, presentations that focused on collecting, interpreting, and drawing conclusions from data formed the core of the final sample for this paper. Examples included lessons on creating scatter plots, calculating statistical measures like mean or variance, and designing interventions based on data insights.

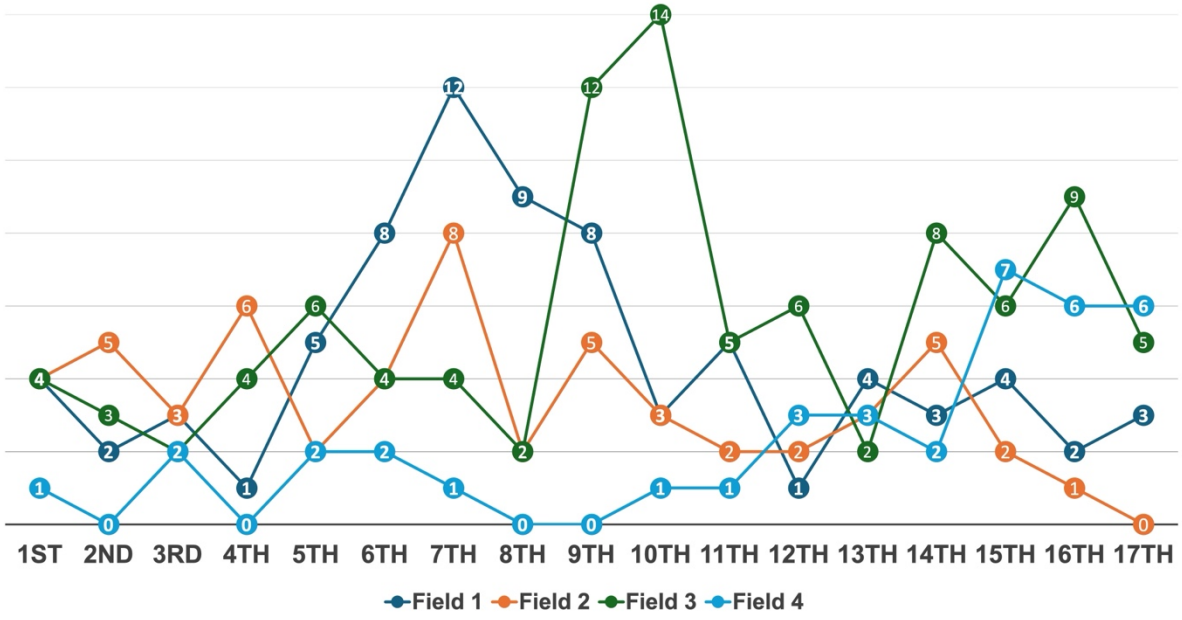
Additionally, qualitative reviews of sample lesson plans, worksheets, and anecdotal student feedback were used to identify recurring teaching strategies, challenges, and reported outcomes. This approach allowed for a deeper understanding of best practices and innovative approaches to teaching data literacy in the high school context.

Results

Overall Distribution of Presentations

Figure 1 provides an overview of how the 468 presentations were distributed across the four categories. As expected, the largest groups were Computers and Programming and Problem-solving in the Information Society, reflecting long-standing curricular objectives and teachers' familiarity with those areas. However, the category of Information Networks and Data Utilization has exhibited a notable increase over the past decade, indicating a growing recognition of the importance of data literacy in today's digital ecosystem.

Figure 1: Number of Presentations at Each Conference in Each of the Four Fields



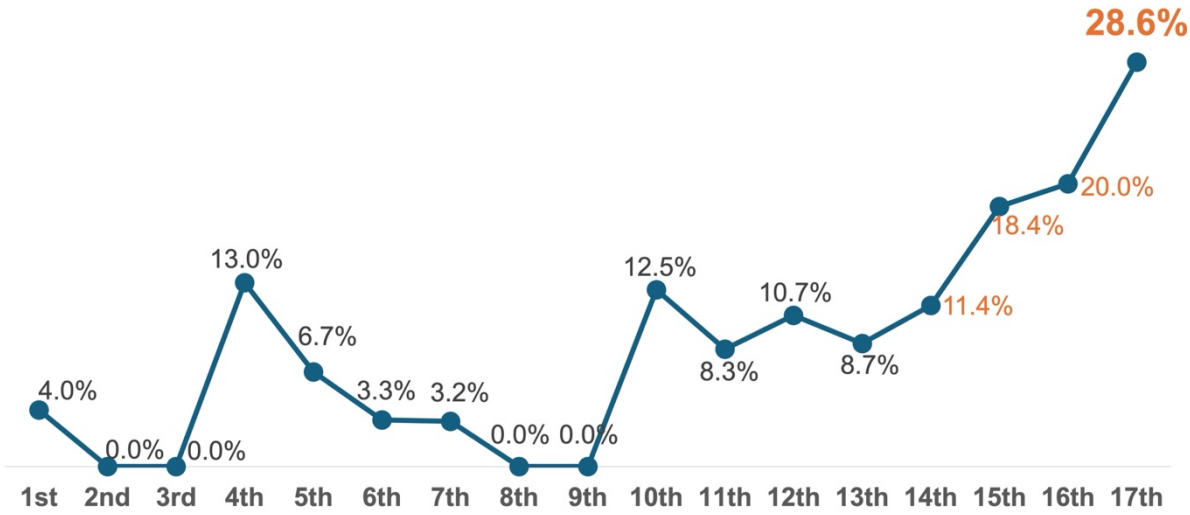
Rising Focus on Data Utilization

A deeper examination of the "Information Networks and Data Utilization" category reveals that a significant proportion of these presentations—particularly those delivered in the past

four years (as shown in Figure 2)—emphasize data-related topics. This aligns with broader societal trends that prioritize data-driven decision-making. Teachers are increasingly designing lessons that allow students to:

(1) **Collect data from personal or community sources**: For instance, students may track their daily screen time, conduct surveys in their local community, or obtain open datasets from government websites.
(2) **Analyze data using tools like spreadsheets or statistical software**: Many educators introduce basic statistical operations, such as calculating averages and correlation coefficients, or use visualizations like histograms, bar charts, and scatter plots to help students interpret data.
(3) **Propose interventions or solutions based on their findings**: After analyzing data, students are often encouraged to brainstorm practical steps or potential applications relevant to the topic at hand (e.g., improving health-related habits, addressing local environmental issues, or optimizing business processes).

Figure 2: Percentage of Oral Presentations in the Field of "Data Utilization"



Discussion

Case Study: Smartphone Usage Analysis

A highlighted example within this body of presentations is a teaching practice conducted by the author (Inagaki, 2020), which explores the concept of data utilization through a lesson on smartphone usage. Students were asked to record and analyze their personal smartphone usage over a one-week period, focusing on metrics such as total daily usage time and the frequency of specific app categories (e.g., social media, games, educational apps).

Lesson Details 1

- **Data Recording**: Students tracked their smartphone usage manually or used built-in monitoring apps, collecting data on both weekdays and weekends.
- **Basic Statistics**: They entered the raw data into spreadsheets and generated frequency tables and histograms. This helped them visualize how usage varied across the entire class and facilitated initial observations about extreme values or interesting patterns.

- **Interpretation**: The teacher introduced measures such as mean and variance, explaining how these statistics help summarize large data sets and highlight variability.

Lesson Details 2

- **Forming Hypotheses**: Students formulated questions such as "Do females spend more total time on social media apps than males?" or "Does usage spike during certain hours of the day?"
- **Data Visualization and Correlation**: They created scatter plots to explore relationships among factors such as time of day, types of apps used, and user demographic profiles. Students also computed simple correlation coefficients, interpreting the results with caution and reflecting on potential confounding variables.
- **Group Presentations**: The lesson concluded with student presentations discussing their findings, limitations of the data, and any proposed strategies for healthier or more productive smartphone usage.

Impact on Student Learning

Exam results and student feedback consistently pointed to increased engagement when lessons were grounded in personal or familiar data. Students remarked that analyzing their own smartphone habits made abstract statistical concepts more tangible and motivated them to delve deeper into topics like variance, correlation, and data visualization tools. The high degree of personal relevance appeared to reinforce conceptual understanding, as reflected in better performance on final exams covering data analysis questions.

Beyond academic achievement, anecdotal reports suggested that students began making more informed decisions about their digital habits. Some reduced unnecessary screen time, while others refined their app usage schedules for better time management. In this sense, the lesson not only meets curricular objectives but also fosters life skills that extend beyond the classroom.

Expanding Data Utilization: Interdisciplinary Connections

One critical observation emerging from the analyzed presentations is the potential for Data Utilization to act as a bridge between Informatics and other disciplines. Cross-curricular collaborations can magnify the real-world relevance of data analysis, as evidenced by several examples from Zenkojoken presentations:

(1) Social Studies: Students used publicly available data to examine local demographic changes or environmental challenges. They learned to propose solutions or policy recommendations based on their findings. This type of project underscores the social impact of data literacy and encourages civic engagement.

(2) Science: In science classes, data analysis is fundamental to understanding experiments and scientific phenomena. Linking data utilization concepts—such as hypothesis testing and correlation analysis—with actual laboratory work helps students see the connectivity between theory and practice.

(3) Mathematics: Mathematics courses provide the foundational tools for statistical analysis, such as probability distributions, standard deviations, and regression models. Collaboration with Informatics teachers can make these concepts more concrete and relatable, allowing students to witness direct applications of mathematical theories.

(4) **Arts and Design**: Although less common, some teachers have integrated data visualization techniques into art or design projects, encouraging students to find creative ways to represent complex data sets. This approach not only makes the data more accessible but also nurtures students' sense of aesthetic presentation and storytelling through graphical means.

Such interdisciplinary projects demonstrate that data literacy resonates across different subject areas and fosters deeper, more meaningful learning experiences. When students encounter data analysis in multiple contexts, they develop robust, transferable skills that will serve them in higher education and in their future careers.

Conclusion

This paper has examined the evolving role of data utilization in Japanese high school Informatics education, drawing on a large corpus of presentations from 17 Zenkojoken conferences. Several key insights have emerged:

(1) **Growing Emphasis**: Over the past decade, there has been a significant increase in presentations related to data-driven activities, reflecting both technological shifts in society and the expanding recognition of data literacy as a crucial educational objective.
(2) **Effective Pedagogical Strategies**: Classrooms that incorporate personal or community-centered data collection—and the subsequent analysis of such data—tend to achieve stronger student engagement. This approach renders abstract statistical concepts more tangible and fosters the practical application of data literacy skills.
(3) **Interdisciplinary Potential**: Expanding data utilization beyond standalone Informatics courses amplifies its relevance and provides students with a more holistic learning experience. Collaborations with subjects like Social Studies, Science, Mathematics, and even the Arts illustrate how data analysis can deepen students' understanding of complex societal and scientific questions.
(4) **Future Outlook**: As Informatics education in Japan continues to evolve under the revised curriculum guidelines, the focus on data utilization is likely to intensify. Ongoing professional development, particularly through platforms such as Zenkojoken, will be crucial for supporting teachers in adopting innovative methods, designing robust lesson plans, and staying abreast of rapidly changing technologies.

Ultimately, the shift toward data utilization in high school education aligns with a broader international trend: the need to equip young people with the competencies required to thrive in a data-rich world. By enabling students to gather, process, and interpret data in meaningful ways, educators help cultivate informed citizens who can make evidence-based decisions and contribute to societal progress.

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A Decade of Challenges and Evolution: Tenri Inter-schools Collaborative Initiatives in English Education

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Abstract
This paper, based on a practical case study, introduces the collaborative initiatives in English education that Tenri University Educational Corporation's elementary, junior high, and high school have undertaken since 2013: the 10-year process, insights gained from surveys of the teachers involved, the initiative's current state, and future challenges. While the importance of school collaboration is recognized in Japanese English education, clarifying goals and ensuring continuity remain challenging. Tenri Schools' approach emphasizes creating a continuum of educational goals for English language achievement across all school levels, with annual reviews and goal chart revisions. The activities by the team, which was established as the Tenri Schools English Education Guidelines (T-SEEGs) Project, include exchanging information among schools, addressing common challenges, training teachers, and student exchange events. The author, who has overseen the project, conducted surveys and interviews with junior and high school English teachers in 2018 and 2021, revealing that involvement in setting shared school goals effectively promotes collaboration and has led to teachers gaining a more concrete and multifaceted awareness of lesson planning, student understanding, and self-reflection. Participation in these activities has served as opportunities for teacher development, enhancing a sense of inter-school collaboration and improving the quality of information exchange. Although it can be said that the positive effects of these factors have resulted in a continuity of school collaboration over the past decade, there have been some slow progress and problems, such as developing schools' own teaching materials and improving the methods for assessing the achievement of goals.

Keywords: English Education, Consistent Achievement Goals, Collaborative Activities

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Introduction

The Japanese Ministry of Education, Culture, Sports, Science and Technology (MEXT) emphasizes the importance of collaboration across different school levels (elementary, junior high, and high schools) in its English education policies. However, according to a 2023 survey, the percentage of high schools that have established curriculum or learning achievement goals in collaboration with elementary and junior high schools was only 3.8%, which is remarkably low. MEXT has highlighted that, moving forward, there is a need to focus on more substantial collaboration, not only through information exchange but also through the sharing of teaching methods and the development of curriculum (Ministry of Education, Culture, Sports, Science and Technology, 2024). While the importance of school collaboration has been recognized by English teachers in Japan at the classroom level, clarifying goals and ensuring continuity remain challenging.

Public and private schools may differ in the way they conduct collaborative activities, but exploring what needs to be done to facilitate collaboration and how to sustain it will contribute to the enhancement of English education in Japan, regardless of the type of school organization. In other words, accumulating examples of inter-school collaboration in English education and analyzing their practices and challenges will broaden the scope of research on collaborative activities.

Collaborative Efforts in English Education at Tenri Schools

Since 2013, the author has been involved in school collaboration activities related to English education at their affiliated institution. Specifically, from 2013 onward, the author has collaboratively created and continuously revised a set of achievement goals for English education, in partnership with English teachers from both the junior high and high school levels. This was done for the entire progression from junior high school enrolment to high school graduation. Through surveys of English teachers at the time and interviews with the teachers involved in creating the consistent achievement goals chart, the author published findings demonstrating that collaboration between junior high and high schools had been promoted over the several years since 2013. Subsequently, the collaboration meeting has been revising the achievement goals chart every year, and through its continuation, has facilitated information exchange about students and classes, as well as developed new ideas for exchange programs.

Over time, the core group of teachers involved in the committee has changed. As a result, it became necessary to assess the awareness of new teachers regarding collaborative activities, and the author conducted interviews with them. The findings revealed that the revision of the consistent achievement goals chart has also played a role in professional development, fostering the growth of teachers. These findings were published by Yamamoto (2023). This paper, drawing on the two survey results and the collaborative practices carried out by the English teachers of Tenri schools across elementary, junior high, and high school levels over the past ten years, presents the following hypothesis in a more empirical manner: continuously revising the achievement goals chart helps promote collaborative initiatives in English education across elementary, junior high, and high school levels.

Teachers of Tenri Schools, have been working together with a shared vision, focusing on nurturing both students and teachers. This effort has been sustained through continuous revisions of the goals chart. This paper aims to examine the essence of inter-school

collaboration activities in English education at Tenri Schools by reflecting on the history and actual practices of these collaborative efforts. In the following section, the author summarizes the efforts made by English teachers at Tenri Schools.

Background of the Initiation of Collaborative Activities

Let us revisit the origins of our collaborative initiatives. In 2007, efforts within the Tenri High School English Department began to establish consistent goals and a unified syllabus. These efforts were sparked by a tweet from a newly appointed teacher, asking, "What should we aim for in our classes?" From around 2008 to 2011, MEXT eagerly promoted policies regarding English education in schools, such as the introduction of elementary English from the third grade, "teaching English in English," and the implementation of the Can-Do List.

In 2011, the English teachers at Tenri High School completed a three-year syllabus and presented their efforts at a national conference of English teachers. This presentation served as a turning point, allowing them to reflect on their activities and providing the impetus to develop them further.

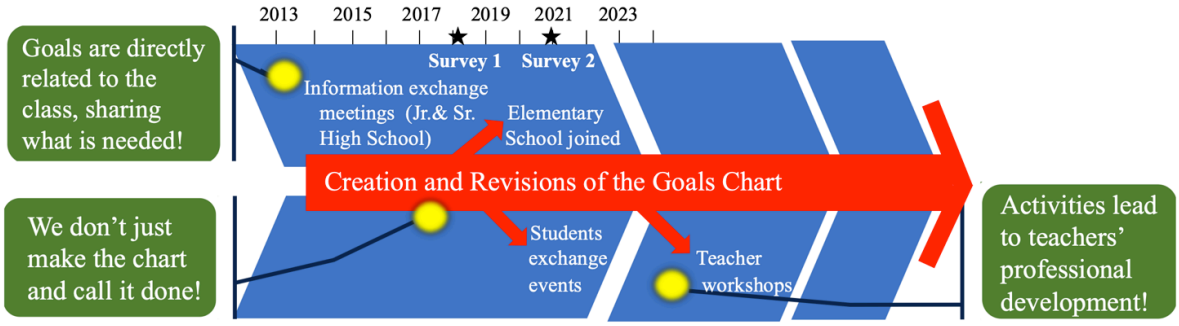
The following year, in 2012, a cross-facility training session was held at Tenri Junior High School. The author, who was then an English teacher at Tenri High School and participated in the session, began to think, "Our consistent goal-setting should be connected with that of the junior high school." Subsequently, the author requested the administrative office of the educational institution that oversees the school to establish a meeting focused on developing consistent achievement goals for English education between Tenri Junior High School and Tenri High School. In response, the collaboration between junior high and high schools in English education officially began in 2013 under the Tenri Schools English Education Guidelines (T-SEEGs) Project Meeting. In 2020, Tenri Elementary School was added to the initiative, and since then, revisions to the achievement goals chart covering elementary, junior high, and high school levels have continued annually.

What We Keep Doing: Information Exchange and Events for Students and Teachers

The process of revising the achievement goals chart with a focus on continuity has had a positive impact on other collaborative activities among teachers at the elementary, junior high, and high school levels. For example, the following activities and events have been consistently carried out, and they have contributed as opportunities for the professional growth of teachers.

† Revision of achievement goals chart (since 2015)
† Regular English education collaboration meetings (since 2013)
† English teachers' workshops (since 2021)
† Students' English speech & recitation festival (since 2021)
† Exchange meetings for university students and international students (since 2013)
† Increase in the number of assistant English teachers (since 2019)

Figure 1: Promotion of Collaborative Activities



Evaluation of the Continuation of Collaboration

Yamamoto (2019) based on the first survey regarding these collaborative initiatives conducted in 2018 argues that the English teachers at the surveyed schools are seeking "meaningful connections," and that taking an interest in the achievement goals across different school levels, as well as collaboratively working on the creation and revision of a consistent set of achievement goals, promotes a sense of collaboration. And Yamamoto (2023) based on the second survey in 2021 suggests that teachers participating in collaborative meetings gain more concrete and multifaceted insights into lesson planning, student understanding, and self-reflection. Participation in collaboration initiatives provides opportunities for teacher development and enhances the quality of information exchange.

Researchers distinguish between two main types of goals: "learning goals" and "performance goals". Learning goals focus on the learner's development of abilities and understanding, whereas performance goals are driven by the desire to appear competent or superior to others. Dweck and Leggett (1988) suggest that students with learning goals are more likely to persist in the face of failure, often viewing setbacks as opportunities for feedback, which in turn enhances their subsequent performance. What we present in the achievement goals chart, of course, are learning goals, and by consistently focusing on these, it is likely that teachers themselves will become more persistent in guiding their students. This mindset may help them to use collaborative activities as opportunities for their own growth.

Challenges: Further Research Based on Practice

While it can be said that Tenri School's collaboration across different school types has been sustained over time, there have been areas of slow progress and issues, such as the development of schools' own teaching materials and the improvement of methods for verifying the achievement of goals. In addition, not all elementary, junior high, and high school English teachers are enthusiastic about these collaborative activities, and the level of enthusiasm varies widely. Further investigation and research based on the situation and practices at these schools should be desirable.

Future Developments: Confidence in Our Efforts and Deepening of Connections

It is very significant that we have been able to continue these activities for 10 years for the education of our students. However, teachers are so busy with their daily educational activities that they do not have time to objectively grasp the significance of these activities. Therefore, it will be necessary to visualize their efforts through further publicity activities in the future. It is hoped that the English teachers at the school will gain more confidence in

their efforts and expand their connections with many more people beyond the boundaries of their subject and school. The teachers of Tenri Schools, will continue our efforts to increase student and teacher satisfaction through inter-school exchange activities centered on the revision of the English achievement goals with consistency.

Conclusion

The author, who has overseen the project, conducted surveys and interviews with junior and high school English teachers in 2018 and 2021, revealing that involvement in setting shared school goals effectively promotes collaboration and has led to teachers gaining a more concrete and multifaceted awareness of lesson planning, student understanding, and self-reflection. Participation in these activities has served as opportunities for teacher development, enhancing a sense of inter-school collaboration and improving the quality of information exchange in spite of some slow progress and problems, such as developing schools' own teaching materials and improving the methods for assessing the achievement of goals. In sum, based on the survey results, it is possible to conclude that teachers' awareness mentioned above and continued existence of the activities for a decade demonstrates that continuous revision of the achievement goals chart can promote cooperative efforts in English education at the elementary and secondary school levels.

Lastly, the current limitations of this study should be addressed. While the positive results from interviews with teachers involved in the creation and revision of the goals chart suggest that focusing on the goals chart itself may foster a sense of collaboration, it cannot be conclusively stated that this focus alone is the key factor in promoting collaborative awareness. In this practice, the activities related to revising the goals chart were not compared with other collaborative activities. Therefore, it is possible that similar collaborative awareness was fostered through other collaborative activities, not just those related to the goals chart. Additionally, it is necessary to consider whether there are other factors that have contributed to the promotion of collaboration in English education at Tenri Schools over the past ten years.

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The Application of Online Learning in International Education: A Comprehensive Exploration of Opportunities and Challenges

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Abstract
Amid the global emphasis on advancing international education, more and more international students are choosing to engage in cross-cultural and cross-linguistic study experiences in diverse countries. In response to current trends in international education, many pioneers proposing a major development of online teaching and distance learning to significantly increase the number of international students studying in their countries. Nevertheless, debate persists regarding the actual effectiveness of this approach. This paper systematically evaluates the advantages and challenges of online learning for students, instructors, and universities through interviews and literature analysis. It examines the potential impact of large-scale online education initiatives on enhancing international student mobility and fostering cross-cultural and cross-linguistic learning globally. The findings suggest that, in the long term, online education will play a vital role in the future of educational systems. However, within the current framework, online teaching and distance learning face limitations in effectively supporting tutor-student interaction and promoting intercultural and interlingual learning for global citizens. This study not only offers insights to the academic community on ways to improve online education and distance learning but also provides valuable considerations for international students contemplating study abroad.

Keywords: International Education, Online Teaching, Distance Learning, Cross-Cultural Learning

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Introduction

In today's digital age, digital technology is reshaping the global higher education landscape with an irresistible force. By 2020, the global online education market will reach 250 billion US dollars, and the growth rate of cross-border online education is 3.2 times that of the traditional overseas study market. This powerful data intuitively shows the profound structural changes that digital technology has brought to the international education field.

This change is not only reflected in the rapid expansion of scale and speed, but also in the fundamental breakthrough of geographical boundaries, enabling educational resources to flow and allocate more freely and efficiently on a global scale. Viewed from the perspective of educational economics, the vigorous development of online education has changed the supply and demand mode of educational resources, effectively reduced the cost of education, and significantly improved the utilization efficiency of educational resources. From the perspective of sociology of education, it breaks the social class barrier of traditional education, provides a valuable opportunity for more groups to receive international education, and effectively promotes the realization of educational equity.

This all-round and deep-seated reform has reconstructed every link of the international education value chain, from the research and development and production of educational products to the provision and consumption of educational services, which have undergone tremendous changes. In this context, international education has ushered in unprecedented development opportunities, such as the significant expansion of international students, the effective enhancement of the influence of education brands, and the full stimulation of the vitality of education innovation (Yang, 2024). However, at the same time, it also faces many severe challenges, such as the improvement of education quality assurance system, the optimization of cross-cultural teaching management, and the enhancement of digital technology application ability.

The purpose of this paper is to comprehensively examine the innovative role of online education in international student mobility from a multi-dimensional perspective, comprehensively apply multidisciplinary theories and research methods, and comprehensively reveal the educational ecological chain changes triggered by online education, so as to provide a solid theoretical basis and practical guidance for the healthy and sustainable development of international education in the digital age. To promote the high quality development of international education in the digital wave.

Paradigm Shift in the Learner Dimension

Revolutionary Reconstruction of Cost Structure – The Emergence of Digital Divide

Online education has greatly lowered the economic threshold of international education by eliminating the restrictions of physical space. Online education has greatly lowered the economic threshold of international education by breaking through the restriction of physical space. According to the estimated data of the University of Sydney in 2022, international students can save up to 23,000 US dollars per year in living costs such as accommodation and commuting through online learning, and the tuition fee of online degree is 40% lower than that of offline mode. This significant economic advantage has profoundly changed the composition of international education students. According to the QS Global Education think

tank, between 2019 and 2022, the share of students from developing countries studying online jumped from 34 percent to 51 percent.

However, behind the cost reduction, new issues of equity in education have emerged, with the digital device divide becoming a key factor. Take the United States and Japan for example. As highly developed countries in science and technology, the United States has invested heavily in digital infrastructure construction, extensive coverage of high-speed broadband network, and high household Internet access rate. According to data from the Pew Research Center, more than 85% of households in the US have a stable high-speed Internet connection, and the penetration rate of smart devices is high. Almost every student has a tablet computer, laptop and other learning terminals, which makes there are almost no equipment and network access barriers for American students to participate in online education.

Japan also attaches great importance to the application of digital technology in the field of education, and has promoted the process of digitization in schools and families through a series of policies. The level of education informatization in Japan ranks among the top in the world. Schools are equipped with advanced online teaching equipment, and all kinds of digital devices are widely used in families. Students can easily access online courses and the online learning environment is smooth (Wang & Chen, 2022).

In an interview on the future development of online education, education expert Professor Li pointed out that although online education has brought more equal learning opportunities for many students, the challenges brought by the digital divide cannot be ignored. "With the popularity of online education, students in many countries and regions can enjoy quality educational resources, but at the same time, the problem of differences between devices and networks has become more obvious," Li said. "In less developed regions, students often miss out on the chance to take online courses because they do not have enough equipment or access to a stable network." Li also noted that in developed countries such as the United States and Japan, improvements in digital infrastructure have provided students with better learning conditions, but this advantage has not spread globally. "Without effective policies and support measures, the digital divide may lead to an exacerbation of the issue of equity in education globally," she noted. "Education should not be the privilege of a few, and how to narrow this gap is an important issue for the future development of global education."

The remarks sparked reflection among participants that while promoting the development of online education in the future, governments and international organizations should strengthen cooperation to ensure that all students, regardless of their economic status or geographical location, have equal access to digital learning opportunities.

In contrast, although China has made remarkable achievements in the development of digital technology, the problem of uneven regional development still exists. In the developed eastern coastal areas, digital infrastructure is relatively complete, Internet coverage is high, students have stable learning terminals, and online education is carried out smoothly. However, in some remote areas in the central and western regions, the construction of Internet infrastructure still needs to be strengthened due to the relatively lagging economic development. Some rural areas have unstable Internet signals and low home digital device ownership, leading to many difficulties for students in these areas when participating in online education. According to relevant surveys, about 20%-30% of students in remote areas

of central and western China encounter problems such as network delays and insufficient equipment during online learning, which seriously affect the learning effect.

This contrast in the digital device divide between the US, Japan and China highlights the huge differences in how different countries and regions enjoy the cost advantages of online education. Although online education provides more people with the opportunity to receive international education, the inequity of digital devices and network access makes educational equity still a serious challenge in the field of online education. How to narrow this digital divide and ensure that students in different regions can equally enjoy the opportunities brought by online education is an important issue to be solved urgently.

Spatial and Temporal Decoupling of Learning Modes

Asynchronous teaching systems create an extremely flexible learning space for online learning. According to data from Coursera, the completion rate of courses with access to the credit certification system has jumped from 13 percent to 67 percent among regular users. This flexibility has enabled 42 percent of online students to work and study in parallel. In Australia, a country in the southern hemisphere, technology students can increase their practice time by an average of 16 hours per week through online learning, which enables them to better combine theoretical knowledge with practice and effectively improve their professional skills. In Indonesia in the northern hemisphere, technical students can increase their practice time by an average of 17 hours per week, and students can flexibly arrange their study time after work, which significantly improves their competitiveness.

But the decoupling of time and space has also led to the fragmentation of the learning experience. According to a 2023 study by the Massachusetts Institute of Technology (MIT), 37% of Asian students suffer from "cognitive jet lag" due to teaching across time zones, with early morning class participation falling by 58% compared to prime time and knowledge internalization efficiency decreasing by 32%. In New Zealand, in the southern hemisphere, due to the large time difference with most universities in Europe and the United States, when students participate in online live courses in European and American universities, the participation rate of early morning classes is only 30% of the normal time, and the learning effect is greatly reduced (Peng & Xu, 2017).

Evolution of Educators' Roles

Digital Transformation of Teaching Ability

The Digital Literacy index of teachers has improved by 58 per cent in three years, thanks to a strong boost from digital technologies, but 31 per cent of teachers worldwide still suffer from "digital overload". A study by the Harvard Institute of Education points out that the time investment required to develop a quality online course is three to five times that of a traditional course. For example, when a senior professor transforms an offline course into an online course, he or she not only has to re-design the teaching content carefully, but also has to learn and skillfully use various online teaching tools, such as live streaming platforms and teaching management systems, which poses a great challenge to his or her time and energy.

Management Innovation in Global Classrooms

The intelligent teaching assistant system plays an important role in the global classroom, handling 83% of the regular question answering. However, cross-cultural classroom interactions are still highly dependent on teachers' interpersonal intelligence. The Open University in the UK uses affective computing technology to analyze students' emotional data such as expressions and language in class and adjust teaching strategies in time, resulting in an increase in teacher-student interaction satisfaction to 89%. For example, in a transnational online course, the teacher found that some students had difficulty in understanding a certain knowledge point and their expressions were confused by affective computing technology, so the teacher slowed down the teaching pace in time and increased the explanation of cases, which effectively improved the students' learning effect and interaction enthusiasm (Chen et al., 2024).

Paradigm Change of Academic Evaluation

The application of blockchain technology has realized the immutable record of learning results, and the distributed certification system of the eight-university Alliance in Australia has been recognized by 28 countries. However, in order to build a perfect capability-based evaluation system, it is still necessary to break the shackles of the traditional credit framework. The traditional credit evaluation system mainly focuses on students' exam results and course attendance, while the competency-based evaluation system pays more attention to the improvement of students' actual ability and comprehensive quality. For example, in some practical courses, students' project completion ability and teamwork ability should become important indicators of evaluation. However, there are still many difficulties and challenges in integrating these abilities into the evaluation system.

Multi-dimensional Characteristics Analysis of Online Teaching

Advantages of Online Teaching: Technology Empowerment and Educational Innovation

Under the background of the deep integration of digital technology into the field of education, online teaching, with its unique technical endowment, has brought a series of positive impacts with transformative significance to the education ecology. From the perspective of resource allocation theory, online teaching breaks the pattern of uneven distribution of traditional educational resources in geographical space. As many scholars have pointed out, with the help of the borderless nature of the Internet, online education platforms enable students in remote areas or developed cities to have equal access to high-quality course resources from top universities and educational institutions around the world (Cao et al., 2018). Take the computer science courses of Harvard University for example for students in remote mountainous areas in China through MOOCs. This practice not only broadens students' knowledge boundaries, but also enables them to have access to cutting-edge international academic ideas and research results, which effectively promotes the realization of equal educational opportunities.

Based on the theory of independent learning, online teaching gives students a high degree of learning autonomy, allowing them to flexibly and independently choose learning content and learning time according to their own learning progress and schedule. For on-the-job staff, this learning mode fits in with their fragmented time characteristics. Employees can use lunch

break, commute and other fragmented time to carry out professional knowledge learning with the help of mobile devices, effectively improve their career competitiveness.

In addition, online teaching has diversified and expanded at the level of teaching interaction. According to the social constructivist learning theory, in addition to the traditional question-and-answer mode between teachers and students, online teaching introduces innovative interactive forms such as discussion boards and group collaborative projects. In discussion boards, students conduct in-depth discussions on specific academic issues, share diverse viewpoints and insights, stimulate the collision of ideas, and realize the social construction of knowledge. For example, in group collaboration projects, online collaboration tools such as Tencent Document and Feishu are used to break geographical boundaries, realize cross-border and cross-regional collaborative work, and cultivate students' teamwork ability and global vision, which is highly in line with the concept of global education (Yang, 2022).

Disadvantages of Online Teaching: Practical Dilemma and Development Bottleneck

Although online teaching has obvious advantages, it also has some disadvantages that cannot be ignored from the perspective of educational practice and academic research. In the dimension of learning experience, the lack of face-to-face interaction is a major problem. According to the research of Hua (2024), emotional resonance and interpersonal interaction in the classroom have an important impact on students' learning motivation and learning effect. In the online teaching environment, students can hardly feel the temperature of such emotional interaction, which is easy to breed loneliness and learning burnout. Taking courses such as literature appreciation and art performance that emphasize emotional expression and body language understanding as examples, it is difficult for online teaching to fully replicate the immersive learning atmosphere and emotional experience created by offline teaching, resulting in a certain degree of discount in teaching effect.

Technical issues are also a major challenge for online teaching. Network instability, platform failure and other technical failures occur from time to time, which seriously interfere with the teaching process and learning effectiveness (Bu et al., 2024). In the process of live teaching, network delay or interruption will cause students to miss key knowledge points, destroy the coherence of learning, and affect the systematic grasp of knowledge. In addition, the technical operation ability of different students is uneven, and some students may encounter technical obstacles in the learning process due to the unfamiliar operation of online teaching tools, thus hindering the learning process, which violates the principle of educational equity to some extent.

Moreover, online teaching has inherent limitations in practical teaching. For science and engineering experiments, medical clinical practice and other disciplines that focus on practical operation and experimental experience, online teaching can not provide real practical environment and operational experience. Zhong and colleagues (2024) mentioned that practical operation is a key link for students to master practical skills and cultivate innovation ability, and virtual simulation of online teaching cannot completely replace the real touch and operational experience of offline practice, which is not conducive to the all-round development of students' practical ability and comprehensive quality.

Explore the Path of Future Sustainable Development of Online Teaching

Technology-Driven: Innovation Leads Teaching Reform

Looking forward to the future, with the continuous iterative development of cutting-edge technologies such as artificial intelligence, virtual reality and blockchain, online teaching will usher in more profound innovative changes. From the perspective of artificial intelligence technology, according to the learning analysis theory, it can deeply mine and analyze the multi-source data such as students' learning behavior data and knowledge mastery level, tailor their own learning plan and personalized learning path for each student, and provide accurate learning advice and guidance. For example, through real-time monitoring and analysis of students' learning process, [specific artificial intelligence education products] push personalized learning content and practice questions for students, effectively improving learning efficiency.

Virtual reality technology is based on immersive learning theory, and is committed to building more realistic teaching scenes, such as virtual laboratories and virtual campuses. Students can carry out learning and practice activities in an immersive learning environment, effectively making up for the shortcomings of online teaching in practice. For example, in the [subject-specific experiments], with the help of virtual reality equipment, students can carry out experiments in an immersive way, feel various physical phenomena and changes in the experiment process, and improve practical ability and innovative thinking.

Based on the principles of distributed ledger and encryption algorithm, blockchain technology will play a more critical role in education certificate certification and learning achievement traceability. Through blockchain technology, the authenticity, integrity and security of educational data can be effectively guaranteed, and the recognition and credibility of online education can be enhanced. For example, [specific blockchain education application cases] have achieved immutable records of students' learning outcomes and mutual recognition of certifications worldwide, providing strong support for students' further education and employment (Hu, 2024).

International Collaboration: Resource Integration and Standard Co-construction

In the context of accelerating globalization and the increasingly prominent trend of education internationalization, international education cooperation will become increasingly close. Universities and educational institutions around the world will actively carry out diversified cooperation such as joint courses and academic exchange activities on the basis of online teaching platforms. By integrating high-quality education resources from around the world, an online education course system featuring international vision and multi-cultural integration will be built to cultivate students' global vision and cross-cultural communication ability. For example, the International Online Education Alliance should be established to pool the educational wisdom and resources of various countries to jointly develop and promote online courses with international influence, so as to share resources and complement each other's advantages (Ren, 2024).

At the same time, it should strengthen international cooperation in education quality certification, establish a unified international online education quality standard system according to international education quality standards and best practices, and promote the standardization, standardization and internationalization of online education.

Policy Guarantee: Institutional Support and Foundation Strengthening

In order to promote the healthy and sustainable development of online education, governments of all countries will increase policy support, formulate a series of relevant laws, regulations and policy measures, standardize the order of online education market, and protect the legitimate rights and interests of students and teachers. For example, a special development fund for online education is set up to provide financial support for technology research and development, curriculum construction and teacher training of online education according to the theory of education finance, so as to promote the innovative development of online education (Zou, 2024). Establish a sound online education quality assurance system, draw on the international advanced education quality evaluation models and methods, strengthen the all-round supervision and evaluation of online education institutions and courses, and ensure the quality and effect of online education. At the same time, strengthen the investment in the construction of online education infrastructure, improve the coverage and stability of the network, and provide a solid material foundation and technical guarantee for the sustainable development of online education according to the theory of education informatization infrastructure construction.

Through the in-depth analysis of the advantages and disadvantages of online education and the outlook of the sustainable development path in the future, we can more comprehensively and profoundly realize the important position and great development potential of online education in the field of international education. In the future development journey, we should give full play to the advantages of online teaching, actively cope with and overcome its disadvantages, actively explore the effective path of sustainable development through multi-dimensional measures such as technological innovation, international cooperation and policy support, and promote the realization of high-quality and connotative development of international education in the digital age.

Conclusion

Online education is booming unstoppably, giving birth to a "borderless higher education ecosystem". Its development track closely follows the evolutionary logic of "technology enabling-model innovation-system reform". From the perspective of technology empowerment, cutting-edge digital technologies such as cloud computing, big data, artificial intelligence and virtual reality, like a powerful engine, provide a steady stream of power for online education, making it break through the heavy constraints of traditional education in time and space, and realize the global dissemination and sharing of educational resources. For example, with the help of artificial intelligence technology, personalized learning content can be accurately pushed according to students' learning behavior and knowledge mastery, which greatly improves learning efficiency.

In terms of mode innovation, online education has pioneered diversified learning modes, such as asynchronous teaching and blended learning, to meet the diverse needs of different learners. These innovative models not only change the traditional teaching methods, but also promote the realization of educational equity, allowing more people to have access to high-quality international educational resources. Take blended learning model as an example, it organically integrates online autonomous learning with offline practical teaching, which not only gives full play to the convenience and resource richness of online learning, but also takes into account the interactivity and practical operability of offline teaching, so that students' learning effectiveness has been significantly improved (Gao, 2023).

With the continuous development of online education, institutional reform has also become an inevitable trend. This involves the adjustment and improvement of educational policies, regulations and management systems. For example, in order to adapt to the development of online education, countries need to formulate corresponding quality assurance systems, credit mutual recognition systems and data security management systems to ensure the healthy and orderly development of online education.

Looking forward to the future, the core of international education competition will gradually focus on the integration ability of digital education value chain. This not only requires educational institutions to have strong technology research and development and application capabilities, and be able to continuously introduce and innovate digital technologies to improve the teaching experience and education quality; They also need to have excellent resource integration capabilities and be able to integrate high-quality global educational resources to create competitive educational products and services. At the same time, it is crucial to build new infrastructure such as sound technical standards, quality frameworks and certification systems. Unified technical standards can ensure the compatibility and interoperability of educational technologies and promote the seamless connection of educational resources. A scientific and reasonable quality framework is the key to guarantee the quality of education and can provide reliable learning guarantee for students; An authoritative certification system is an important symbol of education quality, which helps to enhance the brand image and international recognition of educational institutions.

This educational revolution triggered by digital technology is not a simple replacement for traditional overseas study, but a profound transformation and new evolution of global higher education in the era of digital civilization. It breaks the geographical restrictions and resource monopoly of traditional education, and brings a more diversified, inclusive and innovative development pattern to global education. Under this pattern, students from different countries and cultural backgrounds can learn and exchange on the same platform, promoting cultural integration and innovation. At the same time, the competition and cooperation among educational institutions will become more frequent, which will promote the continuous development of global higher education and cultivate more innovative talents who can adapt to the needs of the digital age (Li, 2025).

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Exploring Differences in Attendance Awareness Between Adapted and Maladapted Junior High School Students in Post-pandemic Japan

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Abstract
This study investigates differences in attitudes towards school attendance between junior high school students who struggle with school adaptation and those who do not. The COVID-19 pandemic introduced remote learning through ICT tools in many schools, which allowed students to experience learning outside the traditional classroom setting. This shift may have contributed to a more diverse perception of the necessity of daily attendance, particularly among students who experience maladaptation. We focus on the concept of "masked attendance," defined by the Nippon Foundation (2018), referring to students who physically attend school but experience internal struggles and reluctance. "Masked attendance" and "disguised school attendance" convey similar meanings. A questionnaire survey conducted in October 2022 targeted 403 junior high school students in the Tokyo metropolitan area, classifying them into three groups: masked attendance, frequent absentees, and well-adapted students. Analysis revealed that students with masked attendance consistently rated their school experiences more negatively than well-adapted students and demonstrated a stronger belief that daily attendance is unnecessary. However, no significant differences were found regarding the perception of school as an appropriate place for learning. These findings suggest the importance of recognizing the internal struggles of masked attendance students and exploring tailored support strategies within the context of post-pandemic education.

Keywords: Compulsory Education, “Masked Attendance”, School Maladjustment, Learning Environment, School Refusal

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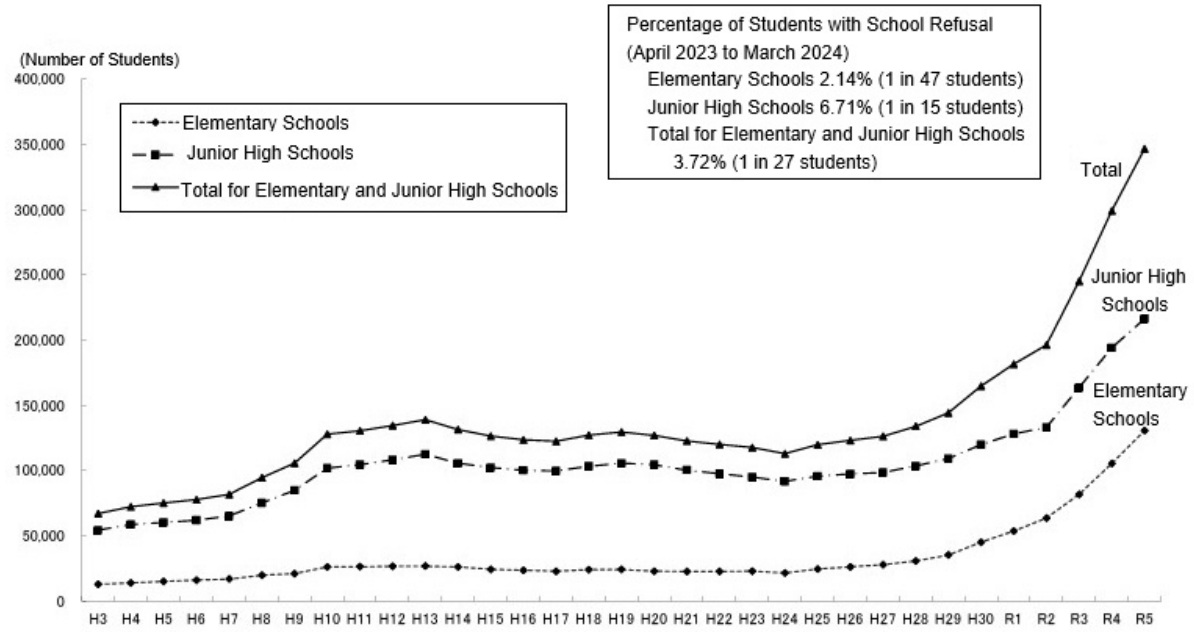
Introduction

The purpose of this study is to examine whether there are differences in attitudes toward attending school between middle school students who experience school maladjustment and those who are well-adjusted. Furthermore, the study aims to explore potential support strategies for students with school maladjustment within compulsory education institutions that cater to a diverse student population.

The number of students refusing to attend school in Japan has been increasing annually. According to the "Survey on Issues Related to Student Guidance, Including Problem Behaviors and School Refusal Among Students for Fiscal Year 2023" published by the Ministry of Education, Culture, Sports, Science and Technology in 2024, the number of students refusing to attend school in elementary and junior high schools was 346,482, an increase of 47,434 students (15.9%) from the previous year. As shown in Figure 1, the number of students refusing to attend school has increased for 11 consecutive years, reaching an all-time high in 2023. This represents 3.7% of the total student population, meaning approximately one student is refusing to attend school in every class.

Japanese schools start in April and end in March of the following year. Therefore, the years shown in Figure 1 represent academic years, and the numbers indicate the number of students who were with school refusal from April of that year to March of the following year.

Figure 1: Trends in Students With School Refusal
(Adapted From Ministry of Education, Culture, Sports, Science and Technology, 2024)



Note: “R5” means 2023 and H3 means 1991.

During the COVID-19 pandemic in Japan, many compulsory education schools conducted remote classes using ICT. As a result, many middle school students experienced "being able to study school subjects without physically attending school." This experience may have diversified students' perceptions of school attendance. Particularly for students who feel maladjusted to school, the resistance to being absent may have decreased, creating an environment where choosing not to attend school became easier.

In this study, we use the concept of "masked attendance," one of the classifications defined by the Nippon Foundation (2018), among middle school students experiencing school maladjustment. "Masked attendance" refers to students who, while spending time in the classroom and doing the same activities as everyone else, internally feel that they do not want to attend school, find school distressing, or dislike it (daily). These students attend school and spend time in the classroom but constantly feel they do not fit in. Based on the results of the questionnaire survey, we classify students into three types: (i) students corresponding to masked attendance, (ii) students with frequent absences, and (iii) students who are well-adjusted to school. We then examine the actual situation of masked attendance among middle school students in the post-pandemic period and whether their attitudes towards attendance differ from those of well-adjusted students.

Method

Participants

The survey participants consisted of 403 first- to third-year students from a public junior high school in the Tokyo metropolitan area. Due to the lack of consent from 2 students, the number of valid responses was 401. The breakdown was as follows: 131 first-year students, 142 second-year students, and 130 third-year students; 195 females, 193 males, and 15 who preferred not to say.

Materials

The survey asked about basic feelings of school adjustment, absence status for the current year, attitudes towards attending school, and evaluations of time spent at school.

Basic Feelings of School Adjustment: Regarding "basic feelings of school adjustment," the following nine items were asked, each rated on a five-point scale from "Strongly Agree" to "Strongly Disagree:"

(1) I like this school.
(2) There are fun things at school.
(3) There are unpleasant things at school.
(4) I want to talk to and ask questions to the teachers.
(5) I feel that the teachers try to understand our feelings.
(6) I think what the teachers say is mostly correct.
(7) I am often alone.
(8) I feel anxious about how others see me.
(9) There are times when I don't want to go to school.

Absence Status for the Current Year: The absence status for the relevant year was asked using a five-point scale: "Never Absent," "Absent for 1-3 Days," "Absent for 4-6 Days," "Absent for 7-9 Days," and "Absent for 10 or More Days." It was specified that absences due to COVID-19 infection, close contact, or vaccine side effects were excluded from this item.

Attitudes Towards Attending School: "Attitudes towards attending school" were assessed with two questions: "I don't think I need to attend school every day" and "I prefer studying outside the classroom". Both questions were rated on a five-point scale from "Strongly Agree" to "Strongly Disagree."

Evaluations of Time Spent at School: Regarding the evaluation of time spent at school, the following 12 items were asked, each rated on a five-point scale from "Very Enjoyable" to "Not Enjoyable:"

(1) During the commute to school
(2) Morning homeroom (*Asa-gakkatsu*)
(3) Class
(4) Break time between classes
(5) Lunchtime
(6) Lunchtime recess (*Ohiru-yasumi*)
(7) Afternoon homeroom (*Shu-gakkatsu*)
(8) Cleaning time
(9) Club activity (*Bukatsu*)
(10) During the commute from school
(11) School events such as sports day
(12) Off-campus events such as field trips

In many schools in Japan, there are homeroom periods called "morning homeroom" held before the first class of the day, and "afternoon homeroom" held after all classes in the classroom have ended before students move to their club activities or go home. These sessions are conducted by the homeroom teacher and are not just for announcements but also for various educational activities designed by each teacher. Additionally, there are other unique periods within the school day that are characteristic of Japanese schools. "Lunchtime" and "cleaning time" are also examples of such periods. In the junior high school where the survey was conducted, there was a school lunch program. "Lunchtime" is considered an educational period called "lunch guidance," during which teachers provide instruction. And in many schools in Japan, there is an educational program where students clean the school themselves. "Cleaning time" refers to this period.

Procedure

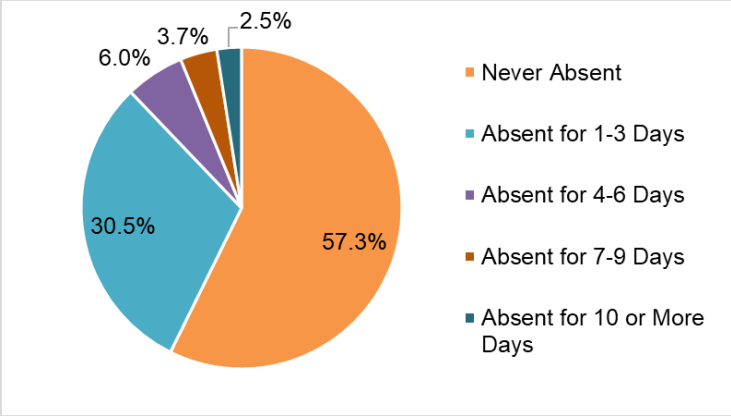
A questionnaire survey conducted in October 2022. This study was conducted using a questionnaire survey administered via Google Forms. The survey participants were provided with the URL and QR code for the Google Forms survey through their school. Each participant completed the survey independently.

Results

Identification of Students With “Masked Attendance”

First, the overall distribution of the number of absences is shown in Figure 2.

Figure 2: Absence Status



As previously mentioned, “masked attendance” is a concept derived from the survey results by the Nippon Foundation (2018). It refers to children who, while generally spending time in the classroom and doing the same activities as everyone else, internally feel that they do not want to go to school, find school difficult, or dislike it (every day). In other words, these students attend school and spend time in the classroom, making it impossible to identify them based on the number of absences, but they constantly feel that they do not fit in at school.

Students corresponding to masked attendance (hereafter referred to as the masked attendance group) were those who answered "Does not apply" or "Does not apply much" to the question "I like this school" regarding school adjustment, and whose attendance status was "Never Absent" or "Absent for 1-3 Days."

Additionally, students who were somewhat prone to school refusal (hereafter referred to as the somewhat prone to school refusal group) were those who answered "Absent for 7-9 Days" or "Absent for 10 or More Days" regarding their attendance status. Furthermore, students who were well-adjusted to school (hereafter referred to as the well-adjusted group) were defined as those who did not fall into either the masked attendance group or the somewhat prone to school refusal group.

Using this extraction method, as shown in Table 1, the masked attendance group was 8.4%, the somewhat prone to school refusal group was 6.2%, and the well-adjusted group was 85.4%.

Table 1: Distribution of Each Attendance Type

The masked attendance		34 students 8.4%	• Response to "I like this school." →"Disagree slightly" & "Disagree" • Attendance status for the year →"Never absent" & "Absemt for 1-3 days"
The somewhat prone to SR		25 students 6.2%	• Attendance status for the year →"Absemt for 7-9 days" & "Absemt for more than 10 days"
The well-adjusted		344 students 85.4%	Other students

Evaluation of Time Spent at School by Masked Attendance Students

The evaluation of time spent at school among the three groups: the masked attendance group, the somewhat prone to school refusal group, and the well-adjusted group, was compared using one-way ANOVA. The results are shown in Table 3. It was demonstrated that students in the masked attendance group rated their time spent at school significantly more negatively than students in the well-adjusted group. This negative evaluation was consistent across various contexts, including daily school life during arrival and departure, within the school during classes and breaks, and outside school activities such as sports days and field trips.

Awareness of School Attendance Among Masked Attendance Students

A comparison of the mean responses between masked attendance students and well-adjusted students using one-way ANOVA revealed a significant difference in the statement "I don't think I need to attend school every day." The results indicated that masked attendance students were more likely to believe that daily attendance at school was unnecessary compared to well-adjusted students.

Regarding the question "I prefer studying outside the classroom," no differences were observed between the attendance types. This suggests that there is no significant difference in the perception of school as a place for learning between masked attendance students and well-adjusted students.

The details of these results are shown in Table 2.

Table 2: Mean Scores and Tests of School Attendance Attitudes by Students With Masked Attendance Group and Other Groups (Comparison of Means via One-Way ANOVA)

		M (Mean)	*SD*	*F*-value	*p*-value	Multiple comparisons	
"I don't think I need to attend school every day."	The masked attendance	3.59	1.46	7.90**	0.00	Masked Attendance	The somewhat prone to SR
	The somewhat prone to SR	3.00	1.71			*n.s.*	
	The well-adjusted	2.60	1.41			**	*n.s.*
	TOTAL	2.71	1.46				
"I prefer studying outside the classroom."	The masked attendance	2.91	1.42	0.36	0.70	Masked Attendance	The somewhat prone to SR
	The somewhat prone to SR	3.04	1.51			*n.s.*	
	The well-adjusted	2.83	1.25			*n.s.*	*n.s.*
	TOTAL	2.85	1.28				

Table 3: Evaluation of Time Spent at School by Attendance Type

		Number	*M*	*SD*	*F*	*p*	Test of Significance	
During the commute to school	The masked attendance	34	2.56	1.40	10.89	.00	The masked attendance G	The somewhat prone to SR G
	The somewhat prone to SR	25	3.44	1.19			**	
	The well-adjusted	344	3.49	1.07			**	*n.s.*
	All	403	3.40	1.13				
Morning homeroom	The masked attendance	34	2.03	1.00	23.39	.00	The masked attendance G	The somewhat prone to SR G
	The somewhat prone to SR	25	2.88	1.01			**	
	The well-adjusted	344	3.20	.95			**	*n.s.*
	All	403	3.08	1.01				
Class	The masked attendance	34	2.18	1.29	21.86	.00	The masked attendance G	The somewhat prone to SR G
	The somewhat prone to SR	25	3.28	1.10			**	
	The well-adjusted	344	3.33	.93			**	*n.s.*
	All	403	3.23	1.02				
Break time between classes	The masked attendance	34	3.26	1.48	25.55	.00	The masked attendance G	The somewhat prone to SR G
	The somewhat prone to SR	25	4.20	.87			**	
	The well-adjusted	344	4.31	.72			**	*n.s.*
	All	403	4.22	.86				
Lunchtime	The masked attendance	34	2.50	1.31	22.73	.00	The masked attendance G	The somewhat prone to SR G
	The somewhat prone to SR	25	3.72	1.06			**	
	The well-adjusted	344	3.73	.98			**	*n.s.*
	All	403	3.62	1.07				
Lunchtime recess	The masked attendance	34	3.38	1.52	23.42	.00	The masked attendance G	The somewhat prone to SR G
	The somewhat prone to SR	25	4.28	.84			**	
	The well-adjusted	344	4.40	.72			**	*n.s.*
	All	403	4.30	.87				
Afternoon homeroom	The masked attendance	34	2.09	1.24	29.73	.00	The masked attendance G	The somewhat prone to SR G
	The somewhat prone to SR	25	3.40	1.22			**	
	The well-adjusted	344	3.47	.95			**	*n.s.*
	All	403	3.35	1.07				
Cleaning time	The masked attendance	34	1.85	1.13	18.71	.00	The masked attendance G	The somewhat prone to SR G
	The somewhat prone to SR	25	3.16	1.31			**	
	The well-adjusted	344	3.00	1.03			**	*n.s.*
	All	403	2.91	1.11				
Club activity	The masked attendance	34	3.00	1.52	10.77	.00	The masked attendance G	The somewhat prone to SR G
	The somewhat prone to SR	25	4.00	.96			**	
	The well-adjusted	344	3.96	1.13			**	*n.s.*
	All	403	3.88	1.19				
During the commute from school	The masked attendance	34	3.12	1.55	10.97	.00	The masked attendance G	The somewhat prone to SR G
	The somewhat prone to SR	25	3.88	1.27			*	
	The well-adjusted	344	3.99	.95			**	*n.s.*
	All	403	3.91	1.06				
School events such as sports day	The masked attendance	34	3.38	1.58	16.63	.00	The masked attendance G	The somewhat prone to SR G
	The somewhat prone to SR	25	4.24	.97			**	
	The well-adjusted	344	4.38	.88			**	*n.s.*
	All	403	4.29	1.00				
Off-campus events such as field trips	The masked attendance	34	3.59	1.48	17.21	.00	The masked attendance G	The somewhat prone to SR G
	The somewhat prone to SR	25	4.16	.99			*	
	The well-adjusted	344	4.48	.78			**	*n.s.*
	All	403	4.39	.91				

Note: G means group, SR means school refusal.

Discussion

It was found that students who engage in masked attendance, even though they attend school and spend time in the classroom just like well-adjusted students, are unable to positively evaluate almost all aspects of their interactions with the school. Furthermore, regarding their awareness of school attendance, it was revealed that these students hold a more negative view of daily attendance compared to well-adjusted students. However, when it comes to perceiving school as a place for studying, there is no significant difference between masked attendance students and well-adjusted students.

Conclusion

From the above findings, two significant conclusions can be drawn from this study. First, it is evident that even though students may appear to spend time in the classroom in the same manner, there is a notable number of students who experience feelings of maladjustment. These students may harbor doubts about the necessity of daily school attendance. This highlights the importance of recognizing and addressing the underlying issues that contribute to their negative perceptions of school life. It suggests that schools need to implement more supportive measures to help these students feel more comfortable and engaged in their daily school activities.

Second, despite the experience of remote learning during the COVID-19 pandemic, where students studied outside the traditional classroom setting, there remains a strong perception among junior high school students that the school classroom is the most suitable place for studying. This indicates that the physical environment of the classroom plays a crucial role in the learning process and that students value the structure and resources provided by the school setting. It underscores the importance of maintaining a conducive and supportive classroom environment to facilitate effective learning.

Furthermore, the study reveals that while students may perceive the school classroom as the appropriate place for studying, the state of adaptation to school varies significantly among them. This diversity in adaptation levels suggests that a one-size-fits-all approach to education and support may not be effective. Instead, it is crucial to adopt a more individualized approach that takes into account the unique needs and experiences of each student.

Recognizing students who spend their school life feeling "not enjoyable" is a critical first step in providing the necessary support. By identifying and understanding the specific challenges these students face, educators and school administrators can develop targeted interventions to improve their school experience. This may include providing additional emotional and psychological support, creating more inclusive and engaging classroom activities, and fostering a positive school culture that promotes a sense of belonging and well-being for all students.

In conclusion, this study highlights the importance of understanding the diverse experiences and perceptions of students regarding their school life. It calls for a more nuanced and empathetic approach to education that prioritizes the well-being and engagement of all students. By doing so, schools can create a more supportive and positive learning environment that enables every student to thrive.

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Enhancing Oral Presentation Skills for Japanese EFL Students: A Research-Based Approach Using AI-Driven Learning Tools

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Abstract
This study explored the effectiveness of a blended approach of combining traditional instruction with AI technology in teaching presentation skills to Japanese university students. For the traditional instruction, *Deliver Your Message* was utilized, which was a textbook developed to enhance oral presentation skills for Japanese EFL students at the university level by offering step-by-step guidance in preparing and delivering presentations. For the AI technology, the AI system on the e-learning platform *EnglishCentral* was adopted, which provided real-time practice and feedback for students outside of class. 12 students participated in the study and filled in a questionnaire consisting of Likert-scale questions and open-ended questions. Quantitative data gathered from the former type of questions were on the students' satisfaction and confidence in public speaking, while qualitative data collected from the latter type of questions were on their engagement with both the blended approach. Initial findings indicated that the combination of structured learning and AI-driven practice helped the students gain confidence and improved their ability to organize and deliver presentations in English. These findings suggested that AI-based systems could be utilized to support language learning efficiently and effectively in higher education, especially in combination with structured textbook instruction to enhance students' presentation skills.

Keywords: Blended Approach, Oral Presentation Skills, AI Technology, English Language Education, Student Engagement

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Introduction and Background

The increasing necessity of effective communication skills in both academic and professional settings has highlighted the importance of developing oral presentation skills among English as a Foreign Language (EFL) learners, particularly in higher education. As universities adopt digital and blended learning approaches to address this need, studies have shown that integrating technology, such as Artificial Intelligence (AI), can significantly enhance student engagement and learning outcomes (Johler, 2022; Wang et al., 2024). This study explores the effectiveness of a blended approach to teaching English presentation skills to EFL students in Japan by using *Deliver Your Message* (Shishido et al., 2025) and AI tools provided by *EnglishCentral* (https://www.englishcentral.com/). The textbook was developed to enhance oral presentation skills specifically for Japanese university EFL students and offers structured, step-by-step guidance on organizing and delivering presentations. The *EnglishCentral* e-learning platform provides AI-driven real-time practice and feedback, allowing students to extend their learning experience beyond traditional classroom boundaries.

Oral presentation skills are essential for language learners even in settings where English is not the primary language outside of the classroom (Al-Issa & Al-Qubtan, 2010). According to Makena and Feni (2023), presentation skills not only improve linguistic fluency but also enhance cognitive abilities such as organization, critical thinking, and confidence. In EFL contexts, these skills are integral to preparing students for academic and professional interactions where English is the medium of communication. However, students often face challenges in acquiring these skills because of limited opportunities for real-time practice and feedback in traditional classroom settings (Wahyuningsih & Afandi, 2020).

Blended learning combines traditional instruction with digital tools, allowing instructors to bridge the gap between classroom teaching and autonomous learning. Research findings show that a blended approach can increase students' motivation and learning outcomes by introducing flexible and interactive learning options (Oweis, 2018). In EFL education, where consistent practice is essential for language acquisition, blended learning can become a practical solution by enabling students to engage with language in various contexts (Hockly, 2018).

In recent years, research has demonstrated that AI-enhanced learning platforms can potentially play a transformative role in language education (Holmes et al., 2019; Huang & Mizumoto, 2024). This is because AI can offer personalized and immediate feedback in simulated real-world scenarios, thus reinforcing language skills (Chan et al., 2024; Yesilyurt, 2023). AI has been shown to facilitate self-directed learning, a critical component in sustaining motivation and skill development among language learners (Li et al., 2024). In other words, AI-based tools have been particularly effective in fostering autonomous learning, encouraging students to practice in their own time, and providing consistent support in skill development (Yang et al., 2022). This means that AI-enabled English learning platforms that offer practice in speaking through interactive simulations resembling real-world scenarios could greatly help students enhance their English skills.

Building on the findings in the literature, *Deliver Your Message* utilizes *EnglishCentral*, an AI-powered English learning platform, as an additional resource to offer students real-time feedback on their pronunciation, fluency, and overall presentation skills, aiming to increase their confidence and proficiency in English public speaking. This integration of traditional

instruction with technology is intended to respond to the dual challenge of teaching complex language skills and fostering student engagement in an EFL environment.

The aim of the current study is to investigate the effectiveness of a blended model combining structured textbook instruction with AI-driven practice in developing oral presentation skills for Japanese EFL students. More specifically, there are three following objectives:

1. To evaluate the effectiveness of blended learning by measuring the impact of combining an English textbook with AI tools on students' oral presentation skills.
2. To examine AI's role in EFL education by analyzing how AI-driven real-time feedback reinforces classroom learning and encourages self-study.
3. To assess the students' perception of the blended instructional model by analyzing their motivation, engagement, and satisfaction.

In the following, this paper will first describe the textbook used in the classroom and the AI tools used by the students. The research methodology will then be described, followed by the results and analysis of the data. This paper will then discuss the impact of blended learning instruction, with an emphasis on the role of AI-supported tools on students' learning experience.

Textbook

In this study, *Deliver Your Message* (Shishido et al., 2025) was used for English language instruction in the classroom. Presentations were chosen as the theme of the textbook because strong presentation skills are vital in today's academic, professional, and everyday communication contexts. The textbook serves as a comprehensive resource for students aiming to improve their oral presentation skills, catering to both beginners and those seeking to enhance existing abilities. It is designed to improve students' oral presentation skills by providing step-by-step guidance in organizing presentations and delivering content. This step-by-step approach enables students to acquire essential skills systematically and apply them in practice.

Figure 1: Warm-up

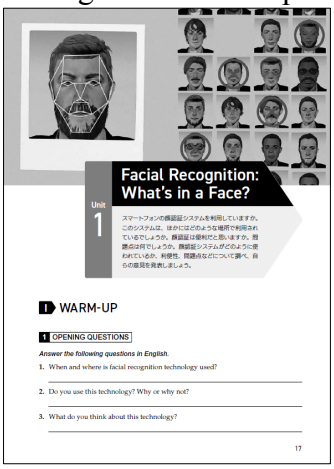


Figure 2: Listening 1

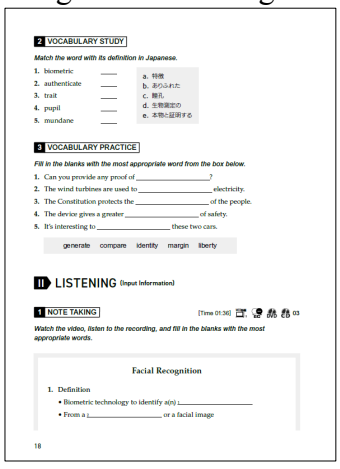
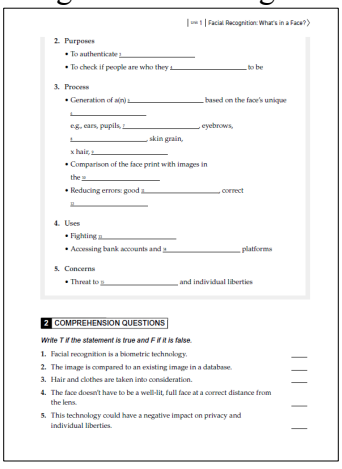


Figure 3: Listening 2

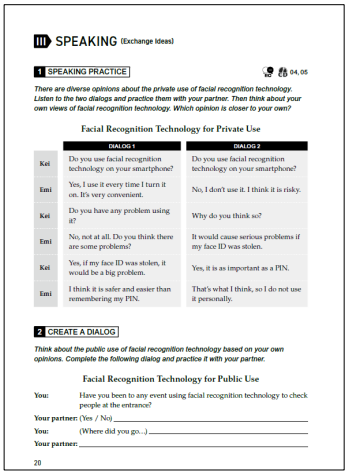


The textbook starts with a Pre-Unit to build foundational skills, covering aspects like setting objectives, audience analysis, organizing content, slide design, speech preparation, effective body language, and handling Q&A sessions. The main part of *Deliver Your Message* is organized into four sections: Warm-up (Figure 1), Listening (Figure 2, Figure 3), Speaking (Figure 4), and Presentation (Figure 5, Figure 6), each designed to progressively develop the

key competencies necessary for oral presentations. The Warm-up section introduces students to topic-related vocabulary and provides exercises in vocabulary recall and contextual application. In the Listening section, students watch videographic content on relevant social topics to practice note-taking and comprehension through true/false questions. The Speaking section encourages students to express opinions, engage in dialogues, and practice responding to questions and comments. Finally, the Presentation section guides students through researching, brainstorming, organizing, and delivering their presentations.

Additionally, the textbook includes practical columns on presentation tips and techniques, and an appendix with evaluation criteria and expressions for logical development, offering templates for various organizational patterns such as chronological order, problem-solution, and cause-effect approaches. This resource is designed to cultivate students' English proficiency while enhancing their confidence and capability to present in structured, impactful ways.

Figure 4: Speaking



SPEAKING (Exchange Ideas)

1 SPEAKING PRACTICE 04, 05

There are diverse opinions about the private use of facial recognition technology. Listen to the two dialogs and practice them with your partner. Then think about your own views of facial recognition technology. Which opinion is closer to your own?

Facial Recognition Technology for Private Use

	DIALOG 1	DIALOG 2
Kei	Do you use facial recognition technology on your smartphone?	Do you use facial recognition technology on your smartphone?
Emi	Yes, I use it every time I turn it on. It's very convenient.	No, I don't use it. I think it is risky.
Kei	Do you have any problem using it?	Why do you think so?
Emi	No, not at all. Do you think there are some problems?	It would cause serious problems if my face ID was stolen.
Kei	Yes, if my face ID was stolen, it would be a big problem.	Yes, it is as important as a PIN.
Emi	I think it is safer and easier than remembering my PIN.	That's what I think, so I do not use it personally.

2 CREATE A DIALOG

Think about the public use of facial recognition technology based on your own opinions. Complete the following dialog and practice it with your partner.

Facial Recognition Technology for Public Use

You: Have you been to any event using facial recognition technology to check people at the entrance?

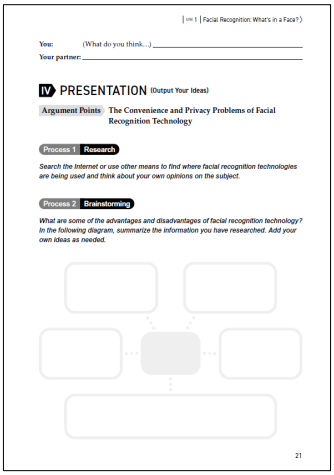
Your partner: (Yes / No) _____

You: (Where did you go…) _____

Your partner: _____

20

Figure 5: Brainstorming



Facial Recognition: What's in a Face?

You: (What do you think…) _____

Your partner: _____

PRESENTATION (Output Your Ideas)

Argument Points **The Convenience and Privacy Problems of Facial Recognition Technology**

Process 1 Research

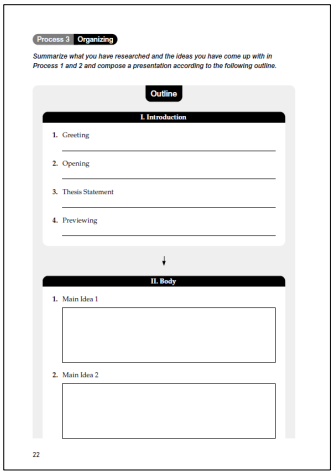
Search the Internet or use other means to find where facial recognition technologies are being used and think about your own opinions on the subject.

Process 2 Brainstorming

What are some of the advantages and disadvantages of facial recognition technology? In the following diagram, summarize the information you have researched. Add your own ideas as needed.

21

Figure 6: Outline



Process 3 Organizing

Summarize what you have researched and the ideas you have come up with in Process 1 and 2 and compose a presentation according to the following outline.

Outline

I. Introduction

1. Greeting _____
2. Opening _____
3. Thesis Statement _____
4. Previewing _____

II. Body

1. Main Idea 1
2. Main Idea 2

22

Artificial Intelligence

The blended approach used in this study combined traditional instruction with AI technology. For the AI language support, the AI system on an e-learning platform *EnglishCentral* was utilized. This AI system allows students to practice speaking English by using two features on the platform outside of class. The first feature asks students to reproduce segments of a videographic orally, and the AI system offers real-time feedback on pronunciation and intonation by showing mistakes and giving scores on the screen. Students can repeat the question multiple times until they are satisfied with the score.

The second feature is a chatbot that responds to students' oral or textual input in simulated presentation scenarios. As Figure 7 illustrates, students can first choose a prompt they would like to work on and start a conversation with the system's chatbot. In response to the student's oral input, the system generates a response and feedback as shown in Figure 8. Students can continue the conversation with the chatbot as long as they want, and the feedback mechanism helps them quickly identify and correct mistakes, improving their fluency and presentation skills.

In short, the continuous and interactive practice provided by AI can help students improve their fluency, organization, and delivery of presentations. AI tools in this way offer additional

practice opportunities outside the traditional classroom setting in an interactive and engaging manner.

Figure 7: Chatbot Menu

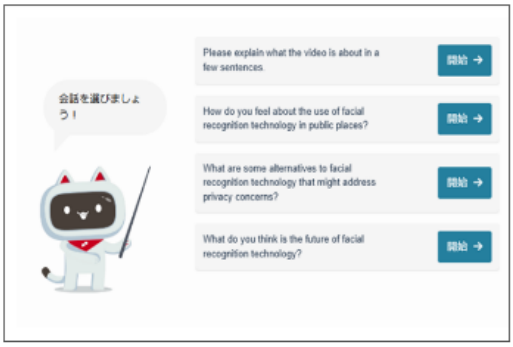
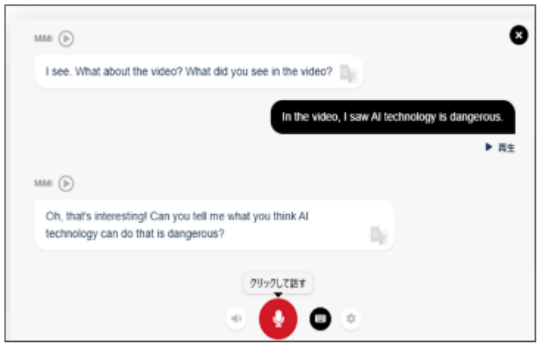


Figure 8: Chatbot Conversation



Methodology

This study utilized a mixed-methods approach by combining quantitative data and qualitative data obtained from questionnaires. 12 engineering students studying at a Japanese university in East Japan participated in this study: 3 junior students, 3 senior students, and 6 graduate students. The students first experienced traditional instruction by using a unit from *Delivery Your Message* in a class taught by one of the authors. They then engaged in additional learning by using the AI system on *EnglishCentral*. Participants then answered a Japanese questionnaire consisting of 10 five-point Likert scale questions and 5 open-ended questions (see Appendix for the English-translated version of the questionnaire). The Likert-scale questions were intended to measure students' satisfaction with the blended approach and AI feedback and their perceived improvement in presentation skills and confidence in public speaking. The open-ended questions were intended to elicit deeper insights into students' perceptions toward utilizing the AI system as language support in terms of their engagement and motivation. For the analysis of open-ended questions, KH-coder (https://khcoder.net/) was used for identification of keywords.

Data Analysis

Quantitative Analysis of Questionnaire Responses

The quantitative data collected from the questionnaires provided insights into the participants' satisfaction with blended learning, their perception of the effectiveness of AI for improving pronunciation and fluency, their perceived improvement in presentation skills, and the overall impact of the blended approach on their motivation and engagement. Figure 1 summarizes the data explained in the first two sections below, and Figure 2 shows the data described in the latter two sections below.

Satisfaction With Blended Learning. The students rated their satisfaction with the combined use of the *Deliver Your Message* textbook and the *EnglishCentral* AI platform at 4.50 out of 5. They were satisfied with the organization of the textbook unit (4.08) for learning to organize and deliver presentations. The students were even more satisfied with the real-time feedback provided by AI (4.67). This high level of satisfaction reflected the effectiveness of the blended approach in meeting the participants' learning expectations.

Effectiveness of AI for Fluency and Pronunciation. The students agreed on the benefits of AI-based chat practice in enhancing their fluency and accuracy, with a score of 4.25 out of 5. As stated above, they found the real-time feedback highly helpful (4.67) although the score for the quality of the feedback was slightly lower compared to the immediacy of the feedback (4.17). This indicated that the students perceived the platform as having a strong potential for helping them improve their accuracy and fluency in English. These findings were in line with the claims in the literature regarding the advantages of real-time AI feedback in language education (e.g., Chan et al., 2024).

Perceived Improvement in Presentation Skills. Responses to the question on overall improvement in presentation skills showed an average score of 4.33 out of 5. This meant that the students perceived significant gains in their skills on organizing and delivering presentations through the blended learning experience. They also indicated that the materials helped them increase their confidence in doing presentations (4.00). The majority of the participants also indicated that their confidence in English speaking skills improved through the experience (3.92). The results underscored the positive impact of the integration of AI-supported practice into traditional presentation instructions on improving the students' ability to deliver presentations in English.

Impact on Motivation and Engagement. A positive outcome of the blended approach was also observed in the participants' responses regarding their perceived improvement in motivation and engagement. They responded that the blended approach of textbook instruction and the AI learning increased their motivation and willingness to learn (4.33). Notably, the participants expressed that the integration of the AI-based system improved their motivation to study English (4.58). This indicated that interactive and autonomous AI elements were helpful in boosting engagement levels in English learning.

Figure 9: Satisfaction

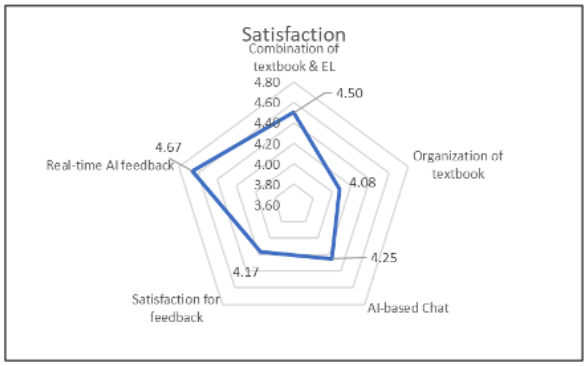
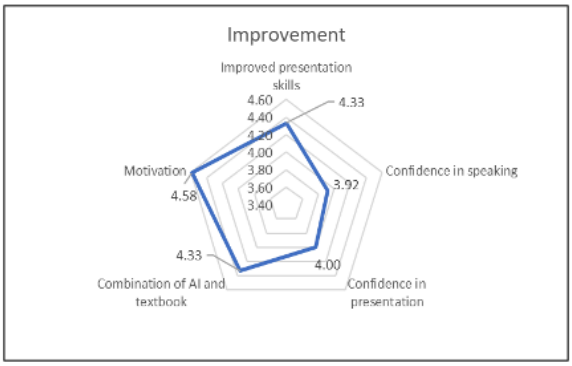


Figure 10: Improvement



These survey findings showed that the integration of AI-based tools with traditional learning approaches enhanced the students' confidence, fluency, and motivation toward English presentations, supporting the effectiveness of a blended learning strategy for EFL education.

Qualitative Analysis of Participant Feedback

The qualitative data collected from open-ended questions offered insights into the participants' personal experiences with and perceptions of blended learning. Specifically, the questions elicited detailed written responses on engagement in structured learning, benefits of AI-driven practice in a blended approach, challenges in AI usability, increased motivation through personalization and immediate feedback, and potential for AI-assisted learning to

supplement traditional learning. KH-coder was used to identify keywords and produce co-occurrence networks. The responses by the students included below were originally in Japanese and were translated into English.

Engagement in Structured Learning. The participants described the materials of *Deliver Your Message* as well-structured and instrumental in systematically improving their presentation skills. For example, Student #2 wrote, "It was good practice for me because I was able to experience the process of researching the topics in the material by myself, giving my opinions and ideas, and structuring them according to the outlines many times." Student #7 also wrote, "I felt that using this material was good for me because I could go through the structure of the presentation at my own pace, which suited my learning style."

Their responses indicated that the step-by-step guidance offered by the textbook helped practice and develop the skills necessary for organizing and delivering English presentations. In addition, the worksheet format of the Presentations section allowed them to prepare the presentation at their own pace. As the co-occurrence network in Figure 11 indicated, feedback from the participants emphasized that the materials not only helped them learn the pronunciation and meaning of words effectively but also enabled a gradual and deepening understanding of the content.

Benefits of AI-Driven Practice in a Blended Approach. The students emphasized that AI feedback on pronunciation, fluency, and content played an important role in developing their presentation skills. For instance, Student #3 wrote, "The AI gave me accurate advice, which made it easy to understand what I lacked. Through repetition of the material and AI, I feel that I have improved my basic communication skills in presentation." Student #10 wrote, "I think it helped me to organize the content of my presentation and to improve my pronunciation. I felt that it was especially useful to be able to clarify areas in which I was lacking," and Student #11 wrote, "I think chatting with the AI will help develop the content of the presentation in terms of how the conversation unfolds."

These responses highlighted that real-time corrections in pronunciation and intonation were particularly helpful and that the AI system helped the participants to organize their ideas and thoughts into a presentation through chatting with the system. In addition, engaging in a conversation with AI in real-time helped to boost confidence in speaking and preparedness for live presentations. Figure 12 shows a co-occurrence network based on the responses for the second open-ended question. As can be seen in this figure, feedback focused on the usefulness of AI in improving the accuracy of pronunciation and intonation, organizing ideas for presentations, and practicing speaking English. The results indicated that the interactive and engaging nature of AI-driven practice was considered beneficial in enhancing presentation skills in a blended approach.

Figure 11: Engagement and Structured Learning

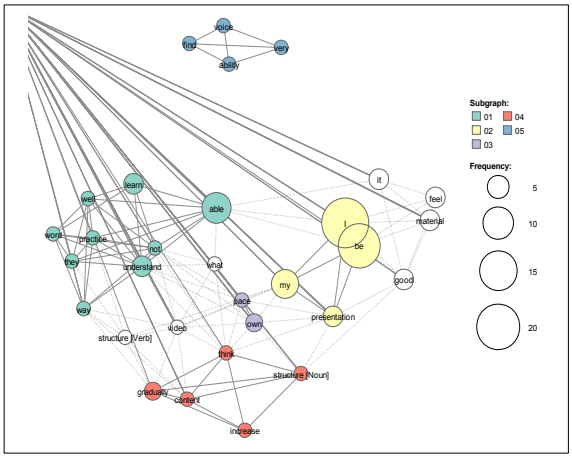
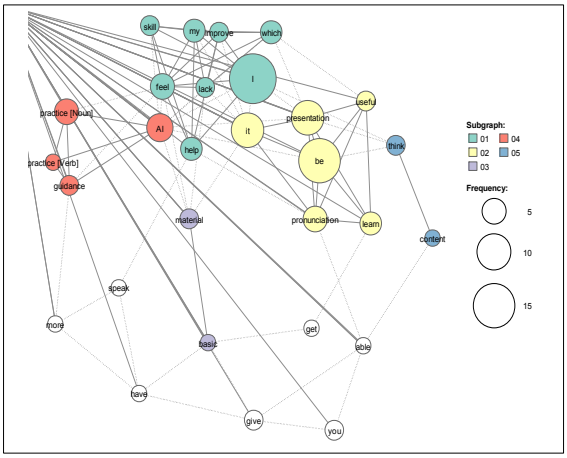


Figure 12: Benefits of AI-Driven Practice



Challenges in AI Usability. The participants' overall feedback to the AI language support was on the positive side as illustrated in the above sections. However, some students identified challenges and difficulties in using the AI system, particularly with regard to text recognition. Figure 13 shows a co-occurrence network for the open-ended question on challenges in AI usability. Student #1 wrote, "AI could not fully recognize the words I said, so I felt the text recognition technology was not good enough," and Student #7 wrote, "It might have been due to my pronunciation, but AI misinterpreted some of the words I said for different words." Student #5 also mentioned that "there were words I had mispronounced which were somehow evaluated as correct pronunciation." The results indicated that the students perceived that the text recognition system was not always accurate although it was difficult to tell whether that was an actual issue with the system or it was a result of inaccurate pronunciation.

In addition, Student #6 wrote, "Errors sometimes occurred in AI chat," pointing out that the system was somewhat unstable at times. As the participants were engineering students, a few students made suggestions on how to improve the system. Student #10 suggested that "it might be better to put a clear delimiter in the UI" because "the end of the AI chat was not clear," and Student #5 added that "it would be good to know how to produce that pronunciation by showing the movement of the mouth." Student #2 recommended that "assistance in creating and speaking English compositions would lower the learning hurdle, especially for beginner level students." These observations provided insightful comments regarding areas where AI design could be improved to better support EFL learners.

Increased Motivation Through Personalization and Immediate Feedback. The students reported that the AI platform's personalized feedback greatly enhanced their motivation to study English. Student #10 wrote, "The immediate feedback on what I didn't understand greatly reduced my tendency to leave things I didn't understand as they were, making it easier to learn. I felt it was easier to maintain motivation because the results were returned immediately." Student #5 also appreciated the immediacy of feedback by saying that "the fact that I could find out what I didn't understand immediately improved my motivation."

In addition, Student #3 wrote, "The AI was refreshing because it allowed me to learn in a way that I was not used to. As a result, my motivation was increased considerably."

These responses indicated that the real-time feedback provided by AI as well as its novelty helped to enhance the students' motivation toward practicing English. Moreover, AI enabled

to lower the psychological barrier to practicing speaking English for some students. For instance, Student #11 wrote, “Even when I feel insecure about my opinion, I think AI can give me a positive response so that I can continue learning without anxiety.”

These positive reactions were also clearly observed in the co-occurrence network illustrated in Figure 14. The expression “a personal teacher” used by Student #1 concisely summarized the students’ satisfaction with the AI learning system as it provided immediate and personalized feedback in an interactive manner. The results supported the potential of AI tools as motivating supplements to traditional teaching methods.

Figure 13: Challenges in AI Usability

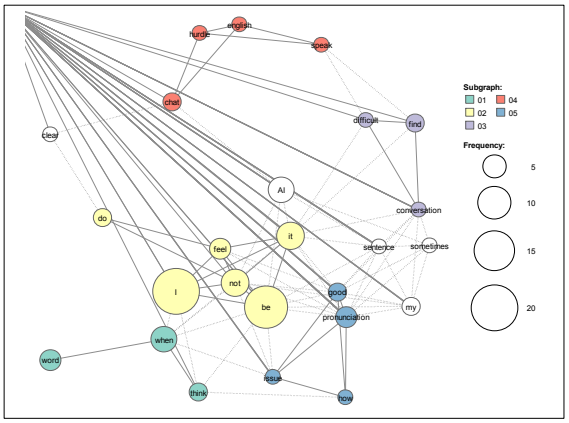


Figure 14: Increased Motivation

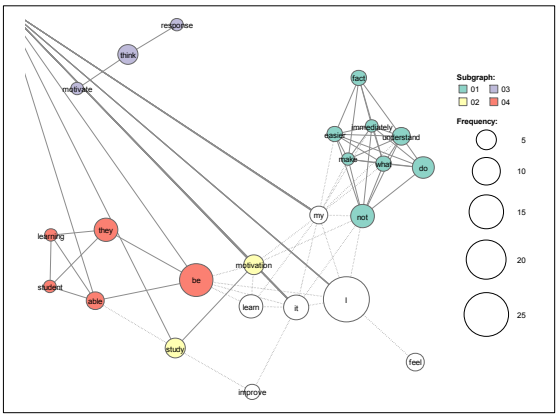
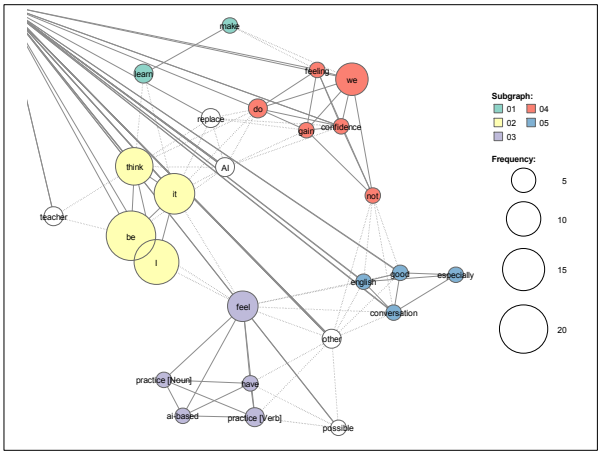


Figure 15: Potential for AI-Assisted Training



Potential for AI-Assisted Learning to Supplement Traditional Learning. In response to the question asking about AI’s potential to replace traditional teaching methods, the participants claimed that AI-based learning could supplement or partially replace traditional instruction. Figure 15 shows a co-occurrence network based on the responses given to this question. Student #4 wrote, “Currently, ALTs often assist English classes, but I think AI will be effective because one teacher is not enough to offer English conversation practice considering the number of students in the classroom.” Student #10 also referred to the shortage of teachers in today’s Japanese schools. In addition, Student #12 wrote, “I think it could be a good alternative especially to online English conversation.”

These comments indicated that the students felt that AI could be a good supplementary tool for practicing speaking English including presentations. Not everyone agreed, however, and Student #2 noted that "we cannot gain confidence in presentation and speaking unless it is done in-person." Student #11 also emphasized the importance of a teacher by writing "I think it is possible to learn the general rules of grammar from AI, although detailed nuances require the guidance of a teacher."

Overall, the participants observed that the AI language learning system could be utilized as a supplemental tool for practicing English. At the same time, they emphasized that it could not fully replace instructions offered by language teachers. These insights supported the view that AI could enhance traditional teaching but not become a substitute for it and that a balanced approach should be taken in integrating AI into language education.

Discussion

The quantitative and qualitative analyses of the data indicated that the blended approach of using *Deliver Your Message* alongside AI-driven tools on *EnglishCentral* greatly enhanced the Japanese EFL students' self-perceived oral presentation skills. Regarding the first research objective of evaluating the effectiveness of blended learning, the study showed that the textbook and the AI system have different roles in developing presentation skills. The textbook can provide students with the opportunity to develop relevant skills necessary for organizing and delivering presentations in a structured manner. The teacher in the classroom can set the pace for initial language exercises and offer additional explanations as necessary. The worksheet format of the presentation section then enables students to work on developing their presentations at their own pace. The AI system offers the opportunities for students to organize their ideas and practice speaking outside of the classroom before giving the presentation to their classmates back in the classroom. In this way, the blended approach is effective in improving students' skills and confidence in delivering presentations in English.

With regard to the second research objective of examining AI's role in EFL education, the study indicated that the real-time and personalized feedback is the most useful feature of AI in developing students' presentation skills. It is not possible for the teacher to provide personalized feedback to all the students in the classroom at the same time, and AI can perform a supplementary role in this aspect. Students can improve their pronunciation and intonation by receiving real-time feedback on their mistakes and by repeatedly practicing the same segment to achieve a better score. They can also practice speaking and organize their ideas for a presentation by utilizing the chatbot function. It is possible to spend as much time as they want with the AI learning tools, and thus it can reinforce classroom learning and encourage autonomous learning. There are rooms for improvement with the AI system as observed by the students in this study. However, the AI system overall has a positive impact on helping EFL students improve their presentation skills.

Finally, regarding the third objective of assessing students' perception of the blended approach, this research found that the integration of AI-enhanced their motivation and satisfaction in practicing English presentations. The use of AI enables students to practice English in an interactive and engaging way outside of the classroom in a low-stakes environment. It helps them maintain and enhance their motivation because they can get immediate feedback from the system. Through practicing with the AI system, students can boost their confidence in speaking English accurately and clearly because they can visually

see the improvement in their pronunciation and intonation in the feedback. At the same time, it is necessary to offer additional support for beginner level students and to keep improving the system by listening to comments by the users.

Conclusion and Future Directions

This study has highlighted that the blended approach of utilizing a structured textbook and AI-driven language learning tools is highly effective in helping Japanese university students improve their English presentation skills. Students can practice speaking English outside of the classroom by using AI tools, and this helps them enhance their accuracy and confidence in delivering presentations. The promising results from this study suggest that the integration of AI into traditional teaching methods can be greatly beneficial for Japanese EFL students.

There are mainly two limitations in this study. First, the questionnaire focused on the participants' perceived improvement in presentation skills. This means that it would be necessary to assess students' English scores before and after the experience in a future study in order to evaluate if the blended approach can lead to an increase in test scores as well. Second, the participants were engineering students, meaning that they tended to have positive attitudes toward AI in the first place. As such, the inclusion of students from other majors would likely offer additional insights.

In addition, future research could investigate the long-term effects of the blended approach utilizing AI tools on university students' development of English speaking skills including presentation skills. Another aspect worth exploring would be the role of different types of feedback provided by AI in relation to specific language learning goals. AI tools have started to change English education, and English language instructors will have to stay aware of their impact whether they are in favor of AI or cautious about AI.

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Appendix

<Likert-scale questions>
1. How satisfied are you with the combination of the *Deliver Your Message* textbook and the *EnglishCentral* platform?
2. How satisfied are you with the way you organized and delivered your presentation using the *Deliver Your Message* materials?
3. To what extent do you feel this program has improved your presentation skills (fluency, organization, confidence, etc.)?
4. To what extent do you agree with the statement, "AI-based chat practice has improved my fluency and accuracy"?
5. How satisfied are you with the AI feedback feature on the *EnglishCentral* platform?
6. Do you find the real-time feedback from AI easy to understand and useful?
7. How much has your speaking confidence changed as a result of this program?
8. After using the learning materials and the AI platform, how much has your confidence in making presentations in English increased?
9. How do you think the combination of AI-based practice and traditional teaching styles affected your interest and motivation in learning?
10. How has your willingness to learn and motivation changed since you adopted the AI-based learning system?

<Open-ended questions>
1. What was your experience creating a presentation using the *Deliver Your Message* materials?
2. How did you feel the combination of the guidance from the learning materials and the AI practice helped you improve your presentation skills?
3. Did you encounter any difficulties or challenges in using the AI platform?
4. How has your willingness to learn and motivation changed since you adopted the AI-based learning system?
5. Do you think AI-assisted training could replace some of the traditional teaching?

Perception on Mental Health Care and Barriers to Seeking Mental Health Services in College Students of Bangladesh: A Qualitative Exploration

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Abstract
Student mental health in the academic context has been a growing concern. They experience a variety of challenges while seeking mental health services. However, there is a severe scarcity of studies on mental health concerns among middle-income semi-urban college students of Bangladesh. This study sought to assess Bangladeshi students' perceptions of mental health and the barriers they encounter when seeking mental health care as well as to offer intervention strategies to overcome these barriers. This study used a qualitative technique, with data collected through 6 focus group discussions (FGDs) including 94 participants from three geographical locations of Bangladesh (Sylhet, Kishoreganj, and Khulna). Purposive sampling methods were employed in the selection of participants. The verbatim transcription and thematic analysis were carried out using manual coding. The findings of the study revealed that participants' perceptions of mental health were mostly influenced by their physical and social perspectives. The shortage of mental health professionals, socioeconomic disparities, financial issues, and unsupportive family settings were found as the most prevalent barriers to getting mental health care. The study highlights the barriers to accessing mental health services and limitations in the availability of preventive and early mental health care. Mental health awareness campaigns, psychosocial support-related training, and psychological counseling can be offered to the students to address the barriers they face. This may help them become resilient and build an efficient support system.

Keywords: South Asia, Mental Health Perceptions, Higher Education, Social Stigma in MH, Bangladesh

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Introduction

Mental illnesses have continued to rank among the top ten major causes of burden worldwide since 1990 (Ferrari, 2022). Around 970 million individuals around the globe experience mental health issues, with anxiety and depression being the most prevalent disorders (Kestel et al., 2022). Mental disorders are highly prevalent globally, particularly in low- and middle-income countries (Naveed et al., 2020). Mental disorders were ranked as the eighth most significant disease burden in Asia in 2019, contributing to 5.0% (4.0–6.1%) of total Disability-Adjusted Life Years (DALYs). Among the analyzed mental disorders in Asia, depressive disorders (37.1%), anxiety disorders (21.5%), and schizophrenia (13.8%) were identified as the top three contributors to the burden of mental disorder-related DALYs (Chen et al., 2024). South Asian countries, which account for one-quarter of the world's population and include nations such as India, Pakistan, Nepal, Sri Lanka, Bhutan, Bangladesh, Afghanistan, and the Maldives, face significant mental health challenges. Approximately 150–200 million people in this region are diagnosed with psychiatric disorders (Thara & Padmavati, 2013). Studies shows that approximately 14.5 million adults in Bangladesh are suffering from mental disorders (Hossain et al., 2014).

Despite the substantial burden of illness, the mental health infrastructure in South-East countries of Asia remains relatively weak, with approximately 2% of national budgets allocated to mental health (Sharan et al., 2017). Moreover, there is a shortage of psychiatrists, clinical psychologists, and other mental health professionals, as well as social workers (Thara & Padmavati, 2013). In Bangladesh, the mental health infrastructure faces severe challenges. With a population exceeding 166 million, there are only 260 psychiatrists and approximately 500 psychologists available to provide care (Hasan et al., 2021). The limited number of service providers and low health budgets indicate that nations do not prioritize mental health as highly as other health issues. Additionally, social stigma and lack of awareness surrounding mental health plays a significant role in discouraging individuals from seeking help for mental disorders (Hasan et al., 2021).

Mental health care among university or college students is also an increasingly significant public health concern. The prevalence of depressive or anxiety disorders was found to be 15.6% among undergraduates and 13.0% among graduate students, as reported by the American College Health Association's 2015 survey (Eisenberg et al., 2007). In a study on mental health issues among university students in Southeast Asia, the prevalence rates were found to be 29.4% for depression, 42.4% for anxiety, 16.4% for stress, and 13.9% for disordered eating. Additionally, suicidal ideation was reported in 7% to 8% of students (Dessauvagie et al., 2022). The mental health of Bangladeshi university students is also a significant concern. A recent study revealed that a total of 55.9% of Bangladeshi students studying at honors or masters level exhibited poor mental health status. Female students were particularly affected, with poorer mental health compared to their male counterparts. Additionally, students in public universities showed worse mental health conditions than those in private universities (Ovi et al., 2024).

A study involving college students found that perceived public stigma was significantly higher among students than personal stigma. Personal stigma was more prevalent among students who identified as male, younger, Asian, international, more religious, or from lower-income families (Eisenberg et al., 2009). The situation regarding mental health perceptions and related stigma is similarly challenging in Bangladesh. A study highlighted that more than one-third of Bangladeshi students lacked adequate knowledge about mental health (Siddique

et al., 2022). Financial support for mental health services is also extremely limited, with only 0.44% of the government health budget allocated to the mental health sector (Hasan et al., 2021). These factors contribute to significant gaps in mental health care accessibility and availability for students in Bangladesh. Students' energy level, concentration, dependability, cognitive abilities, optimism etc. can be significantly impact by mental health problems thereby hindering their academic performance. College students studying at honors and masters level frequently cite stress, anxiety, depression, sleep difficulties, and other mental health issues as factors negatively affecting their academic performance. Moreover, these issues can have long-term consequences for students, potentially affecting their future employment opportunities, earning potential, and overall health (Eisenberg et al., 2007, 2009).

A lot of significant research have been conducted on mental health issues among Bangladeshi university students, exploring conditions such as depression, anxiety, stress, suicidal tendencies (Ali et al., 2022; Islam et al., 2020; Mamun et al., 2019). However, most studies have primarily focused on students in large cities attending public and private universities. Mental health concerns among Bangladeshi college students studying at honor's or master's level from semi-urban areas have been largely neglected. Furthermore, to the best of the author's knowledge, no study has explored Bangladeshi college students' perceptions of mental health issues or the barriers they face in accessing mental health care services. Based of the findings of some previous studies, we have a sense that Bangladeshi students studying at honors or master's level may face barriers in assessing mental health care services (Faruk et al., 2023; Sifat et al., 2023). Consequently, the primary objectives of the present study is to explore the Bangladeshi college students' perceptions of mental health. It also aims to explore the barriers students encounter in assessing mental health care.

Methodology

Sampling

For this particular study, information was gathered through six focus group discussions (FGDs), which included a total of 94 participants aged 19 to 25 years old. These participants were selected from three geographical locations in Bangladesh (Sylhet, Kishoreganj, and Khulna) using purposive sampling methods. The number of respondents from each student group in a single FGD varied from 15 to 16.

Study Design and Data Collection

In the present study, a qualitative research design was utilized. Data collection involved the use of focus group discussions (FGDs), during which a chosen group of students participated in an open ended discussion led by the data collector(s). This method was utilized to the elicit participants' attitudes, perceptions, knowledge, experiences, and practices, which were shared during interactions. In total, six FGDs were conducted with the students from Sylhet, Kishoreganj, and Khulna divisions of Bangladesh. The duration of each FGD varied from one hour and 15 minutes to one hour and 30 minutes. A participatory approach was followed in each FGD. Before the commencement of data collection process, each participant received an explanation detailing the purpose of the study. The data collector(s) reassured the participants about the security of their information by detailing the confidentiality measures in place and encouraged them to express their thoughts freely. Following a comprehensive description of the study procedures, verbal consent was obtained from each participant. After the

introductory session, the primary discussion commenced with their permission to record. Each session was documented for future reference and documentation. They were provided with a socio-demographic questionnaire to gather information about their demographic, social, and personal backgrounds. Then, the participants were actively engaged in open discussions focused on pre-established open-ended questions concerning their perceptions on mental health, coping strategies, and barriers to seek mental health services. Further clarification of their responses was achieved through follow-up probing questions.

Data Analysis

Upon finishing the data collection, native Bengali speakers conducted verbatim transcription. The transcripts were carefully read and examined. A priori codebook that was created based on pertinent literature was used in addition to inductive coding during an open coding procedure. Subsequently, the completed codebook was used to code the entire dataset, and thematic analysis was carried out using techniques for identifying themes, involving manual coding for text mining and summarization.

Results

Characteristics of the Participants

The study comprised 94 participants, with a mean age of 22.5 years. More than one third of the participants were male (78.73%), and the majority studying at honors level (65%), with 53.2% reporting a monthly income between 25,000 and 50,000 BDT.

Table 1: Demographic Features of the Participants (N=94)

Variables	Number	%
Sex		
Male	74	78.73
Female	20	21.28
Educational Status		
Honor's	61	65
Master's	33	35
Monthly Family Income		
<25,000	25	26.6
25,000-50,000	50	53.2
50,000-100,000	12	12.8
>100,000	7	7.4

After reviewing the results of focus group discussions (FGDs), we found a several themes which depicts the perceptions of mental health developed among Bangladeshi rural college students as well as the kind of obstacles they face when trying to access mental health services. The themes are shown below:

Theme 1: Explaining Mental Health From Physical and Social Aspects

The first theme depicts perceptions of mental health developed among Bangladeshi rural college students based on the results of focus group discussions (FGD). This theme is divided

into two sub-themes, according to which physical and social viewpoints influenced people's opinions of mental health the most.

Defining Sound Mental Health As Having Physical Wellness

In our study, the majority of participants interpreted mental health from a physical standpoint, stating that positive mental health or well-being is defined as a life free of physical sickness among students.

One male student (age: 20) mentioned, "We rarely discuss well-being or mental health; rather, we focus on physical health. A person's mental health or well-being is deemed to be sound when they are physically strong and free of illness."

Another female student (age: 23) mentioned, "Our mind is linked to our body; if both are in good working order, we will be healthy. Mental health is a condition in which people appear to have a well-fitted physical structure."

Another male student (age: 19) stated, "A healthy lifestyle can lead to overall well-being. Physical activity is essential for maintaining good mental health."

Defining Sound Mental Health As Having Social Connectivity

Some participants believe that good mental health is a result of both physical and social connectedness. Though physical health is prioritized, social components are overlooked. According to the participants, having a strong sense of societal connection improves one's ability to retain well-being.

One of the quotes from a male student (age: 22) is as follows: "Everyone believes that being physically fit is sufficient to ensure well-being. However, I believe that if we have assistance from our nearest people, our mental health will remain stable."

Another male student (age: 25) stated, "If we have the opportunity to do something for ourselves and society, we are satisfied." It provides some level of inner tranquility. It promotes our well-being.

Another female student (age: 20) said, "I feel happier and more at ease when I can keep up positive relationships with the individuals who live around me. I feel upset if my relationships with them don't work out."

Theme 2: Shortage of Mental Health Professionals

The study revealed that students find it difficult to seek any forms of mental health support as there is a shortage of mental health professionals in rural areas of Bangladesh. There are no expert psychiatrists or counselling services available in these regions; such services are limited to divisional hospitals. Additionally, colleges do not provide student counseling services.

A female student (age: 20) expressed:

> When I got failed in my third-year final exam, I was hopeless about my future. Meanwhile, I also experienced break up in my relation which affected me in a most profound way. I was looking for a psychologist or psychiatrist from whom I could get support but I didn't find any in my district. At last, I took some medicines after consulting with a general physicians due to the absence of psychiatrists.

Another male student (age: 22) said, "I am unaware of specialists who provide support for mental health issues in my area, and we use to go to neurologists in handling such issues."

One male student (age: 24) mentioned, "Our college lacks the supportive teacher who can listen to us in our tough times. Sometimes, we need support during our stressful exam period but we couldn't get any as there is no mental health counselor in our college."

Theme 3: Socioeconomic and Financial Disparities

Most of our study participants (53.2%) belong to lower middle-class family with a monthly family income between 25,000 and 50,000 BDT. These socioeconomic disparities also emerged as another significant barrier identified in the study, hindering college students from accessing mental health services. Students from lower socioeconomic backgrounds with financial disparities perceive mental health care as inaccessible for them.

One female student (age: 24) expressed:

> I tried to seek consultation from a psychologist in my hard times, but the amount he charged is much higher than my capability. When, I struggle to afford money for my education and hostel expenses, it is impossible for me spend money for my mental health issues. Mental health treatment is a kind of luxury for us.

Another male student (age: 19) stated:

> I went to Dhaka (capital city) to take a session from a psychologist. The psychologist told me to take a few more sessions. But, I couldn't able to go Dhaka once again as the travelling expenses are high. I am still trying to manage some money for going back to Dhaka and take a few sessions. I think mental health care is only accessible to wealthy individuals, not for poor people like me.

Theme 4: Unsupportive Family Settings

The research also found that family members frequently have a negative attitude toward mental health and fail to provide support or work together with their children when they experience mental health challenges.

One male student (age: 25) shared that:

> When I was experiencing exam related stress in my first-year final exam, I shared about it in my family. But my family members didn't support me at all. They thought that I was feigning illness or trying to avoid studying. I requested them to take me to a psychologist, but they didn't. They dismissed my need for mental health care.

Another female student (age: 20) shared:

> When I lost my mother, I felt lonely. I got poor grades as it also affected my study. All of these factors eventually led me to do self-harm attempts. Instead of providing mental health support, my father thought of arranging marriage for me, assuming that it would lead to recovery.

Another male student (age: 23) described:

> My parents are busy with their work at field with agricultural activities. They cut off my social interactions with my friends, and only allow me to go out on family occasions. They don't have time for me. It makes me feel low all the time.

Conclusions

Our findings revealed that participants' perceptions of mental health were predominantly shaped by their physical and social perspectives. Many viewed physical health as the primary indicator of well-being and did not acknowledge the importance of mental health in overall wellness. Additionally, participants often refrained from seeking professional help for mental health issues due to various social and familial barriers. Key obstacles to accessing mental health care included a shortage of mental health professionals, socioeconomic disparities, financial constraints, and unsupportive family environments. To facilitate a clearer understanding, we have separately discussed each sub themes organized under the following subheadings:

Explaining Mental Health From Physical and Social Aspects

In our study, most participants defined sound mental health solely in terms of physical wellness. They viewed mental health exclusively through the lens of physical fitness, asserting that if a person is physically healthy, their overall well-being is assured. They believed that sound physical health automatically leads to sound mental health. The outputs from (James et al., 2023) provide evidence for our findings demonstrating that there exists an intricate connection between physiological and psychological well-being that encompasses the interplay of various hormones. Dopamine, known as the "happiness hormone," along with estrogen plays a significant role in various cognitive functions, such as motivation to do something. Research has also demonstrated the interplay between physical and mental health; poor mental health can lead to physical illness, and individuals with physical conditions may also develop mental health issues (Doherty & Gaughran, 2014).

The study also found that mental health is closely associated with social connectivity. Many participants reported feeling mentally well when they had strong social connections with those around them. Building social bonds with others made them happier and enhanced their mental health. The research results we obtained are also backed up by a different study conducted by (Saeri et al., 2018) which revealed that social connectedness is a more robust and enduring indicator of mental well-being. Another pertinent longitudinal research has shown that social connectivity shields persons in the general population against the signs and symptoms of negative mental health consequences (Wickramaratne et al., 2022). Additionally, another study found that interventions focused on enhancing social relationships have the potential to improve mental health (Andersen et al., 2021).

Shortage of Mental Health Professionals

The shortage of mental health professionals is found to be a significant suppressive factor for students' access to mental health support. This is backed up by the findings of Nuri and colleagues (2018) which also stated that assessing psychiatrists and other mental health providers is particularly challenging for rural populations. Mental health services are often limited to divisional tertiary centers, where psychiatrists work in public medical college hospitals located in urban areas. With only 260 psychiatrists serving a population of 162 million, a large portion of the population struggles to access necessary mental health services. Only 0.44% of all health spending is currently allocated to mental health in Bangladesh. In addition, less than 0.11% of people have free access to mental health services (Hasan et al., 2021). The majority of these services are based on urban areas, particularly in the capital city of Dhaka. Similar findings have been reported in the U.S., where barriers to mental health care persist. Access to treatment remains out of reach for many despite more than one-fifth of U.S. adults (21%, or 52.9 million) experiencing a mental illness (Modi et al., 2023).

Socioeconomic and Financial Disparities

Students from lower socioeconomic backgrounds often perceive mental health care as inaccessible. Most participants in this study came from middle-class families, making it difficult for them to manage their livelihoods while facing the high costs of mental health treatment, which they cannot afford. Additionally, many students lack access to mental health services in their areas, necessitating travel to the city, which incurs significant expenses and makes ongoing treatment implausible. A study conducted with the Bangladeshi students during the COVID-19 pandemic also indicated the same by stating that financial hardship often restricts people to seek mental health support (Sujan et al., 2022). Similar findings have been also reported in developed countries like USA, where financial barriers have also been linked to increased negative mental health symptoms (Pabayo et al., 2022).

Unsupportive Family Settings

A lack of support and negative attitudes towards mental health issues among family members are found as the obstacles in accessing mental health services for our study participants. Participants noted that their families often do not listen attentively to their mental health concerns, and when they do, they tend to dismiss them, believing their children are merely feigning their struggles. For female participants, disclosing mental health issues often leads families to attempt to conceal the problem and arrange marriages as quickly as possible, driven by a belief that such issues could harm their social standing. These findings align with qualitative studies conducted in Saudi Arabia, where major barriers to accessing mental health services included unsupportive families (Noorwali et al., 2022). The probable reason behind this sort of unsupportive attitude is their insufficient understanding of mental disorders and rooted misconceptions in the society (Dehbozorgi et al., 2022).

Implications

Based on the findings of this study, several preventive measures should be implemented to raise awareness and reduce barriers for students. To address these challenges, mental health awareness campaigns, psychosocial support training, and psychological counseling should be offered to students. These measures could help them build resilience and develop a more effective support system.

Limitations

There were several limitations to this study. First, the sample was selected through purposive sampling, which means that the participants may not be representative of the entire study population. Second, the FGDs were conducted mostly with the male college students of Bangladesh, probably because of the conservative mindset of female students to talk on open forum. Third, participants might have withheld their genuine feelings and provided responses they believed would be socially acceptable, a possibility of social desirability bias. Fourth, some participants' responses may have been influenced by dominant personalities within the focus group discussions.

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Mental Health Conditions of Youth: Understanding Their Challenges and Coping Mechanisms After the Geopolitical Crisis in Bangladesh

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Abstract
Bangladeshi youth protested the return of quotas, resulting in a geopolitical crisis. They face internet outages and callous aggression (Amnesty International, 2024), which seems to have affected their mental health negatively. The purpose of this study was to understand the predominant mental health issues experienced by youth and young adults that became visible after the recent geopolitical crisis. It also explores coping techniques utilized by this population to manage their issues. This study employed a qualitative approach, with data collected through eight focus group discussions (FGDs), including 80 youth from Bangladeshi public and private universities. Purposive sampling was used to choose participants. Inductive reflective thematic analysis was carried out for data analysis using text mining and manual coding. The geopolitical crisis had a range of psychological consequences on the study population, including major psychological symptoms such as depression, anxiety, stress, and post-traumatic stress. Additionally, they dealt with minor symptoms such as sleep difficulties, exam phobia, feelings of hopelessness, helplessness, and grief. Male participants at the private university were found to be more vulnerable because of their frequent exposure to violence. The study also found that peer support, creative outlets, social media involvement, and denial of the circumstance were found as coping techniques for the youth. To address the mental health issues of students, different measures should be taken, such as mental health awareness initiatives, one-to-one or group psychological counseling sessions, peer group support sessions, etc. These measures can assist students in building resilience and accessing an effective supportive system.

Keywords: Higher Education, Youth, Mental Health, Geopolitical Crisis, Bangladesh

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Introduction

An estimated one billion people worldwide suffer from a mental illness, demonstrating the prevalence of mental diseases. Anxiety disorders afflict 260 million individuals, or 3.6% of the world's population, while depression affects about 322 million people, or 4.4% (Chaudhari et al., 2024). A substantial amount of the global disease burden is attributed to mental diseases, which are the primary causes of impairment in young people (Erskine et al., 2014). High rates of depression (29.4%), anxiety (42.4%), stress (16.4%), disordered eating (13.9%), and suicide ideation (7-8%) are prevalent among Southeast Asian youth, mainly university students (Dessauvagie et al., 2021). This data highlights the growing mental health issues that local youth are facing.

Risky behaviors, poor academic performance, unemployment, poor sexual health outcomes, self-harm, and an increased risk of early mortality are just a few of the severe results that young people who are experiencing psychological distress may have to deal with (Livingston et al., 2012). Additionally, young individuals who experienced increased depressive symptoms reported a lower quality of life in terms of meeting basic needs and their own personal lives (Celebre et al., 2021).

Civil rights, economic injustice, gender equality, and political freedom are among the issues that young people are actively concerned about. According to Wahyuningroem and colleagues (2024), these movements usually manifest as both online activism and live protests. Young people often experience both short-term and long-term mental health issues as a result of global crises, political unrest, violence, and internet restrictions (Kirkbride et al., 2024; Ventriglio et al., 2024). Young people are more likely to commit suicide when political instability exacerbates feelings of hopelessness and social isolation in this group (Tasfi & Mostofa, 2024). Particularly for urban male students who have firsthand experience with violence, prolonged exposure to violence and ongoing instability significantly raises the risk of PTSD and other mental health problems in young people (Khoury-Malhame et al., 2024). Adolescents from Hong Kong who took part in anti-government protests reported experiencing a range of mental health issues, such as emotional distress and sleeplessness (Kwan, 2023b). In addition, statistics showed that major depression rose by 7% and the rate of PTSD varied from 4% to 41% in riot-affected districts, impacting the broader population irrespective of individual involvement (Ni et al., 2020).

A geopolitical crisis marked by internet outages and harsh government responses, such as disproportionate force, arbitrary detentions, and bloodshed, has resulted from young people's protests in Bangladesh against the return of quotas (Amnesty International, 2024). People may experience anxiety, depression, prolonged grief, and post-traumatic stress disorder (PTSD) as a result of these measures, which have sparked conversations about violations of human rights (Faruk, 2024). However, as far as the authors are aware, there isn't much thorough study on the main mental health issues that Bangladeshi teens and young adults face during the recent geopolitical crises. Our goal is to investigate the key mental health issues and coping strategies used by this population in order to improve students' well-being during these difficult circumstances.

Methodology

Sampling

Eight focus group discussions (FGDs) with a total of 80 participants, ages 19 to 25, with a mean age of 22.5 years, were used to gather data for this study. The Purposive sampling method used to choose the participants from Bangladesh's public and private universities to explore the primary mental health issues and the coping strategies utilized by this demographic to promote the well-being of students during challenging periods. There were ten participants from each student group in each FGD.

Study Design and Data Collection

This examination was conducted using a qualitative research design. Focus group discussions, or FGDs, were utilized to collect information. Ethical approval was taken before starting the data collection process. Selected students participated in open-ended discussions led by the data collectors. This strategy was used throughout the talks to elicit participants' challenges and coping mechanisms following Bangladesh's geopolitical crisis. Each FGD lasted from sixty to ninety minutes. Confidentiality of the participants were ensured and every FGD was recorded with permission for in-depth data and analysis. The FGD was structured to include demographic data collection and open-ended questions to understand mental health challenges of the participating youths and also to understand their coping strategies in times of challenging situations. The FGDs were in Bengali but later transcribed and translated to English. The focus was to make sure that the translations were as precise as possible while still preserving the original context and sense of the original verbatim. To analyze the data, an inductive reflective theme analysis methodology was used. This method combined text mining with data coding. The first phase entailed manually categorizing and summarizing the data, arranging related codes into overarching themes.

Results

Characteristics of the Participants

The study involved 80 participants, with a mean age of 22.5 years. The majority were male (60%) and pursuing honors-level education (68.75%). Family income ranged widely, with 45% reporting a monthly income between 50,000 and 100,000 BDT ($400-$800). Detailed demographic characteristics are presented in Table 1.

Several themes were identified through the analysis of focus group discussions (FGDs), and they shed light on the mental health challenges encountered by Bangladeshi youth during geopolitical crises, while the coping mechanisms they used to navigate these challenges were also drawn attention to. Both adaptive and maladaptive strategies were identified through the analysis of the themes.

Table 1: Demographic Features of the Participants (N=80)

Variables	Number	%
Sex		
Male	48	60%
Female	32	40%
University		
Public	36	45%
Private	44	55%
Educational Status		
Honor's	55	68.75%
Master's	25	31.25%
Monthly Family Income		
<25,000	10	12.5%
25,000-50,000	26	32.5%
50,000-1,00,000	36	45%
>100,000	8	10%

Theme 1: Major Psychological Symptoms

This theme highlights the significant psychological symptoms experienced by Bangladeshi youth following the geopolitical crisis. Depression, anxiety, stress, and post-traumatic stress syndrome are the primary themes that emerged from the FGDs when exploring the symptoms participants experienced during and since the geopolitical crisis.

Depression

Participants in the focus group discussions frequently reported symptoms of depression, illustrating the profound emotional and psychological disruptions they faced following the geopolitical crisis. Many expressed feelings of detachment, hopelessness, and changes in routine that significantly impacted their lives.

For instance, one male participant described his disinterest in formerly enjoyable activities, stating, "I don't feel like doing anything... even watching football feels useless... I can't sleep, I get irritated with people around me... I don't know what to do with life anymore" (Participant: 1, age: 22, FGD: 2).

Similarly, a female participant articulated her struggles, saying, "It's like being in a dark room with no door… I feel weak and stay in bed most of the time" (Participant: 2, age: 23, FGD: 4).

These accounts reflect not only a loss of interest in activities and social connections but also the physical toll of prolonged emotional distress, such as fatigue and changes in appetite.

Anxiety

The research identified significant anxiety among students as they faced the aftermath of the geopolitical crisis. Many expressed ongoing concerns about their safety, the instability of the current situation, and uncertainties regarding their future, particularly in terms of education and career paths.

One female participant shared, “Each sound of notification triggers anxiety, and I worry whether violence has erupted again. These thoughts often prevent me from focusing on anything else” (Participant: 2, age: 20, FGD: 1).

Similarly, another male student shared, “I am paralyzed by indecision about my career, and the pressure to choose makes me avoid family discussions altogether” (Participant: 6, age: 25, FGD: 3).

Stress

The data shows the stress during moments of crisis is being carried in different forms. They feel stressed out about the current incident, returning to studies, preparing and giving exams again, conflicts in the group, etc.

One male student expressed, "Even as things return to normal, I still feel tense about the chaos and conflicts among my peers. They remain stuck in the protest mindset, and it’s exhausting trying to make them understand″ (Participant: 2, age: 20, FGD: 6).

Similarly, a female student shared, "I get headaches and irritability when I hear about violence, and my body feels stiff" (Participant: 8, age: 21, FGD: 2).

Another female participant conveyed, "I don't know how to return to normal; everything is delayed, and I feel overwhelmed by the uncertainty of starting over" (Participant: 3, age: 24, FGD: 7).

Post-traumatic Stress Symptoms

Participants reported experiencing trauma-related symptoms following the geopolitical crisis. Some had direct exposure to traumatic events, while others were indirectly affected by hearing accounts or viewing distressing media. These experiences led to symptoms such as intrusive memories, nightmares, and heightened startle responses.

One male participant recounted, "Being a private university student, I was not prepared for anything. But then suddenly the situation changed. I saw people being struck, blood, screams, and tear gas. Those memories replay when I hear loud noises, and I feel like hiding" (Participant: 1, age: 21, FGD: 5).

Another male participant described how consuming news and videos created vivid, painful imagery: "In a private university, we always see less protest. But this time it was different. I saw it becoming a battlefield. Also the videos from my classmate about the violence were on

social media. The screams and graphic details still haunt me. I still have nightmares about them" (Participant: 6, age: 25, FGD: 3).

A female participant noted feelings of detachment and physical reactions: "I feel ashamed for not participating; remembering the events makes me sweat and shake" (Participant: 9, age: 19, FGD: 1).

Theme 2: Minor Physiological and Psychological Symptoms

The study identified that while some students did not exhibit severe psychological symptoms following the protest and post-protest crisis, they experienced mild symptoms that disrupted their daily lives. This included difficulty concentrating, minor anxiety, and irritability, which negatively impacted their productivity. Over time, the persistence of these symptoms could place them at risk of developing more serious psychological distress if not addressed. These findings emphasize the importance of early interventions to support mental well-being and prevent escalation into major psychological challenges.

Sleep Difficulties

The research highlighted that some participants experienced persistent yet mild psychological symptoms that disrupted their everyday functioning. These symptoms included sleep disturbances or developing insomnia, difficulty concentrating, and irritability, which impaired their productivity and quality of life. While not severe, the prolonged presence of these symptoms could predispose participants to significant psychological distress.

A female participant shared, “I sleep but wake up after having nightmares. I don’t always remember them, but the bad feelings linger” (Participant: 3, age: 22, FGD: 8).

A male participant explained, “At night, I can’t sleep. I just lie in bed thinking about everything, unable to rest” (Participant: 2, age: 20, FGD: 4).

Exam Phobia

In some FGDs, participants mentioned experiencing significant academic challenges post-crisis. The pressure of impending deadlines, exams, and assignments, coupled with the disruptions in their academic routines, has left them overwhelmed and apprehensive about their educational progress and future.

A female participant stated, “I’m worried about the sudden rush of exams. I can’t focus or recall anything I studied before. It feels like I never prepared” (Participant: 4, age: 21, FGD: 7).

A male participant shared, “I couldn’t adjust to university life before the crisis, and now I’m lost. I haven’t studied and feel unprepared for exams or presentations” (Participant: 1, age: 25, FGD: 3).

Feeling of Hopelessness

The participants expressed feelings of hopelessness regarding the future of their country and personal lives, reflecting a sense of hopelessness about their efforts during the protest.

A male participant reflected, “It’s not like I expected drastic changes, but the violence and conflicts between groups make me question what the protest was for. It feels pointless. Maybe I should have left the country like my friends” (Participant: 1, age: 24, FGD: 1).

A female participant shared, “I thought things would improve, but now I wonder—what does ‘better’ even mean? I feel lost about what I want anymore” (Participant: 4, age: 22, FGD: 3).

Helplessness

The findings revealed that students felt a profound sense of helplessness during the crisis, marked by a belief that they lacked control or the ability to effect meaningful change.

A male participant shared, “I joined the protest, but it felt like an endless journey. I saw my classmates get hurt, some even hospitalized, yet nothing changed. I felt powerless—nothing I did seemed to matter” (Participant: 5, age: 25, FGD: 3).

A female participant reflected, “The situation doesn’t make sense anymore. People only care about their own benefit. What are we supposed to do? I feel helpless” (Participant: 1, age: 20, FGD: 5).

Grief

The findings revealed that some participants experienced grief stemming from the loss of mobility, physical abilities, or loved ones due to the crisis. This grief manifested as a profound emotional struggle, reflecting the long-term impacts of traumatic events.

A male participant reflected, “I wasn’t close to my classmate, but whenever I see the seat left empty in his memory, I can’t process it. He should have been here, studying with us, worrying about his career. He was so close, like a friend, and now he’s gone. We’ll continue, but his life ended in chaos” (Participant: 6, age: 22, FGD: 2).

Another female shared, “My younger brother, who is in college, joined the protest. When the police responded with violence in the protest, I went there to find him. On my way, a police officer told me to go home. When I explained that I was looking for my brother, he struck my leg with his baton. As a result, I sustained an injury to my leg and still experience difficulty walking.

Theme 3: Coping Strategies

The study explored various coping strategies used by youth and young adults in response to mental health challenges following the recent geopolitical crisis. The participants shared several approaches to managing stress and psychological distress. These strategies, which were critical for maintaining emotional balance, included engaging in physical activities, seeking social support from friends and family, and limiting exposure to distressing news. Many students also reported the use of isolation or withdrawal from social media to reduce stress, while others focused on engaging in creative or recreational activities to distract themselves from negative emotions.

Sub-theme - Adaptive Coping

From the focus group discussions (FGDs), several adaptive coping strategies emerged, which were categorized into distinct themes. These strategies varied among participants, reflecting their individual responses to the geopolitical crisis. The themes included seeking social support, engaging in physical activities, limiting exposure to distressing media, and practicing avoidance through isolation. Other strategies involved focusing on academic or personal goals as a means of distraction and cultivating a sense of resilience through self-reflection or creative outlets. These coping mechanisms helped participants manage stress and maintain emotional stability during challenging times.

Peer Support

The research indicated that spending time with family and peers during distressing times helps students cope and manage their emotions. Several participants highlighted the importance of sharing their feelings with loved ones.

One female participant noted, "I talk to my mother and sister, or friends; when feeling overwhelmed, I listen to music or watch films" (Participant: 1, age: 23, FGD: 6).

A male in an FGD shared, "I read books, talk to friends, or play when distressed, and sometimes my favorite work helps distract me positively" (Participant: 2, age: 22, FGD: 1).

Another male student emphasized, "I try not to stay alone; being with my family calms me down" (Participant: 3, age: 23, FGD: 10).

Self-Care

The findings show that engaging in self-care activities, such as creative outlets, playing games, writing, and some relaxation techniques, helped participants manage stress and distract themselves from their problems.

One female student explained, “Self-care is something I used to do that makes me feel good about myself or is interesting” (Participant: 1, age: 24, FGD: 2).

Another female student shared, “I am drawing pictures and also trying to draw mandalas so that I can distract myself from stress” (Participant: 1, age: 20, FGD: 4).

Some also found comfort in prayer, with one male participant stating, “I can pray and that gives me peace” (Participant: 1, age: 24, FGD: 9).

Sub-theme - Maladaptive Coping

During the focus group discussion, participants shared numerous maladaptive copings they have experienced. After analyzing their responses, we organized them into several themes.

Over-Reliance on Social Media

Many students reported over-reliance on social media and news channels during the protests, which they identified as a maladaptive coping mechanism. This reliance triggered anxiety,

leading some to binge-watch movies or series to alleviate stress. These behaviors disrupted their daily activities, including sleep schedules.

One male student shared, "I do sleep and when I get up seeing a bad dream, I start using social media to make myself easy, and during the daytime, my mood becomes very irritated" (Participant: 1, age: 21, FGD: 2).

Another female student stated, “Whenever I feel overwhelmed, I binge-watch shows all night to avoid thinking about my problems, even though I know it makes me tired the next day” (Participant: 5, age: 22, FGD: 1).

Denial and Avoidance

Many participants mentioned using avoidance as a coping strategy to deny their feelings of overwhelmness that developed from the national situation.

One male student shared, "To avoid the situation's anxiety, I keep myself engaged in gaming. Day and night I play games using a device. Once I do not feel hungry, lose interest in taking a shower, become disorganized in my daily routine, changed my sleep cycle, and consequently feel irritated all the time" (Participant: 6, age: 24, FGD: 3).

Similarly, a female student stated, “I want to avoid these problems because when I think about them, they make me feel like a puzzle” (Participant: 2, age: 19 FGD: 3).

Conclusion

This study investigates the psychological impact of the recent geopolitical crisis on youth in Bangladesh and examines their coping strategies. Employing a qualitative approach, the research analyzes verbatim accounts to document the mental health status of young people following the crisis. The findings reveal that the geopolitical upheaval resulted in a spectrum of psychological effects on youth, encompassing severe symptoms like depression, anxiety, stress, and post-traumatic stress. Furthermore, minor symptoms such as disrupted sleep patterns, exam phobia, feelings of hopelessness, helplessness, and grief were observed. Male students at private universities were identified as particularly vulnerable due to their frequent exposure to violent incidents. The study also uncovered various coping mechanisms employed by youth, including seeking support from peers, engaging in creative activities, utilizing social media, and employing denial as a defense mechanism. Research indicates that prolonged exposure to violence and persistent instability significantly increases the likelihood of PTSD and other mental health disorders among young people, with urban male students being especially at risk due to their direct encounters with violence (Khoury-Malhame et al., 2024).

Previous research has indicated that men in conflict-ridden areas such as Kashmir experience greater exposure to traumatic events than women. This includes observing acts of violence and being directly involved in violent situations, leading to a high incidence of trauma among males (Dar & Deb, 2021). Our research also revealed that men who acted on the frontline during this geopolitical crisis witnessed situations where friends were struck by bullets, pellets, or other explosive devices and experienced anxiety during search operations. Furthermore, following the forced evacuation of major public universities, male students from private institutions actively participated in protests, resulting in their frequent exposure to violent incidents. Our study findings imply depressive symptoms like low mood, loss of interest, and sleep problems

in the young participants due to the geopolitical crisis, make it challenging for participants to lead functional lives. The finding is similar to another study that showed COVID-19-like crises also showed the rate of moderate to severe depressive symptoms increased from 6.4% to 8.8% (Peters et al., 2020). The study also revealed that youth experience significant anxiety due to the current instability, compounded by concerns about future events and the uncertainty surrounding their education and life choices. These factors contribute to heightened anxiety levels. This finding aligns with other studies, which show that anxiety levels were notably elevated during times of war, with average scores exceeding the threshold for mild anxiety symptoms (Gottschick et al., 2023). The crisis events brought about significant stress, leaving many youth feeling overwhelmed and exhausted by the ongoing conflicts among peers. The added pressures of academic and career concerns also contributed to stress-related symptoms, such as headaches and fatigue. These findings are consistent with a study that reports over one-third (37.4%) of participants experiencing at least one stress-related symptom during crisis events (Bleich, 2003). The current findings indicate that youth are experiencing post-traumatic stress symptoms as a result of both direct and indirect exposure to violence. Common symptoms include nightmares about the traumatic events, a tendency to avoid discussions about them, re-experiencing the emotions associated with the violence, and heightened sensitivity to anything that triggers memories of the events. These patterns align with a study that found multiple exposures to traumatic events resulted in PTSD-like symptoms in 20.4% of participants (Scholte, 2004).

Participants reported difficulties falling asleep and experiencing restful sleep, which negatively impacted their daily productivity. This finding aligns with a study showing that 23% of individuals in unrest situations reported experiencing sleep difficulties (Hunt et al., 2016). It is not major but affects the functioning of the participants. The geopolitical crisis and the resulting vulnerable conditions have heightened participants' concerns about their studies and future career paths. The pressure of approaching exam deadlines further exacerbates their stress, which aligns with a survey showing that university students experience moderately high levels of exam anxiety (Jirjees et al., 2024). The study highlighted participants' feelings of hopelessness following the crisis. Due to the changes and uncertainty they experienced, many felt despair about both the future of the country and their own personal prospects. This finding is similar to a study showing that, after a disaster, participants exhibited high levels of hopelessness and intolerance of uncertainty (Erkan & Budak, 2024). Some participants showed helpless feelings due to violence and uncertain events. They had a feeling of not being controlled and also felt that there were some parts of the geopolitical crisis that they couldn’t predict. There is a positive relationship between conflict and helplessness (Dijkstra et al., 2005). Participants in this study exhibited a grief response immediately following the crisis. The geopolitical upheaval led to feelings of grief related to the loss of mobility and the loss of loved ones which is similar to a study that found that while the death of friends and community members can lead to grief and distress, prolonged grief outcomes were relatively rare (Harms et al., 2015). This research indicates that strategies aimed at "denial" or distracting oneself may initially be successful in reducing psychological distress during ongoing conflicts where individuals have limited ability to address their stressors. However, the study found that avoidance was ultimately maladaptive, as it only provided short-term relief while disrupting daily life and limiting social well-being. One study revealed that for girls, avoidant coping effectively reduced psychological symptoms of internalizing and externalizing problems but negatively impacted empathy as a measure of handling challenging environments and experiencing improved well-being outcomes measures (Cherewick et al., 2016). This research also noted that sharing distress with friends helped individuals cope with situations and manage their emotions more effectively. Consequently, despite significant political instability, those

who exhibited support-seeking behavior were better equipped to handle challenging environments and experienced improved well-being outcomes. The findings are supported by another study which demonstrated that positive coping strategies involving support-seeking behavior are well-established methods for enhancing psychological well-being and significantly reducing distress (El Khoury-Malhame et al., 2024). The current findings suggest that creative activities such as writing and drawing serve as effective coping mechanisms for young people facing mental health issues. These pursuits enable emotional expression, introspection, and stress alleviation, thereby enhancing mental well-being. This aligns with a previous study involving university students, which found that engaging in self-initiated creative literacy practices like reading, writing, and journaling could assist students in managing their mental health (Peach, 2023). This study reveals that media sources, including television, social networks, and newspapers, have contributed to anxiety and disrupted daily routines, particularly sleep patterns. Participants noted that while they use social media for relaxation, the prevalence of infodemics or potential misinformation often results in irritability or reliance on movies and series to improve their mood. Comparable outcomes have been observed in other research. The finding is supported by another study which finds that persistent exposure to crisis-related news and narratives can induce feelings of anxiety, fear, uncertainty, panic, or psychological distress (Rocha et al., 2021).

Limitations

There may have been social desirability bias among participants, as the data were collected through Focus Group Discussions (FGDs). Participants could have been inclined to provide responses they deemed more socially acceptable. Furthermore, the use of online platforms for data collection led to the loss of non-verbal cues, which might have offered additional context to the participants' responses.

Implications

The study identified key mental health challenges faced by youth and explored the coping strategies they employ to address these concerns. Based on the findings, various initiatives can be implemented to raise mental health awareness. These could include individual or group counseling sessions and peer support groups, all of which would significantly benefit young people. It is also important to disseminate the findings through conferences and collaborate with governments and stakeholders to address vulnerabilities and promote youth mental well-being. By taking proactive steps to help youth build resilience and connect with a strong support system, we can better equip them to practice self-care, be more confident and proactive, and also manage the after-crisis stressors more efficiently.

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Kebede Michael and the Ethiopia-Japan Academic Partnership: A Review

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Abstract
Kebede Michael, a prominent Ethiopian intellectual, is celebrated for pioneering academic cooperation between Ethiopia and Japan in the 20th century. His book "Japan Indemin Seletenech" stand out as reflections of his vision for Ethiopia's development and his admiration for Japan's modernization model. This review focuses on his strategic efforts to foster bilateral relations through educational and cultural diplomacy, emphasizing his vision of learning from Japan's rapid modernization while maintaining Ethiopia's national identity. We conducted historical and contextual analysis, content analysis of Kebede's works, comparative educational diplomacy framework, based on the books, articles, research papers, and archival documents authored by Kebede and other relevant scholars to analyze his role in shaping Ethiopia-Japan academic relations. The findings highlight his advocacy for Ethiopian students to pursue higher education in Japan, particularly in science and technology fields, positioning Japanese education as a model for Ethiopia's modernization efforts. By critically assessing these sources, the review demonstrates how Kebede's intellectual diplomacy—based on education and cultural exchange—laid the foundation for lasting academic cooperation. Furthermore, it evaluates the long-term influence of his contributions, revealing how his ideas continue to impact current partnerships between Ethiopian and Japanese universities, with important implications for research collaborations, student exchanges, and capacity building.

Keywords: Ethiopia-Japan Relations, Academic Diplomacy, Japan Indemin Seletenech, Kebede Michael, Educational Cooperation, Cultural Exchange

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Introduction

Ethiopia and Japan share a unique and historically significant relationship that has been shaped by intellectual diplomacy, educational exchange, and cultural admiration (Mequanent, 2022). Among the key figures who contributed to this bilateral partnership is Kebede Michael, a distinguished Ethiopian intellectual whose contributions in the mid-20th century laid the groundwork for a deeper academic and cultural engagement between the two nations (Wikipedia, n.d.). Kebede's classical work, "Japan Indemin Seletenech" (How Japan Modernized), stands as a landmark text, reflecting his impression for Japan's industrialization and socio-economic modernization during the Meiji era (Michael Kebede, 1956). Through this book, Kebede advocated for Ethiopia to draw lessons from Japan's experience, emphasizing the need to modernize without compromising national identity and cultural heritage.

Figure 1: Cover Page of the Book "Japan Indemin Seletenech" in Amharic

Despite the pivotal role Kebede Michael played in bridging Ethiopia and Japan academically and culturally, there remains a notable lack of comprehensive research on his contributions and the broader implications of his work. While Ethiopian scholars have occasionally highlighted Kebede's intellectual legacy, much of the existing literature focuses narrowly on his contributions to Ethiopian nationalism (Tamrat & Belay, 1998) and literary achievements (Abebe, 2023), without exploring the depth of his international influence. Similarly, in Japanese academic circles, the emphasis on Ethiopia-Japan relations often centers on contemporary economic and diplomatic partnerships, with little attention paid to historical figures like Kebede who were instrumental in shaping these ties.

This under-researched area creates significant gaps in our understanding of the historical roots of Ethiopia-Japan academic cooperation (Mequanent, 2022). For instance, there is limited analysis of Kebede's role in advocating for Ethiopian students to study in Japan or his broader vision of using Japanese educational models as a framework for Ethiopian development. Furthermore, while Kebede's writings offer a rich source of insights into the cultural and educational diplomacy between the two nations, they remain underexamined in comparative educational studies and international relations literature. This lack of critical engagement hinders a full appreciation of how Kebede's intellectual efforts influenced and

continue to impact the dynamics of Ethiopia-Japan relations. By focusing on Kebede Michael's contributions, this paper seeks to contextualize his efforts within the broader framework of educational diplomacy and examine their enduring relevance in shaping academic collaborations between the two countries, contributing to a deeper understanding of the historical foundations and potential of Ethiopia-Japan academic partnerships.

Methodology

The study employs a literature-based review, integrating:

- Historical and Contextual Analysis: Situating Kebede's contributions within the mid-20th-century Ethiopian and Japanese socio-political contexts.
- Content Analysis: Examining Kebede's books and articles for recurring themes and strategies in promoting academic diplomacy.
- Comparative Educational Diplomacy Framework: Analyzing Ethiopia-Japan cooperation through scholarly works on international educational exchanges.

Primary sources include Kebede's "Japan Indemin Seletenech" and government records from the Ethiopian Ministry of Education and Japan's Ministry of Foreign Affairs. Secondary sources include research articles and books by scholars and researchers. The study is constrained by the availability of primary sources, particularly archival records from the mid-20th century. Additionally, the limited scholarship on Kebede Michael's contributions to international relations necessitates reliance on broader contextual analyses to fill gaps in the literature. Table 1 shows the conceptual framework for this paper, which is grounded in the theory of educational and cultural diplomacy as a tool for international cooperation and national development.

Table 1: Conceptual Framework

Dimension	Key Focus	Illustration in the Study
Intellectual Diplomacy	Role of thought leaders in shaping partnerships	Kebede Michael as a pioneer of Ethiopia-Japan relations
Education as a Modernization Tool	Exchange of knowledge for technological progress	Ethiopian students in Japan; STEM promotion
Cultural Exchange and Identity	Mutual respect and preservation of heritage	Kebede's dual focus on modernization and tradition

Key Themes in "Japan Indemin Seletenech"

Upon its publication, "Japan Indemin Seletenech" garnered significant attention among Ethiopian intellectuals and policymakers. It was celebrated for its forward-thinking analysis and for providing a practical roadmap for Ethiopia's development. The book became a cornerstone of Ethiopia's intellectual discourse on modernization, influencing prominent figures in politics and academia. The work reflects Kebede's admiration for Japan's remarkable transformation during the Meiji Restoration (1868–1912). Kebede perceived Japan's ability to modernize rapidly while maintaining its cultural heritage as a model that Ethiopia could emulate. His work not only celebrated Japan's achievements but also critiqued the socio-economic and political stagnation in Ethiopia, urging his compatriots to learn from Japan's experience.

The Meiji Restoration as a Blueprint for Modernization

Kebede extensively analyzed the reforms undertaken during the Meiji Restoration, which he considered a pivotal period in Japan's history (Wittner, 2022). These reforms, which included the establishment of a centralized government, industrialization, and an emphasis on education, were instrumental in transforming Japan into a global power. Kebede highlighted how Japan successfully assimilated Western technology and practices without undermining its traditions. This balance, he argued, was critical for any non-Western nation seeking to modernize without losing its cultural identity.

For instance, Kebede praised Japan's adoption of Western scientific knowledge while preserving its language, arts, and customs. He contrasted this with Ethiopia's limited engagement with modern education and technology at the time, calling for similar systemic reforms in Ethiopian governance and education to foster progress.

Education as the Foundation of Development

A recurring theme in Kebede's work is the role of education in national development. He admired Japan's focus on universal education during the Meiji era, particularly its emphasis on science and technology. Japan's establishment of specialized institutions like Tokyo Imperial University (now the University of Tokyo) to cultivate a generation of engineers, scientists, and administrators resonated with Kebede's vision for Ethiopia.

Kebede advocated for a similar approach in Ethiopia, urging the government to prioritize education, especially in technical fields.

In his vision for education, he adopted the Japanese approach, emphasizing a practical perspective for all educational efforts in the country. He aspired to emulate Japan's strategy of sending students abroad to learn and replicate advanced technologies, then returning home to adapt those innovations to align with the nation's resources, capabilities, and needs (Tamrat & Belay, 1998). He believed that sending Ethiopian students to study in Japan, particularly in STEM disciplines, would equip them with the skills necessary to drive Ethiopia's modernization. This vision anticipated later scholarship initiatives and educational exchanges, such as those supported by the Japan International Cooperation Agency (JICA), which reflect Kebede's early insights. Kebede's work contributed to shaping the Ethiopian government's early efforts to establish educational and cultural ties with Japan. His advocacy laid the groundwork for policies promoting academic exchanges and inspired generations of Ethiopian students to pursue higher education in Japan. For example, Kebede's vision was later realized through initiatives such as the African Business Education (ABE) Initiative for Youth, which continues to foster academic and professional exchanges between Ethiopia and Japan (JICA, 2025).

The Importance of Cultural Identity

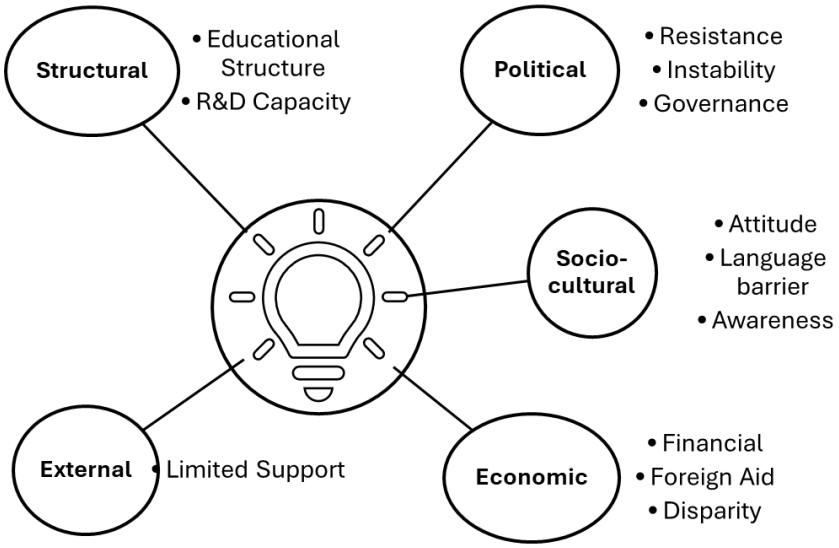
One of the most profound aspects of Kebede's vision is his emphasis on preserving Ethiopia's cultural identity while pursuing modernization. He lauded Japan's ability to maintain its traditional values, such as respect for hierarchy, discipline, and a strong sense of community, even as it adopted Western industrial practices. Kebede warned against the wholesale adoption of foreign customs, arguing that modernization should not come at the expense of Ethiopia's rich cultural heritage and historical legacy.

In *"Japan Indemin Seletenech",* Kebede frequently drew parallels between Ethiopia and Japan as two ancient civilizations with proud histories (Levine, 2002). He saw Japan's success as proof that a nation could modernize without losing its soul, a message that resonated deeply in Ethiopia during a time of growing nationalism.

Challenges to Implementing Kebede's Vision

Kebede'S emphasis on education, technological advancement, and cultural preservation resonated deeply with Ethiopian intellectuals and policymakers. However, translating this vision into practical reforms and policies encountered numerous challenges, which can be categorized into structural, political, socio-cultural, and economic factors. Many of the challenges Kebede faced in implementing his vision remain relevant today. Although Ethiopia has made significant strides in expanding access to education and fostering international academic partnerships, issues such as resource constraints, uneven development, and cultural resistance continue to hinder progress.

Figure 2: Challenges to Implementing Kabede's Vision (by the authors)



Structural Challenges

Educational Infrastructure. At the time Kebede was writing, Ethiopia's education system was underdeveloped and lacked the infrastructure to support the level of modernization he envisioned. The country had a low literacy rate, a limited number of higher education institutions, and insufficient access to technical and vocational training programs (Felleke, 2005). Unlike Japan, which had established a robust educational foundation during the Meiji Restoration, Ethiopia faced a monumental task in creating an education system capable of producing a skilled workforce. For example, Ethiopia's first modern university, Addis Ababa University, was established only in 1950, decades after Japan had already institutionalized higher education (Teeroovengadum, 2020). The absence of a network of technical schools and research institutions further impeded efforts to align education with the demands of modernization.

Research and Development (R&D) Capacity. Japan's Meiji-era investments in scientific institutions and technical expertise, which enabled the country to rapidly adopt and adapt Western technologies. Modernization, as envisioned by Kebede, required a strong emphasis

on science, technology, and innovation. The situation has been improved in the recent decades. Citable journals, patents, and technology exports have a significant and positive effect on GDP growth of Ethiopia, while research expenditure does not show any sound statistical evidence effect on economic growth (Agezew, 2024). In the recent decade, increasing R&D activities has proven to be associated with innovation and productivity for Ethiopian firms (Keraga & Araya, 2023). However, Ethiopia still had limited R&D capacity, with few resources allocated to scientific research. Ethiopia hosts a relatively low number of researchers (45 per million people) in comparison to the African average. Recently, the R&D expenditure has quadrupled between the years 2007 and 2013, indicating a commitment to improving the national research environment on the part of the government, however Gross domestic Expenditure in Research and Development (GERD) of 0.6% in 2013 is still considerably lower than the 1% target set by African Union (AU) (Research Consulting, 2019).

Political Challenges

Resistance from Conservative Elites. Kebede's vision for modernization faced significant opposition from conservative factions within Ethiopian society. Many traditional elites viewed modernization efforts as a threat to Ethiopia's cultural and religious heritage. These groups were wary of the influence of foreign education systems and technologies, fearing that they might erode Ethiopia's unique identity and destabilize the established social order (Girma, 2007; Messay Kebede, 2023).

Political Instability. Political instability also posed a significant challenge. Ethiopia underwent a series of political upheavals during the 20th century, including the overthrow of Emperor Haile Selassie in 1974 and the subsequent socialist rule of the Derg regime. These shifts in political leadership often disrupted educational policies and long-term planning, undermining efforts to implement Kebede's vision. For instance, during the Derg era, the focus shifted toward ideological education, sidelining the practical and technical aspects of education that Kebede had championed (Messay Kebede, 2023).

Fragmented Governance and Bureaucracy. Japan had a centralized and coordinated governance structure during the Meiji Restoration (Wittner, 2022), a favorable condition for educational reform (Liu, 2019). Implementing large-scale educational and infrastructural reforms required strong governance and efficient bureaucracy, both of which were lacking in Ethiopia at the time. Unlike Japan during the Meiji Restoration, Ethiopia struggled with fragmented governance and limited administrative capacity. This hindered the execution of Kebede's proposals, particularly in the areas of curriculum development and international academic collaboration at the time. Until recent years, Ethiopia has been undergoing further educational reforms aimed at addressing the various challenges that persist in the education system and achieved some progress. Improving the quality, relevance, and efficiency of education, in particular, has been the prime focus of recent reforms (Tena & Motuma, 2024). Higher education in Ethiopia also has been going through significant reforms in recent years. The government of Ethiopia has been implementing various strategies to improve the quality, accessibility, and relevance of higher education. A good example in this regard is the Higher education policy and strategy introduced in 2020 (MOSHE, 2020).

Socio-Cultural Challenges

Cultural Attitudes Toward Modernization. Kebede's vision emphasized the need to preserve Ethiopia's cultural identity while adopting modern practices. However, achieving this balance proved challenging. Modernization was often perceived as synonymous with Westernization, leading to resistance from communities fearing the loss of cultural traditions. In rural areas, where traditional values were deeply entrenched, Kebede's arguments faced significant opposition. The association of modernity with Europeanization created ambivalence towards modernization efforts, as many Ethiopians equated adopting modern practices with abandoning their cultural identity (Giorgis, 2010). The Ethiopian Japanizers, a group of intellectuals including Kebede, sought to emulate Japan's model of modernization. Despite their efforts, the movement faced challenges due to Ethiopia's unique socio-political context and the deep-rooted traditionalism in rural communities. The failure to effectively integrate modern practices without disrupting cultural heritage led to limited acceptance of their proposals (Clarke, 2011).

Language Barriers. Education in Japan required proficiency in Japanese, a significant barrier for Ethiopian students. Unlike English, which was already being used in Ethiopia's emerging education system, Japanese was not widely taught or understood (Lee, 2017). In contrast, Ethiopia's education system has increasingly incorporated English as a medium of instruction, particularly in higher education. This shift has been associated with both opportunities and challenges. While English proficiency can enhance access to global knowledge, students' and teachers' lack of competence in the language of instruction has been linked to deteriorating quality of learning and teaching (Simie & McKinley, 2024). The disparity between the languages of instruction in Ethiopia and Japan poses a significant barrier for Ethiopian students. This linguistic challenge limited the number of Ethiopian students who could benefit from Japan's educational opportunities.

Limited Awareness of Japan's Modernization Model. While Kebede's work sought to popularize Japan's success story, awareness of Japan's modernization model remained limited among Ethiopia's broader population and policymakers. Many Ethiopians were more familiar with Western examples of development, particularly from Europe and the United States, which dominated the global discourse on modernization during the mid-20th century. The prevailing perception associated modernization with Westernization, leading to ambivalence towards adopting non-Western models like Japan's (Tamrat & Belay, 1998).

Economic Challenges

Financial Constraints. Ethiopia's financial limitations were perhaps the most significant obstacle to implementing Kebede's vision. Establishing modern educational institutions, investing in R&D, and sending students abroad required substantial financial resources, which were scarce in Ethiopia. Ethiopia's education sector faced challenges due to limited financial resources, affecting the country's ability to achieve its educational development goals (World Bank, 2005). In contrast, Japan's modernization during the Meiji era was supported by economic reforms and industrial growth, which provided the necessary funding for education and infrastructure development (JICA, 2019).

Dependence on Foreign Aid. Ethiopia's reliance on foreign aid for education and development projects often led to donor-driven priorities that did not align with Kebede's vision. For example, while some aid programs focused on basic education, Kebede

emphasized the need for higher education and technical training to drive modernization. This misalignment of priorities further constrained the implementation of his ideas. A study examining the influence of foreign donors on Ethiopia's higher education system highlights that while aid has supported the expansion of higher education, it has also introduced external priorities that may not always align with national development goals (Molla, 2019). This can result in tensions between donor agendas and local needs, particularly in the emphasis on quality and relevance of higher education to Ethiopia's socio-economic context (Hertaas, 2011).

Uneven Development Between Urban and Rural Areas. Kebede's vision required nationwide access to education and modernization efforts, but Ethiopia faced significant disparities between urban and rural areas. Rural regions, where the majority of the population resided, had limited access to schools, healthcare, and basic infrastructure (Arefaynie et al., 2024; Belay, 2020; World Bank, 2020). This uneven development made it difficult to implement Kebede's vision on a national scale.

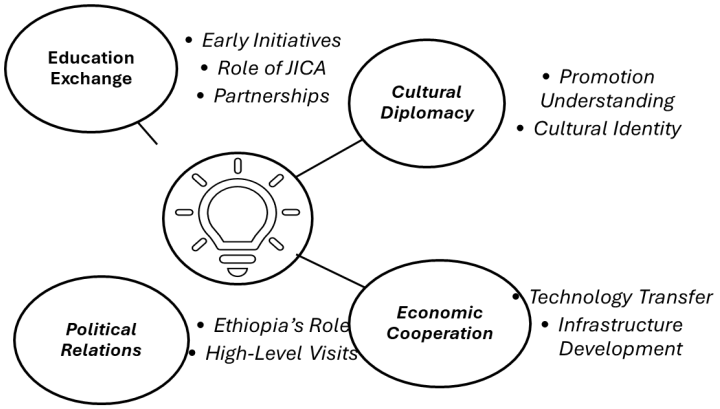
External Challenges

Limited International Support for Ethiopia-Japan Relations. While Kebede advocated for closer ties with Japan, the broader geopolitical context of the mid-20th century limited the scope of Ethiopia-Japan cooperation. Japan's focus during this period was on rebuilding its own economy and forging alliances with Western powers, which often left less room for fostering academic partnerships with African nations (Wikipedia, 2021). Additionally, Ethiopia's diplomatic efforts were more focused on relations with Western nations, further sidelining potential collaborations with Japan (Mehretu, 2014). Japan's engagement with Africa in the early 1960s was often mediated through collaboration with Western countries, such as the United Kingdom, rather than through direct bilateral relations with African nations (Ampiah, 2011).

Impact on Ethio-Japan Academic Relations

Kebede Michael's contributions had an enduring impact on the relationship between Ethiopia and Japan, particularly in the realm of academic and cultural cooperation. His writings and advocacy efforts inspired a generation of Ethiopian intellectuals and policymakers to view Japan as a model for development, modernization, and cultural resilience. This section examines the various ways Kebede's vision influenced Ethiopia-Japan relations, focusing on educational exchanges, cultural diplomacy, and long-term bilateral cooperation.

Figure 3: Impacts on Ethio-Japan Relations (by the authors)



Educational Exchanges

One of Kebede's most significant contributions was his emphasis on the importance of educational exchanges as a bridge between Ethiopia and Japan. By drawing attention to Japan's success in using education to drive modernization during the Meiji Restoration, Kebede underscored the value of sending Ethiopian students to Japan to gain technical knowledge and skills.

Early Educational Initiatives. Kebede's advocacy played a role in inspiring early educational exchanges between Ethiopia and Japan. Although these initiatives were limited in scale during Kebede's lifetime, they laid the groundwork for more formalized academic partnerships. For instance, Japan began to offer scholarships to Ethiopian students in the late 20th century, particularly through programs like the Monbukagakusho (MEXT) Scholarship (Embassy of Japan in Ethiopia, 2025). These programs provided Ethiopian students with opportunities to study in fields such as engineering, agriculture, and medicine—disciplines that Kebede identified as critical for Ethiopia's modernization (MEXT, 2024).

The Role of JICA in Expanding Exchanges. The Japan International Cooperation Agency (JICA) has been a key player in advancing the educational cooperation envisioned by Kebede. JICA's initiatives have focused on building Ethiopia's technical and vocational education capacity, aligning with Kebede's emphasis on practical education. For instance, the "Technical and Vocational Education and Training Support Project" (TVET) was established to enhance the quality and relevance of vocational training in Ethiopia. This project aimed to strengthen the capacities of trainers involved in vocational and technical training, thereby boosting technological development and productivity in the country (JICA, 2007). Programs such as the African Business Education (ABE) Initiative for Youth have facilitated academic exchanges, allowing Ethiopian students to pursue graduate studies in Japanese universities while participating in internships with Japanese companies. These exchanges not only enhance the technical skills of Ethiopian students but also promote cross-cultural understanding (JICA, 2023).

Educational Partnerships. Today, Ethiopian universities maintain active partnerships with Japanese institutions, reflecting Kebede's vision of sustained academic collaboration. For example, Addis Ababa University has established joint research projects with Japanese universities such as Kyoto University and the University of Tokyo. These collaborations focus on areas like disaster management (Addis Ababa Institute of Technology, 2024), agricultural innovation (JST, 2020), and public health, leveraging Japanese expertise to address Ethiopia's development challenges. As a case study of cooperation, Tokushima University is active in hosting graduate students and scholars from Ethiopia (Tokushima University, 2019), expanding academic agreements with Ethiopian universities such as Gondar University, conducting joint research in Ethiopia (Amare et al., 2012; Kassu et al., 2007, 2008) as well as activating the alumni network in Ethiopia for future initiatives.

Cultural Diplomacy

Kebede's writings emphasized the importance of cultural exchange as a means of fostering mutual respect and understanding between Ethiopia and Japan. He admired Japan's ability to modernize without compromising its cultural heritage and saw this as a model for Ethiopia to emulate. This perspective has influenced Ethiopia-Japan relations by highlighting the role of culture in strengthening bilateral ties.

Promotion of Mutual Understanding. Kebede's work contributed to the promotion of mutual understanding between Ethiopians and Japanese people. His writings introduced Ethiopian readers to Japan's history, culture, and development strategies, fostering an appreciation for Japan's unique approach to modernization (Felleke, 2006). Similarly, Japan's cultural diplomacy efforts in Ethiopia, such as Japanese language programs and cultural festivals (Embassy of Japan in Ethiopia, 2013; MOFA, 2019), have enhanced Ethiopian awareness of Japanese traditions and values.

Preservation of Cultural Identity. Kebede's vision of modernization emphasized the need to preserve Ethiopia's cultural identity, a theme that resonates in Ethiopia-Japan cultural exchanges. Japanese institutions, such as the Japan Foundation, have supported initiatives that celebrate Ethiopia's cultural heritage while promoting cross-cultural dialogue (Japan Foundation, 2024). For example, collaborative art exhibitions and music festivals have showcased the rich traditions of both nations, strengthening their cultural ties (UNESCO, 2024).

Economic and Technological Cooperation

While Kebede's primary focus was on education and culture, his vision has also influenced economic and technological cooperation between Ethiopia and Japan. He identified technology transfer as a critical component of modernization, and this idea has been reflected in various bilateral projects.

Technology Transfer Through Education. Educational exchanges between Ethiopia and Japan have facilitated the transfer of technology and expertise. Ethiopian students trained in Japanese universities often return to their home country with advanced knowledge in fields such as renewable energy (Northwestern University, 2021), infrastructure development, and information technology. Knowledge Co-Creation programs cover a wide range of professional fields, including education, health, infrastructure, energy, trade, and finance (JICA, 2024). These contributions align with Kebede's belief in the transformative power of education.

Infrastructure Development. Japan's commitment to Ethiopia's development is evident in its support for major infrastructure projects, such as the construction of roads, bridges, and industrial facilities (Fanabc, 2020; Reuters, 2024). While these initiatives are not directly linked to Kebede's vision, they reflect the broader influence of Ethio-Japan relations shaped by the intellectual groundwork he laid.

Political and Diplomatic Relations

Kebede's vision also contributed to strengthening political and diplomatic ties between Ethiopia and Japan. His work encouraged Ethiopian policymakers to view Japan as a strategic partner in development, fostering a bilateral relationship that extends beyond education and culture.

Ethiopia's Role in Japan's Africa Policy. Ethiopia has played a prominent role in Japan's Africa policy, particularly through platforms like the Tokyo International Conference on African Development (TICAD) (JapanGov, 2016). Kebede's emphasis on Ethiopia-Japan cooperation laid the intellectual foundation for Ethiopia's active participation in TICAD, which promotes sustainable development across the African continent.

High-Level Visits and Diplomacy. Ethiopia and Japan established diplomatic relations in 1930, further solidified with the establishment of embassies in both countries' capitals by 1958 (Capital, 2023). The enduring legacy of Kebede's vision is evident in the high-level visits and diplomatic engagements between Ethiopia and Japan. The then Crown Prince and Princess of Japan visited Ethiopia, marking a significant milestone in diplomatic relations. Ethiopian Prime Ministers have frequently visited Japan to strengthen bilateral ties. For instance, during a visit, discussions emphasized Japan's support in sectors such as agriculture, rural development, infrastructure, and education in Ethiopia (MOFA, 2014).

Conclusion

Kebede Michael's work "“Japan Indemin Seletenech”" serves as a testament to the power of intellectual diplomacy in shaping international academic relations. His advocacy for Ethio-Japanese cooperation in education and cultural exchange has left a lasting legacy, influencing current initiatives in research, student exchange, and capacity building. By critically examining his contributions, this review underscores the importance of leveraging education as a bridge between nations and offers insights for strengthening future partnerships. While Kebede's vision has had a significant impact, its full realization has faced challenges, including resource constraints, limited institutional capacity, and geopolitical factors. However, opportunities for furthering Ethiopia-Japan relations remain abundant.

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Factors Influencing Geography Students' Motivation and Their Significance for the Work in a Community-Based Research Service-Learning Course

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Abstract
In this paper, we aim to address the major motivational factors of geography students in general and explore the extent to which these factors were important in working in a community-based research service-learning course. We designed a qualitative interview study as accompanying research to a study project in the bachelor's degree programme at the Ruhr University Bochum. Participation after the end of the course was voluntary; 13 course participants agreed to take part. One area of the interview guideline focussed specifically on motivational aspects. We examined the following research questions: RQ 1 What form does motivation take among participants? What are key factors that drive them in general? RQ 2 What role does motivation play in the work of the study project? The interviews were fully transcribed, and the qualitative data was pseudonymised and analysed by qualitative content analysis using the inductive category formation method. In response to the question regarding different forms of motivation, the following main categories could be identified: "relationship-related motivation", "performance-related motivation", "innovation-related motivation" and "personality-related motivation". The highest code frequency is in the main category of "performance-related motivation" which shows the particular importance of things like setting a goal or achieving your own success through your own effort for the students. Followed by "relationship-related motivation", the second most important. For the work in the study project, the motivation factors with a performance reference are precisely those that are relevant. Relationship-related motivational factors, however, played no role in working in the study project course.

Keywords: Motivation, Student, Student Motivation, Community-Based Research, Service-Learning, Qualitative Interviews, Qualitative Content Analysis

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Introduction

Research on motivation has a long tradition in psychology and education. What exactly is meant by motivation, which factors have a motivational effect and what exactly does this look like? What individual differences exist? These are questions of particular importance to both instructors at universities and colleges and school teachers. For the purpose of this study, we would like to refer to the definition of Ryan and Deci (2000, p. 54), "To be motivated means to be moved to do something. A person who feels no impetus or inspiration to act is thus characterized as unmotivated, whereas someone who is energized or activated toward an end is considered motivated." Classically, a distinction is made between different contrasting types of motivation: intrinsic and extrinsic motivation. Whereby intrinsic motivation is seen in the context of one's own interest, curiosity, enjoyment of a thing or activity, without external incentives or drivers. And extrinsic motivation is seen in the context of external drivers, with a goal to be pursued, a specific outcome, a reward (Eccles & Wigfield, 2002; Ryan & Deci, 2000). This dichotomous juxtaposition of intrinsic and extrinsic motivation is criticised by others. Reiss and Havercamp (1998) and Jackson (1984) (both as cited in Reiss, 2012) pointed out that human motives are not dualistic but have a multifaceted nature. Morris and colleagues (2022) emphasised that on a psychological level, this kind of separation can be suitable, but on the biological, neuronal level, current findings indicate an overlap. In our study, we did not want to follow a simplified juxtaposition of intrinsic-extrinsic either, nor did we want to make a restrictive preliminary decision on motivational factors previously identified from the literature. Instead, we wanted to maintain the greatest possible openness.

Our main goal was to develop a better understanding of student motivation. We pursued two approaches. On the one hand, we wanted to use the research study to look at the phenomenon of student motivation in general and to identify fundamental motivational factors of students. On the other hand, we sought to gain a more specific understanding of which of these factors were particularly important for students participating in our community-based research service-learning project, which focussed on social inequality, poverty, and homelessness in the Ruhr area.

The sub-study on student motivation presented in this paper, which was part of a larger study on the accompanying research of the community-based research service-learning course, was thus divided into two main areas of investigation. We examined the following research questions:

- What form does motivation take among students? What are key motivational factors that drive them in general? (RQ 1)
- What role does motivation play for the students, specifically in the work of a community-based research service-learning course? (RQ 2)

Before introducing the research design and the methods, we would like to briefly address why student motivation was a central aspect of our accompanying research on the community-based research service-learning course. The course was designed as a project-oriented teaching format, planned to last two semesters, took place partly during the COVID-19 pandemic and was developed from scratch as part of a received teaching grant from the Ruhr University Bochum. It combined two teaching formats, the service-learning approach (see for example Furco, 1996) with the community-based research approach, or research-based teaching and learning (see for example Huber & Reinmann, 2019). The 16 students worked together in several project groups. Further information on the teaching concept can

be found in the following publications: Bittner and Kempchen (2024a) and Bittner (2025). Bittner and Kempchen (2024b) provide information on the composition of the course participants.

Working in the community-based research service-learning course included a larger proportion of guided or temporarily completely independent project work, which presented the students who were at the end of their bachelor degree programme, with a number of challenges. For the students, working on a project with a larger portions of independent work was new, as well as working together with other students in project groups over the long period of one year and working with non-university project partners, social organisations. Additionally, they faced the challenge of interacting and exchanging ideas with vulnerable individuals, including homeless and formerly homeless people. Also the need to reorganise the study project in accordance with the university's requirements after the outbreak of the COVID-19 pandemic posed specific challenges, for the students and also for the lecturer. Furthermore, technical difficulties, including restrictions and temporary system failures caused by a cyberattack on the university, further complicated the situation. Regardless of these particular incidents, it can generally be said that successful work in a study project over such a long period of time requires a high degree of motivation, volition and stamina. That was ultimately the main reason for dealing with the question of student motivation in our community-based research service-learning course.

Methods

Research Design and Setting

The research study employed a basic qualitative research design to investigate students' motivational factors. The sample for the study consisted of 13 geography students in the bachelor degree programme at the geographical institute of the Ruhr University Bochum, all participants of the community-based research service-learning course "social inequality, poverty and homelessness". The one-year course took place during the winter semester 2019/2020 and the summer semester 2020.

Participants

Of the students participating in the interview study, five were male (38.5 %) and eight were female (61.5 %). The intensive collaboration with the students over the course of a year revealed the high level of diversity within the group. For example, in terms of study interests, origin and social situation, current life situation. Insights were qualitatively recorded in conversations but not documented. The students were between 21 and 27 years old, with 11 of the 13 study participants beeing between 21 and 22 years old. 11 students were from Germany, two were born abroad. Of the study participants from Germany, all were born in North Rhine-Westphalia.

Data Collection

The data were collected using qualitative interviews. An interview guide was developed in advance, which addressed various topics as part of a more extensive accompanying educational research project. In developing the interview guide for the comprehensive accompanying research study of the community-based research service-learning course, we followed the approach described by Helfferich (2009) and Kruse (2007, 2015). We find the

SPSS method described here to be extremely suitable for developing high-quality interview guidelines that enable structured interviewing while at the same time maintaining the necessary openness of the researcher to the research subject and interviewees, as well as enabling the collection of extensive qualitative data. Of the 12 narrative-generating key questions of the interview guide one of the key questions addressed the topic of motivation. As described, associated maintenance questions and follow-up questions were formulated based on these key questions. For the two research questions which are on the focus of this paper, the following guiding question and one of the associated follow-up questions are relevant:

- Think about what the key factors are that spur you on and motivate you. This doesn't have to be related to the work in the study project, but rather in general, in your university studies, in your private life, in sports. It's easiest to think of a specific situation where you were absolutely sure: I'll give it my all, I'll see this through, I really want this. So, what are key factors that motivate you? What would you say?
- What role has motivation played in the study project so far? Can you give us an example to illustrate that?

The interviews were conducted online using the Zoom conference system during the COVID-19 pandemic, in accordance with the university's regulations for avoiding contact. The interviews were not conducted by the lecturer of the course, who was also the principal investigator responsible for the accompanying research, but by a student research assistant, a master student in geography with a focus on urban and regional development, in order to avoid excessive power imbalances. The interviews were audio-recorded, and a postscript was written. The total length of the interviews (including all 12 guiding questions) was between 32 and 60 minutes. The transcription followed the rules of content-semantic transcription (Dresing & Pehl, 2017). The interviews were pseudonymised.

Data Analysis

Qualitative content analysis following the specific approach of Mayring (2010a, 2010b, 2022a; Mayring & Frenzl, 2019) was undertaken to analyse the interview transcripts. The qualitative data analysis was performed software-assisted. MAXQDA Analyics Pro software, version Release 22.8.0 (Kuckartz, 2010; Rädiker & Kuckartz, 2019) was used because the principal investigator and data analyst of the research study had extensive experience in using this software since 2006. The new AI assistant, which has been offered for some time by VERBI, was not activated and not used. The coding of the text material was done manually. We personally consider the application of the AI tool to be unsuitable for conducting a qualitative content analysis, as well as for other qualitative data analysis methods that go beyond a rough thematic assignment and we see our suspicions confirmed at the moment by initial study results, which point to errors and limitations (Mayring, 2025). Of the various process models described by Mayring (2010a, 2010b, 2022a) the procedure of inductive category formation was used in order to approach the qualitative data with as much openness as possible. The clear meaning component was defined as the coding unit, the minimum size of a text element assigned to a category. As context unit at the beginning the whole text of the respective interview transcript. According to the clearly structured form of the interview guide according to subject areas, this could be corrected after reviewing several interviews to the entire text of the answer to the leading question six. In addition, the level of abstraction was defined for both research questions, which served as "search matrix" when going through the interview transcripts line by line. In this way, categories were gradually formed from the text material. Finally, the categories formed were summarised at a higher level. In doing so,

deductive steps were also used in some cases. It turned out that concepts from a model that is actually used to classify values (Charter of Values, cf. Rebmann & Fauth, n.d.) could also be helpful, in a modified form, for describing different forms of motivational factors. So, in some cases, the categories formed were based on the concepts used in this model, which were supplemented by further superordinate categories. Inter- and intracoder reliability is regarded as quality criteria for the approach of qualitative content analysis (Mayring, 2010a, 2010b, 2022a). In the case of our research study, a second review of the interview material was carried out by the first coder to verify the results. In doing so, a final addition was made at the main category level. The main category "relationship-related motivation" was added to the category system and text passages were (re)assigned.

Results

This section comprises of two parts. First, the results of RQ 1 will be provided. Second the results of RQ 2. The presentation of the results follows the approach commonly used in other studies based on a qualitative content analysis, specifically the approach outlined by Mayring (2010a, 2010b, 2022a). The frequencies of categories are given, whereby we limit ourselves to presenting the results for the main categories. In each case, in one table the documents, the interview transcripts serve as a reference, in another table, the coded segments serve as a reference. In addition, we will then present the results of the content analysis in more detail, illustrating them at the level of the subcategories (subordinate level) with sample interview quotations. For ease of reading and comprehension by the readers of this paper, the interview quotations given in the tables are mostly longer than the actual passage assigned to the subcategory in the interview transcripts.

Motivational Factors in General

We will start with the results of RQ 1, this includes the question of the motivational factors that play a role for students in general. The results of the category formation process described in the methods section are shown in Table 1. Five main categories could be formed, these can be seen as a classification system of the motivational factors mentioned in the qualitative interviews by the study participants. For these main categories, the category frequencies are given and sorted in descending order of occurrence: a) performance-related motivation (85 %, 11 out of 13 interviewees), b) relationship-related motivation (23 %, 3 out of 13 interviewees), c) innovation-related motivation (15 %, 2 out of 13 interviewees), d) personality-related innovation (15 %, 2 out of 13 interviewees) and e) other mentions, not assigned (8 %, 1 out of 13 interviewees).

Table 1: Frequencies of Main Categories (Documents With Codes) – Motivational Factors of Students in General

	Documents	Percentage	Percentage (valid)
Relationship-Related Motivation	3	23.1	23.1
Performance-Related Motivation	11	84.6	84.6
Innovation-Related Motivation	2	15.4	15.4
Personality-Related Motivation	2	15.4	15.4
Other Mentions, Not Assigned	1	7.7	7.7
DOCUMENTS with code(s)	13	100.0	100.0
DOCUMENTS without code(s)	0	0.0	-
ANALYSED DOCUMENTS	13	100.0	-

Table 2 shows an alternative representation of the results. Here, the coded segments form the unit of analysis.

Table 2: Frequencies of Main Categories (Segments With Codes) – Motivational Factors of Students in General

	Segments	Percentage
Relationship-Related Motivation	8	21.1
Performance-Related Motivation	23	60.5
Innovation-Related Motivation	2	5.3
Personality-Related Motivation	2	5.3
Other Mentions, Not Assigned	3	7.9
TOTAL	38	100.0

Relationship-Related Motivation

In terms of the main category "relationship-related motivation", students mentioned family, friends and companions, as well as the desire to be independent of other people. Hans-Jochen Löffler, a male student, told us for example, "Probably the biggest standard answer: my family, of course. But also my girlfriend. I just want to try harder, for myself on the one hand and for her on the other, because then we can definitely have a very happy future together." The point of not wanting to become dependent on other people later in life, the wish to be independent, was a motivational factor for Carmen Spieß, a female student, "(…) Independence, i.e. not being dependent on other people. (…) I wanted to be independent and do something that makes me feel good later on. (…)"

Performance-Related Motivation

The main category "performance-related motivation" is particularly well represented. The following subcategories located at a subordinate level belong to this main category: setting a goal, identifying with a task / work / cause, interim results / interim status, continuous work, own happiness through own effort, own success through own effort and deterrent effects. Interview quotations that exemplify these subcategories are given in Table 3. In the discussion here, we will limit ourselves to the presentation of the particularly frequently occurring subcategory "setting a goal."

The study participants frequently mentioned that setting a goal, having a goal and working towards a goal is a great motivating factor for them, whether it be in their university studies, or previously at school, in sports or in life in general. Our interview partners illustrated this with a variety of examples. Nico Gunf, a male student explained, "Yes, just having a goal in what you do. I think, as I said, that in terms of motivation and psychology, setting yourself a goal when you do things is very important anyway. If you have a goal, you are automatically more motivated and willing to do the whole thing, to tackle it and work to the maximum to achieve that goal, provided you really want to achieve it. Of course, it makes sense to set a goal that you really want to pursue with all your heart. If not, then somehow the goal has missed its meaning. That's for sure, and you can apply that to almost every situation in life. (…)" He turns out that achieving the goal if this a prerequisite for the next step in life is particularly motivating. "(…) or a bachelor's thesis, for example. I know I have to hand it in by such and such a time, and that's important in the final paper. Or let's say I would like to do a master's degree now, then I would have to go into the job afterwards, and then my final grade is certainly important somewhere, and since it doesn't count that much now either, but

it's still what you can see, which is also relevant for exams afterwards, then of course I have a goal to get a good grade, to do a good job somehow, to be able to take the next step afterwards. (… incomprehensible, computer sound) The overarching goal of getting a good job later on, where I'm happy, and to do that, of course, I have to deliver, so that I can really get to where I really want to be." Ludmila Mude, a female student, reported on her experiences with motivation in her university studies, "And the goal itself, so that I can achieve it, because it is also a source of satisfaction in itself. And now, as in my studies, I want to graduate at the end, to have the CPs registered. That sounds so banal and also so/, I always feel that way, I'm so sorry to say it: I just want the CPs, but that's why you study the module. So, yes. And what motivates me/, (well, but the word)/, no driving forces/?"

Innovation-Related Motivation

The main category "innovation-related motivation" includes the following subcategories: own interest and personal growth (through tasks). Both subcategories each occur in one interview. Carmen Spieß told us when we asked about the factors that motivate and inspire her, "And yes, to pursue my true interest. So when I imagined that I started studying geography, even though I didn't have to. That was my desire, and I said, I'll do it, I'll see it through. Because it was tied to my interests, which I had as a child, but also in the further course." Rosi Trupp, a female student, emphasised, "(...) So what motivates me most is to grow as a person, to broaden my own horizons. If you stay in the same place, you don't grow beyond yourself. And if something doesn't challenge you, it won't make you stronger. That's the motivation behind what I do."

Personality-Related Motivation

The main category "personality-related motivation" is divided into the subcategories curiosity and believe in yourself / own self-confidence. They each appear in one interview transcript. Berta Schleich, a female student, explained the importance of self-confidence as a motivating factor, "And you should always believe in yourself. So you should never lose faith in yourself or think you can't do something just because of something, but everyone has their own strengths. And everyone is good in their own way and can do things. Even if, for example, one person takes longer than the other, there is always this motivation and what you can really achieve in the end, I think (unintelligible, rustling at the microphone) more work for it."

Other Mentions, Not Assigned

In addition, the interviewees also mentioned faith and food as contributing to motivation.

Overview of the Category System for Research Question 1

Table 3, 4 and 5 show the entire category system that was developed for research question 1 as a result of the qualitative content analysis that was carried out.

Table 3: Category System With Sample Quotes – Motivational Factors of Students in General

Relationship-Related Motivation

- Family
  Sample Quote: "But actually, family is the most important thing." *(Ludmila Mude, female, age: 21)*
- Friends
  Sample Quote: "Family, friends, my boyfriend." *(Ludmila Mude, female, age: 21)*
- Companion
  Sample Quote: "But also my girlfriend. I just want to try harder, for myself on the one hand and for her on the other, so that we can definitely have a very beautiful future together later on." *(Hans-Jochen Löffler, male, age: 21)*
- Independence from other People
  Sample Quote: "Independence, i.e. not being dependent on other people." *(Carmen Spieß, female, age: 27)*

Table 4: Continuation - Category System With Sample Quotes – Motivational Factors of Students in General

Performance-Related Motivation

- Setting a Goal
  Sample Quote: "So for me, I think that's just the goal. I need a goal in mind. Something I can work towards, so I can motivate myself. For many years of my life, I did athletics. And especially then, for example, in sprints or something, you really have the goal in mind. And then you just really said, okay, I want to achieve that as quickly as possible." *(Enno Roskoth, male, age: 21)*
- Identifying with a Task / Work / Cause / Topic
  Sample Quote: "Well, it's definitely something you stand behind 100 percent. You can say, okay, be it related to an exam, I absolutely want to pass it so that I can take this exam next semester. (…)" *(Maria-Luise Haase, female, age: 22)*
- Interim Results / Interim Status
  Sample Quote: "One factor, for example, would be if you have some kind of interim result or status that shows you how far you or the group has progressed, depending on the case, and you are exactly as far as you had hoped or even further. And everything is going well." *(Alfons Eberth, male, age: 21)*
- Continuous Work
  Sample Quote: "And to get to the point where I know exactly what I have to do. And that is to work consistently, every day a little bit more. I think that's what motivates me." *(Norma Girschner, female, age: 22)*
- Own Happiness Through Own Effort
  Sample Quote: "Yes. Yes, sport, right? Well, I think that's just the best example. I could tell you a lot about it now, but I think that would take too long. I notice it myself when you don't do something for a while and then maybe let yourself go a bit and then start again and you realise: Oh, why did I actually stop? It's so much fun. And you immediately see goals and you feel different too." *(Amelie Scheibe, female, age: 21)*
- Own Success Through Own Effort
  Sample Quote: "And that with some failure rates of over 50 percent, you were one of those who had passed with a perfectly reasonable grade." *(Wolfram Wagner, male, age: 21)*
- Deterrent Effects
  Sample Quote: "Where you then perhaps just saw other students who had taken it less seriously or who thought it would somehow work out. And then it didn't work out after all." *(Wolfram Wagner, male, age: 21)*

Innovation-Related Motivation

- Own Interest
  Sample Quote: "And yes, to pursue my true interest. So when I imagined that I started studying geography, even though I didn't have to. That was a desire of mine and I said, I'll do it, I'll see it through. Because it was tied to my interests, which I had as a child, but also later on." *(Carmen Spieß, female, age: 27)*
- Personal Growth (through Tasks)
  Sample Quote: "(...) So what motivates me most is to grow as a person, to broaden my own horizons. If you stay in the same place, you don't grow beyond yourself. And if something doesn't challenge you, it won't make you stronger. That's the motivation behind what I do." *(Rosi Trupp, female, age: 22)*

Personality-Related Innovation

- Believe in Yourself / Own Self-Confidence
  Sample Quote: "Curiosity, definitely." *(Carmen Spieß, female, age: 27)*
- Curiosity
  Sample Quote: "And you should always believe in yourself. So you should never lose faith in yourself or think you can't do something just because of something, but everyone has their own strengths. And everyone is good in their own way and can do things." *(Berta Schleich, female, age: 22)*

Table 5: Continuation - Category System With Sample Quotes – Motivational Factors of Students in General

Other Mentions, Not Assigned

- Faith
  Sample Quote: "And otherwise, faith also gives me strength." *(Ludmila Mude, female, age: 21)*
- Food
  Sample Quote: "The factors, for me it's also food, I have to say. Well, if you eat while you're doing it, (with some?) things go much better." *(Ludmila Mude, female, age: 21)*
- Not Specified / Unspecific
  Sample Quote: "A lot. These key factors support me. And that's why the study project has gone so well so far. Clear statement. "*(Ludmila Mude, female, age: 21)*

Motivational Factors in the Community-Based Research Service-Learning Course

In the following, we will now turn to the results for RQ 2, i.e. the question of which motivational factors were particularly important for the students when working in the community-based research service-learning project. Table 6 shows that the two main categories 'relationship-related motivation' and 'personality-related motivation' which emerged as results of the coding process for RQ 1 are not represented in relation to the results for RQ 2. The results can be summarised as follows: a) performance-related motivation (75 %, 6 out of 8 interviewees), b) innovation-related motivation (25 %, 2 out of 8 interviewees) and c) other mentions, not assigned (13 %, 1 out of 8 interviewees).

Table 6: Frequencies of Main Categories (Documents With Codes) – Relevant Motivational Factors that Played a Role in the Community-Based Research Service-Learning Project

	Documents	Percentage	Percentage (valid)
Relationship-Related Motivation	0	0.0	0.0
Performance-Related Motivation	6	46.2	75.0
Innovation-Related Motivation	2	15.4	25.0
Personality-Related Motivation	0	0.0	0.0
Other Mentions, Not Assigned	1	7.7	12.5
DOCUMENTS with code(s)	8	61.5	100.0
DOCUMENTS without code(s)	5	38.5	-
ANALYSED DOCUMENTS	13	100.0	-

Table 7 presents the results when the code segments are used as unit of analysis.

Table 7: Frequencies of Main Categories (Segments With Codes) – Relevant Motivational Factors That Played a Role in the Community-Based Research Service-Learning Project

	Segments	Percentage
Relationship-Related Motivation	0	0.0
Performance-Related Motivation	7	70.0
Innovation-Related Motivation	2	20.0
Personality-Related Motivation	0	0.0
Other Mentions, Not Assigned	1	10.0
TOTAL	10	100.0

Performance-Related Motivation

The main category 'performance-related motivation' contains the subcategories set(ing) a goal, identifying with a task / work / cause and creating added value for partners, whereby the subcategory 'setting' a goal occurs most frequently, in four of the interviews. The subcategory 'creating added value for partners' could be assigned to text passages in two interviews.

Lotte Heinrich, a female student, told us answering our question about what role key factors that motivate her have played so far in the project work, "Yes, well, in a project it's also important to follow through on the goals you set. I just think that it's the same thing that the project is also followed through, and all the tasks are completed, yes, on time and on schedule." And Rosi Trupp also emphasised the importance of the motivational factor of setting and pursuing a goal for the successful work in the community-based research service-learning project, "We never lost sight of our goal. And it was very critical at times, and I was also very pessimistic about further collaboration. But we thought, no, we've come this far and we can't stop now. That's not an option. Instead, we just keep going. Even when it's hard."

The collaboration with non-university partner organisations in community-based research or service-learning projects is a special feature of these teaching formats. In our study project, we worked with three social organisations that are active in the field we were dealing with theoretically in the course. Enno Roskoth, a male student, highlighted the motivating effect of creating added value for the partner organisations and expressed it as follows, "And on the other hand, there is also the added value that you then have, if applicable. Which you can then, so to speak, convey to your partners. These are factors that motivate me. Yes, due to the situation, at least the one aspect is no longer relevant. And yes."

Innovation-Related Motivation

For Carmen Spieß and Rosi Trupp, the own interest and personal growth were not only fundamental motivating factors but also played a role in their work in the community-based research service-learning project. Carmen Spieß explained, "Yes, and the interest has remained. So yes, but it is also somehow a duty to decide. I admit that too." Rosi Trupp discussed the tasks and challenges that have arisen as a result of the COVID-19 pandemic, "And of course the coronavirus has presented us with certain challenges. But you can only grow from them. It has made us stronger. We have found solutions to the problems. And if you tackle it all, you solve it all."

Overview of the Category System for Research Question 2

Finally, the category system for research question 2 is given in Table 8 for the sake of completeness. As with Table 3-5, the interview quotations are usually longer than the actual coded text passage to facilitate easier reading and provide more comprehensive insights into the content.

Table 8: Category System With Sample Quotes – Relevant Motivational Factors That Played a Role in the Community-Based Research Service-Learning Project

Performance-Related Innovation • Setting a Goal Sample Quote: "Yes, well, in a project it's also important to follow through on the goals you set. I just think that it's the same thing, that the project is also followed through, and all the tasks are completed, yes, on time and on schedule." *(Lotte Heinrich, female, age: 22)* • Identifying with a Task / Work / Cause / Topic Sample Quote: "And because you've dealt with a topic that you really stand behind, that you're interested in, you work much harder for it, you put a lot more into it. You'd much rather spend time on it than on things you don't like so much. Where you don't stand behind it." *(Maria-Luise Haase, female, age: 22)* • Creating Added Value for Partners Sample Quote: "On the other hand, there is also the added value that you might have. Which you can then, so to speak, communicate to your partners. These are factors that motivate me. Yes, due to the situation, at least the one aspect is no longer relevant. And yes." *(Enno Roskoth, male, age: 21)*
Innovation-Related Innovation • Own Interest Sample Quote: "Yes, and the interest has remained. So yes, but it is also somehow a duty to decide. I admit that too." *(Carmen Spieß, female, age: 27)* • Personal Growth (through Tasks) Sample Quote: "And of course the coronavirus has presented us with certain challenges. But you can only grow from them. It has made us stronger. We have found solutions to the problems. And if you tackle it all, you solve it all." *(Rosi Trupp, female, age: 22)*
Other Mentions, Not Assigned • As in the Rest of the Study Programme Sample Quote: " Yes, well, the project work is still a part of my studies and a part of the path I have to take. So it plays a normal role, like everything else. " *(Ludmila Mude, female, age: 21)*

Discussion

In summary, our findings showed that student motivation is a complex and multidimensional phenomenon. There are several motivational factors among students, which in general, however, also played a very specific role in the work in the university course we examined. Motivational factors that fall under the umbrella term 'performance-related motivation' are of particular importance. Especially the subcategory 'setting a goal'. With the introduction of the tiered study structure, shorter study durations, the goal orientation of students has certainly increased. It was striking that motivational factors falling into the main categories 'relationship-related motivation' and 'personality-related motivation' were only mentioned as general motivational factors. And not explicitly recognised for the project work in the university course. It is not possible to interpret why this is the case at this point, due to the small number of cases and the lack of statements on research question 2 in some interviews.

Strengths and Limitations

The results obtained in our qualitative research study provide a new perspective to the existing research on student motivation. We tried to maintain the greatest possible degree of openness when conducting and analysing the data in accordance with the qualitative research paradigm. Kruse (2007, 2015) speaks of the central principle of openness in relation to qualitative interview research. This also means that we did not conduct a preliminary orientation towards common classifications of motivational factors that are well documented in the literature. This is one of the study's key strengths, as it enabled categories at a lower level that are very close to the available text material and at the end a new category system

developed through the process of inductive category formation which cab supplement existing classification systems.

Some limitations of our research study were encountered. One is that the number of study participants is small. This is a consequence of the course size limitation. No parallel courses with the same content focus and teaching design were offered. Qualitative interpretative studies have normally a small number of cases compared to quantitative studies (T. Smith, 2009), even if the pure number of cases is not a clear demarcation criterion between qualitative and quantitative research (Mayring, 2001). This, results among other things, from the overall objective of investigation differing from quantitative studies, different paradigmatic views in qualitative and quantitative research (Bryman, 1988; Creswell & Creswell, 2018; J. K. Smith, 1983; Mayring, 2007), different research strategies (Witt, 2001), the different data collection approaches and designs (Bryman, 1988; Creswell & Creswell, 2018), the nature of the analysed and produced data (Bryman, 1988), different sampling strategies (cf. Sandelowski, 1995) although there is also an ongoing debate on the significance of the generalisability of qualitative research findings (Osbeck & Antczak, 2021). Nevertheless, larger case numbers than our research study has are recommended, especially for qualitative studies using content analysis as the primary analysis method (Mayring, 2022b), an approach that combines both qualitative and quantitative analysis steps (Mayring, 2012). Regarding the second research question examined, it was found that out of the 13 qualitative interviews in total, no codes could be assigned in five interviews. This resulted from an interviewer error. The corresponding follow-up question relating to this research question was not asked in the five relevant interviews. This can probably be attributed to the inexperience of the interviewer, who conducted her first qualitative interviews as part of this research study. Despite the interviewer training provided, the effects of nervousness due to a lack of previous experience could not completely avoided.

Conclusion

In general, the research study offers an interesting insight into general motivational factors of university students and the relevance of these motivational factors in the context of a project-based university course. The gained new insights can help instructors at universities and universities of applied sciences to better understand their students and the link between learning success, motivation, emotions and cognition, the acquisition of knowledge. For more information on the role of emotions in the community-based research service-learning course, see Bittner and Kempchen (2024a). The research findings can also be useful to draw conclusions for designing new teaching-learning arrangements. Motivational factors should ideally always be considered, but in the opinion of the authors of this paper, they play a particularly important role in project-based teaching and learning formats with a high proportion of independent student work, in university courses in which students are confronted with highly challenging situations, and in courses that extend beyond the usual format of one semester. The basic idea in our research study was to compare general motivational factors that play a role for students, for example in studying, at work, in sports or even just in performing everyday activities. And then, as a second step, to look at which of these general motivational factors play a role or are important with regard to the work, the learning activities in a specific university course, a teaching project. In the case of our research study, it was a community-based research service-learning course. Doing research about motivational factors would also be conceivable in an independent learning activity setting. This distinction between general motivational factors and those that play a role in

working in a specific university course also seems interesting for further research studies with a larger number of participants and comparative studies in educational research.

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Authors' Contributions

JB: principal investigator, conceptualisation, design and methods, data analysis, drafting the paper. JK: conducting the interviews and contributing to interview guideline development, reviewing the manuscript

Conflicts of Interest Statement

The authors have no conflict of interest to declare.

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Product Experience Design (PXD): A Pedagogical Framework for Experience-Driven Product and Systems Design With Emerging Technologies in Industrial Design Education

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Abstract

Traditional Industrial Design (ID) education has focused on teaching students how to create physical products that are functional, manufacturable, and aesthetically appealing. However, the rapid advancement of emerging technologies and the increasing complexity of modern design challenges necessitate a shift in design education toward a more holistic and integrated approach. This paper presents *Product Experience Design (PXD)*, a pedagogical framework developed for graduate-level ID education and applied to a graduate PXD Studio that incorporates *experience-driven design, systems thinking, and technology integration*. The PXD framework introduces a structured three-phase methodology: (1) *Experience Analysis*, in which students define experiential gaps and conduct user research to identify challenges; (2) *Systems Integration*, where students apply systems thinking to understand the interactions between users, products, and environments; and (3) *Technology Implementation*, which explores the role of emerging technologies such as artificial intelligence (AI) and spatial computing in enhancing product experiences. Two case studies from the PXD studio course illustrate how this methodology encourages innovative and systemic design thinking. The first case study, CareMate, focuses on an AI-driven medication management system that helps older adults maintain medication adherence with contextual AI-agent support tailored to the user's needs. The second case study, SPACIAL, highlights spatial computing technology to assist creative professionals in ideation, collaboration, and workflow optimization. By embedding emerging technologies into the design process and bridging physical and digital experiences, the PXD framework equips students with the skills necessary to address real-world challenges in an increasingly interconnected design landscape. This paper discusses the structure of the PXD framework, its pedagogical strategies, and its impact on design education. It contributes to a new paradigm in ID education that prepares students for 'experience-driven innovation and systems-level thinking.

Keywords: Industrial Design Education, Product Experience Design (PXD), Systems Thinking, User Experience (UX) Design, Emerging Technology, Spatial Computing, AI in Design

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Introduction

Industrial Design (ID) education has traditionally focused on creating tangible, functional, and aesthetically refined products. However, as technology advances and user expectations shift, designers must move beyond standalone physical objects to consider integrated systems of digital interfaces, services, and intelligent interactions. This shift necessitates a new design approach that blends physical and digital experiences, addressing the increasing complexity of real-world challenges.

The Product Experience Design (PXD) framework was developed to bridge this gap, emphasizing experience-driven design, systems thinking, and emerging technology integration. Unlike conventional ID approaches, PXD encourages designers to view products as part of larger ecosystems, ensuring seamless interactions between hardware, software, and services. This approach equips students to tackle interdisciplinary challenges and design for the evolving landscape of hybrid physical-digital experiences.

This paper introduces the PXD framework and its implementation in a graduate-level studio course. It explores case studies to highlight its pedagogical structure and real-world applications. The paper then demonstrates how PXD fosters a holistic design perspective, preparing students to create user-centered, adaptable, and future-ready solutions.

The Need for a New Industrial Design Education Model

Addressing Complex, Systemic Challenges

The world is facing increasingly complex challenges, from climate change and sustainability to healthcare accessibility and digital transformation. Industrial designers create standalone products and develop integrated systems holistically to address user needs (Meadows, 2015). The traditional ID curriculum, emphasizing product-centered design, does not provide students with the necessary tools to design for these systemic challenges (Meyer & Morman, 2020).

The Shift From Physical to Hybrid Product Experiences

The proliferation of digital interfaces, IoT devices, and AI-powered products has shifted the design landscape. Today, products are often embedded within digital ecosystems, requiring designers to think beyond traditional physical design constraints (Buchanan, 2019). For example, wearable health devices are not just physical objects—they rely on data analytics, AI decision-making, and cloud-based user interactions. Digital transformation is a key driver of this shift, influencing how businesses and users interact with technology (Verhoef et al., 2021).

The Role of Emerging Technologies in Design

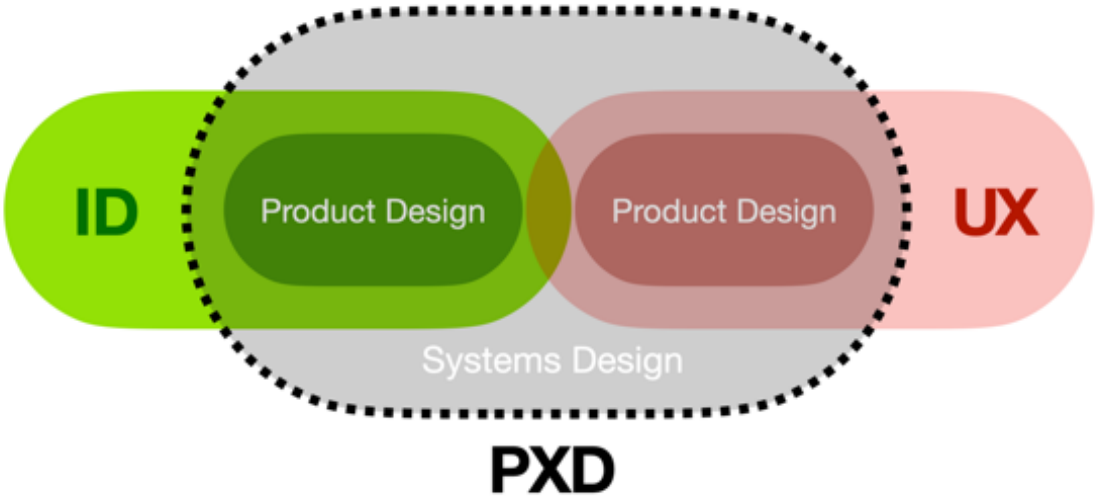
Emerging technologies such as spatial computing (AR/MR), AI-driven automation, and smart systems fundamentally reshape how users interact with products by making experiences more immersive, intelligent, and adaptive. Spatial computing extends interaction beyond screens, allowing users to engage with digital elements in physical space, leading to more intuitive and seamless product experiences. AI-driven automation enhances personalization and efficiency, enabling products to anticipate user needs, automate repetitive tasks, and offer

real-time adaptive interfaces. Smart systems, including IoT and connected ecosystems, ensure that products no longer function in isolation but operate as part of larger, data-driven environments, improving convenience, usability, and long-term engagement. By integrating these technologies, the PXD framework enables designers to create functional and responsive products, evolving alongside users and their environments. Digital transformation has accelerated the need for designers to consider multi-modal interactions across physical and digital touchpoints (Verhoef et al., 2021).

The Product Experience Design (PXD) Framework

The Product Experience Design (PXD) framework represents a comprehensive approach that spans three key domains: Industrial Design (ID), User Experience (UX), and Systems Design as illustrated in the diagram (Figure 1). This framework provides a unified perspective on how these different areas of design interact and complement each other in the modern design landscape.

Figure 1: Product Experience Design Domains



Industrial Design (ID) is the physical aspect of product design. Its roots are deeply embedded in hardware development, tangible product design, and manufacturing processes. ID practitioners focus on the concrete elements of design, such as form, function, materiality, and ergonomics. Their approach is traditionally product-centric, emphasizing the physical creation, manufacturing, and use of objects.

On the digital side, User Experience (UX) design focuses on creating meaningful digital interactions. UX designers prioritize usability and cognitive interactions to create seamless user flows. Their methodology aligns closely with software-centric design, emphasizing digital tools and experiences that enhance user interaction.

Where these two domains intersect, we find a fascinating space of hybrid physical-digital solutions. This overlap represents a crucial area where ID and UX contribute to product innovation. Industrial design brings expertise in creating tangible, functional forms, while UX design contributes to understanding interaction models and user interface (UI) design. This collaboration results in products that successfully bridge the physical and digital worlds.

Systems Design is the foundational layer of PXD, bridging physical and digital product design. This approach extends beyond individual products to consider service design, platform ecosystems, and multi-modal experiences. It enables designers to think beyond isolated solutions and create harmoniously interconnected design systems.

The overarching scope of PXD differs from traditional design approaches in that it places experience at the center of the design process. Rather than focusing solely on physical or digital aspects, PXD encourages holistic problem-solving that ensures products function effectively within larger interoperable systems. This comprehensive approach incorporates emerging technologies such as AI, XR, and spatial computing to enhance user engagement, creating more meaningful and integrated product experiences.

The PXD Methodology: Three Phases of the Framework

The PXD framework is designed to bridge the gap between traditional Industrial Design education and the demands of a rapidly evolving technological landscape. By integrating experience-driven design, systems thinking, and emerging technology, PXD provides students with a structured approach to problem-solving that extends beyond individual product creation to holistic systems-level thinking. This framework is built on a three-phase methodology: *Experience Analysis, Systems Integration, and Technology Implementation*. Within the graduate PXD studio course, these three phases serve as the foundation for hands-on learning, guiding students as they explore real-world design challenges and develop innovative solutions.

Experience Analysis: Defining Experiential Gaps

The first phase of PXD begins with an in-depth analysis of how users experience a product, service, or system. This step is crucial in uncovering experiential gaps—the space between what users currently encounter and what would create an ideal interaction. To guide students through this process, the PXD studio course incorporates various research methods that encourage deep inquiry into user behavior, expectations, and frustrations.

Students start by conducting user journey mapping, breaking down each touchpoint in an interaction to understand where friction, inefficiency, or discomfort exists. They then apply ethnographic research methods, including direct observation and interviews, to capture the nuances of real-world product usage. Through context mapping, they explore the broader environmental, social, and technological factors that shape a product's impact on its users.

An essential part of this phase is reframing the problem statement. This practice challenges students to look beyond surface-level issues and consider the more profound, systemic reasons behind a poor user experience. In one example from the studio course, students investigating medication management among elderly individuals found that while many existing apps provided reminders, they failed to account for contextual factors such as forgetfulness, confusion, or reluctance to take medication due to side effects. By shifting the focus from simply providing reminders to developing a holistic, AI-driven support system, the students redefined the problem and opened new avenues for more meaningful solutions.

Through this process, students see design as improving human experiences rather than just creating objects. By the end of this phase, they have a clear understanding of user needs, pain

points, and opportunities for innovation, setting the stage for deeper exploration into system-wide integration.

Systems Integration: Understanding Context and Relationships

With a well-defined experiential gap, the next phase of the PXD framework encourages students to explore how their proposed solutions interact within a broader system. In contrast to traditional product design, which often isolates an object from its environment, PXD requires students to consider the interdependencies between users, products, services, and technology.

At this stage, students engage in system mapping, a process that enables them to visualize the relationships among stakeholders, touchpoints, and external factors. This approach helps them move beyond a single-product mindset and develop solutions that consider the entire ecosystem of interactions. One technique utilized in the studio course is service blueprinting, where students outline how a product or service operates across multiple layers of engagement, from front-end user interactions to back-end infrastructure and support systems.

For instance, in the CareMate case study, the student initially focused on an AI-driven medication reminder system. However, through systems integration, he realized that addressing medication adherence required more than just reminding users to take their pills. The design had to integrate with caregiver networks, healthcare providers, and pharmacy services to create a seamless and supportive experience. As a result, the final concept included an AI agent-driven application that communicated with caregivers, automatic prescription refill notifications, and contextual AI adjustments based on the user's habits and routines. This system possibly incorporates a potentially wearable product to help the AI agent better understand the users' context at moments that matter most in critical health situations.

By working through this process, the student gains a critical systems-thinking mindset, which prepares him to create design solutions that are adaptable, scalable, and relevant to larger societal challenges. This phase emphasizes the importance of seeing design not as an endpoint but as part of an evolving ecosystem in which every decision impacts multiple stakeholders.

Technology Implementation: Leveraging Emerging Technologies for Meaningful Innovation

The final phase of the PXD framework focuses on technology as a bridge between experience and innovation. Students now explore how emerging technologies such as AI, spatial computing (AR/MR), IoT, and multimodal interfaces can be harnessed to enhance user interactions and create new engagement possibilities.

Unlike traditional Industrial Design programs, where technology is often introduced as a separate discipline, the PXD studio course integrates technology directly into the design process. Students learn to prototype AI-driven interactions, build immersive spatial computing experiences, and develop connected ecosystems that enable more fluid user-product interactions.

Throughout the course, students engage with hands-on prototyping tools such as:

- Unity and Bezi for developing AR/MR interfaces for Apple Vision Pro
- Figma for UI/UX wireframing and prototyping the interaction design

A notable example from the studio is the SPACIAL project, where a student designed an MR workspace for creative professionals. Recognizing that traditional screens limit ideation and collaboration, the project explored how spatial computing could transform designers' interaction with content in three-dimensional space. The system integrated gesture-based controls, AI-powered organization, and immersive 3D sketching tools, enabling users to ideate and iterate dynamically rather than being constrained by flat 2D displays.

By the end of this phase, students move beyond theoretical applications of technology to develop tangible, working prototypes that showcase how emerging tools can fundamentally reshape human-product interactions. This hands-on engagement prepares them for real-world challenges and equips them with the skills to lead innovation in physical and digital product ecosystems.

Case Studies: Applying PXD in Graduate Studio Projects

As part of their PXD project, the students were challenged to create products that solve everyday problems using advanced technology. The PXD Studio project involves research and design phases for physical and digital products. The students must consider the latest technology integration to enhance the design solution and provide an ideal user experience for the identified issues. This section introduces the design challenge students are working on, followed by two case studies from the course.

Design Challenges

- Identify a critical issue at home or work based on individual interests and research discoveries.
- Conduct focused research on specific human needs, define the ideal experience, develop concepts, and test the designs.
- Define the ideal user experience that students want to help their users achieve.
- Specify the gaps between the current state and the ideal user experience.
- Explore design opportunities for products they largely control in size, functionality, and testing.
- Familiarize yourself with the various advanced technologies and have in-depth knowledge of the promising technologies to apply.
- Be an expert in explaining the technology you are applying to your solution.
- Determine the most promising and appropriate technology for their design to bridge the experimental gaps.
- Functionally creative and practical while aesthetically pleasing as an offering to the target user segments.

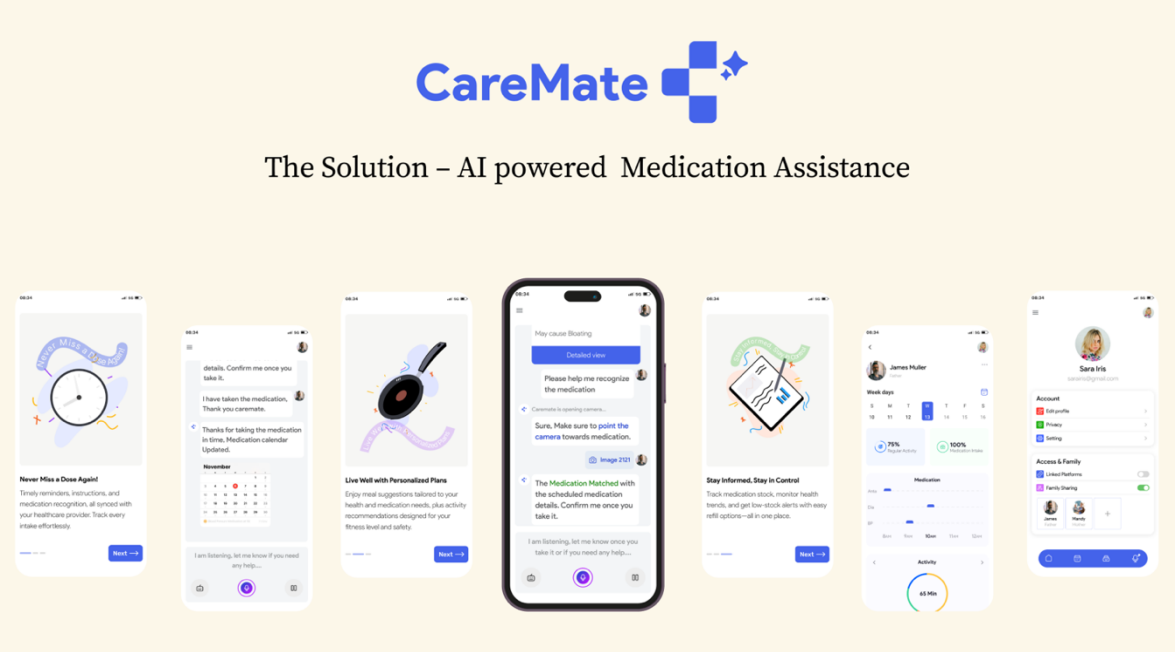
Case Study 1. CareMate: AI Agent-Driven Medication Management System

One project, CareMate, addresses medication adherence for older adults (Figure 2). Designed by graduate student Muhammad Akanda (2024) in the PXD studio course, the system integrates AI-powered reminders, wearable sensors, and smart home technology to provide a

seamless, context-aware medication management experience. The AI agent personalizes reminders based on user habits and offers real-time support through voice or mobile interfaces.

This project demonstrates the power of combining AI, systems thinking, and user-centered design to create solutions that enhance accessibility, usability, and patient independence.

Figure 2: CareMate: AI Agent-Driven Medication Management System



At the heart of the CareMate system is an AI agent that tailors reminders based on the user's habits and daily routines. As the user interacts with the system, the AI learns and adapts, becoming increasingly effective. If a user forgets their medication at a particular time, for example, the system adjusts the reminders or even offers different ways to notify the user, ensuring they stay on track.

Another key feature is the system's integration with wearable sensors. These sensors monitor a range of health metrics, from physical activity to sleep patterns, providing the AI with real-time data. By continuously analyzing this information, the system can make informed, context-aware decisions. For instance, if the sensors detect that the user is experiencing a fluctuation in health, the AI might adjust the medication schedule or send a warning about a possible interaction.

To make the medication management experience as seamless as possible, CareMate also connects to smart home devices like Alexa or Google Home. These devices become part of the caregiving ecosystem, allowing reminders and notifications to be delivered directly through familiar channels. Whether through a spoken reminder or a notification on a smart speaker, the system ensures that the user is never far from the support they need.

The mobile app provides a comprehensive overview of the user's medication schedule for those who prefer to manage their health on the go. It displays upcoming doses, health data, and relevant information in an easy-to-understand format. The app also enables family

members or caregivers to monitor the user's medication adherence, ensuring a support network is always in place.

In addition to passive reminders, the AI offers real-time support. If users have doubts or questions about their medication, they can quickly interact with the system through voice commands or the mobile app for immediate assistance. This feature provides clarity, reduces anxiety, and makes users feel confident in managing their health.

The user-centered design of CareMate ensures that it is accessible and intuitive, taking into account the unique needs of older adults. Large text, voice-activated commands, and simple navigation make it easy for users with limited technical literacy or mobility issues to interact with the system. Moreover, the system empowers users to take control of their medication regimen while maintaining their independence. Caregivers are also included in the design, so they can stay informed and provide help when necessary.

The CareMate project is a perfect example of systems thinking in action. Instead of viewing medication management as a standalone issue, the system considers the broader context of the user's life. Incorporating an AI agent-driven assistant into the system creates a holistic, personalized experience that addresses the physical and environmental factors affecting medication adherence. This integrated approach ensures that medication is taken on time, but it also contributes to better overall health management and improves quality of life.

The potential benefits of the CareMate system are immense. First and foremost, it improves medication adherence, reducing the likelihood of missed doses and related health complications. Greater accessibility enables users with varying levels of tech-savviness or mobility to stay engaged in their health management. Perhaps most importantly, it gives older adults the tools to remain independent while being supported by a seamless network of technology and caregivers. With better health outcomes as the ultimate goal, CareMate is poised to make a real difference in the lives of older adults, helping them lead healthier, more independent lives.

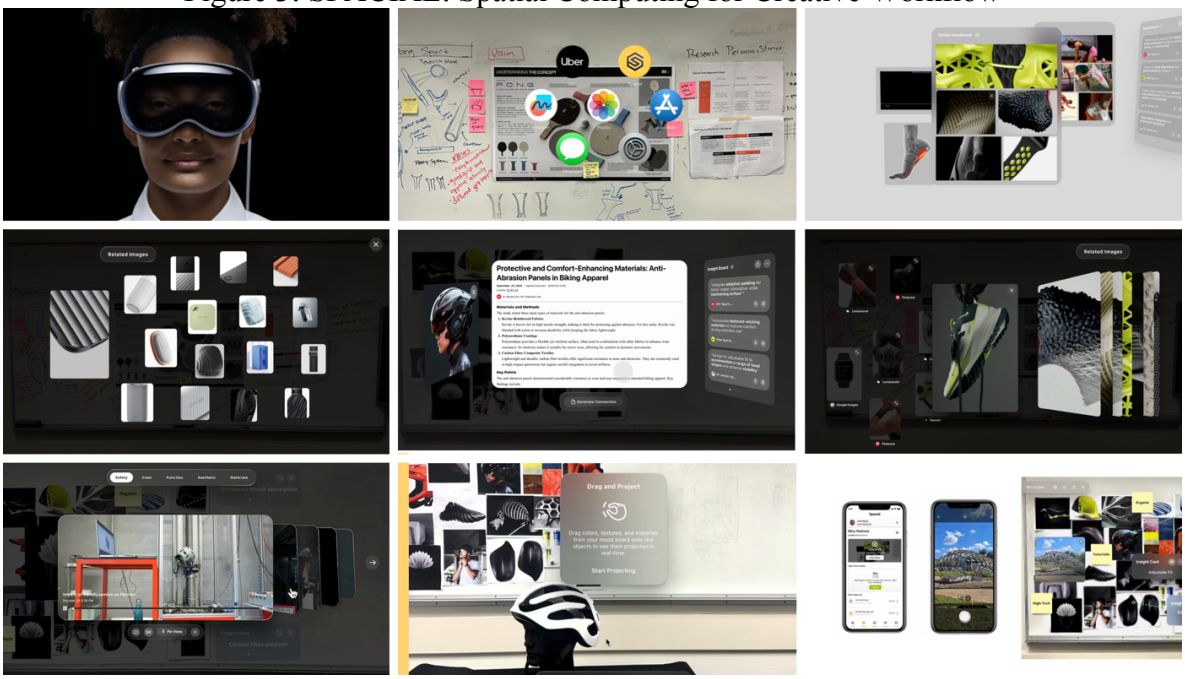
In all, CareMate demonstrates the power of combining AI, systems thinking, and user-centered design to solve a critical problem in healthcare. Integrating these elements creates a tailored, context-aware experience that enhances medication adherence and promotes overall well-being. It is a model for leveraging technology to support vulnerable populations, ultimately improving accessibility, usability, and independence.

Case Study 2. SPACIAL: Spatial Computing for Creative Professionals

The second project, SPACIAL, designed by graduate student Dillon Narcisse (2024) explores how spatial computing can enhance designers' creative workflows (Fiture 3). The system uses Apple Vision Pro to provide an immersive 3D workspace where professionals can ideate, collaborate, and prototype in a shared virtual space. AI agents assist by generating design suggestions, organizing content, and streamlining repetitive tasks.

This project redefines how creative professionals interact with their work environment by leveraging spatial computing and AI. It aims to bridge the gap between physical and digital creative processes.

Figure 3: SPACIAL: Spatial Computing for Creative Workflow



The core idea behind SPACIAL is to bridge the gap between the physical and digital realms. It utilizes the powerful capabilities of Apple Vision Pro and spatial computing to enable designers to engage with their work in entirely new ways. Through this immersive 3D workspace, designers are no longer confined to traditional screens or static workspaces. Instead, they are placed in a dynamic, virtual environment that offers unprecedented flexibility and freedom for ideation, collaboration, and prototyping.

The system's integration of AI agents elevates the experience by assisting designers in ways that go beyond simple task automation. These intelligent agents generate design suggestions, streamline content organization within the 3D space, and handle repetitive tasks, freeing up the designer's cognitive load. This support enhances the creative process and fosters efficiency, allowing designers to spend more time on their work's strategic and innovative aspects.

A key strength of SPACIAL is its ability to foster collaboration across distances. In an increasingly remote and global professional landscape, SPACIAL enables multiple users to enter a shared virtual space, collaborate in real time, and interact with the design from every angle. This fluid interaction helps bridge the gap between teams that may be located in different parts of the world, creating a shared environment where ideas can be exchanged seamlessly and intuitively.

By rethinking prototyping, SPACIAL also significantly advances how designers test their ideas. Rather than relying on traditional methods, such as static 2D designs or physical prototypes, designers can now interact with and iterate on 3D models in real time. The ability to instantly manipulate designs within the spatial computing environment offers immediacy and responsiveness that accelerates the entire design process.

The project's focus on user-centered design ensures that the SPACIAL system is functional and profoundly aligned with the needs and preferences of creative professionals. Its intuitive interface, combined with the physical interaction of a spatial workspace, reduces barriers for

designers who may be less familiar with technology, making this advanced system accessible to a wide range of users.

This graduate project demonstrates excellent potential for the future of creative industries by leveraging emerging technologies to improve workflows and enhance collaboration. Through spatial computing, SPACIAL creates a new type of creative workspace where the boundaries between the digital and physical worlds no longer exist and the environment actively participates in the design process. This reimagined approach holds significant promise for empowering designers to innovate in once inconceivable ways, redefining the future of design workspaces.

SPACIAL is an exciting exploration into how AI and spatial computing can be harnessed to push the limits of creativity, collaboration, and efficiency in professional environments. It exemplifies the forward-thinking, technology-driven design essential for the next generation of creative professionals, positioning itself as a key tool for rethinking the spaces in which they work and the tools they use to bring their visions to life.

Conclusion and Future Directions

The PXD framework represents a transformative approach to ID education. It integrates experience-driven design, systems thinking, and the adoption of emerging technology. By training students to design beyond individual products and toward complete system experiences, PXD prepares them for real-world, future-ready careers.

PXD as a Model for the Future of Design Education

The PXD framework is more than a methodology. It represents a fundamental shift in how ID education prepares students for the future. The PXD studio course fosters a new generation of designers equipped to tackle complex, interconnected challenges by merging experience-driven insights, systems thinking, and cutting-edge technology.

Unlike traditional design programs that separate physical product design from digital user interaction(UI)/UX design, PXD emphasizes a seamless, hybrid approach that acknowledges designers' evolving role as systems innovators. Students graduate from the program as skilled product designers and strategic thinkers who understand how to create holistic user experiences across physical and digital touchpoints.

Through real-world case studies, interdisciplinary collaboration, and iterative prototyping, PXD ensures that students are prepared for the evolving demands of the design industry. Whether working on AI-driven healthcare solutions, MR-enhanced workspaces, or IoT-connected smart environments, graduates of the PXD framework enter the professional world with a mindset that is adaptable, forward-thinking, and deeply rooted in experience-driven innovation.

Future Research Focus

As the PXD framework evolves, future research will focus on expanding its reach and impact within design education. One key development area is the integration of PXD principles across undergraduate and interdisciplinary programs. While the graduate-level studio course has successfully fostered experience-driven design thinking, introducing these concepts

earlier in undergraduate education can better prepare students to approach design challenges holistically. Additionally, incorporating PXD into interdisciplinary programs—such as those intersecting with engineering, computer science, or business can further enhance collaboration and innovation in product and systems design.

Another crucial focus is evaluating student outcomes through industry collaborations, design competitions, and research publications. Engaging with industry partners will provide valuable insights into how PXD-trained designers adapt to real-world challenges. At the same time, participation in competitions will allow students to test their problem-solving skills against global design standards. Furthermore, publishing research on PXD-based design methodologies will help refine the framework and establish it as a foundational approach in contemporary design education.

Finally, the role of AI and spatial computing in design education presents exciting opportunities for the continued advancement of PXD. By exploring how AI-driven tools and immersive spatial computing (AR/MR) environments can support ideation, prototyping, and collaboration, design educators can further enhance the learning experience and creative process. As PXD establishes itself as the next evolution of Industrial Design—ID 2.0—it lays the groundwork for a more adaptable, innovative, and experience-driven approach to preparing future designers for the complexities of an increasingly hybrid physical-digital world.

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Balancing Act: Ethical Exploration of AI Tools to Support Student Learning in a Library and Information Science Program

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Abstract
As artificial intelligence (AI) technologies like ChatGPT become more prevalent, library professionals face the challenge of promoting ethical use of AI as an emerging dimension of information literacy. Students in Library and Information Science (LIS) programs recognize that AI tools will shape their future roles, making it essential for LIS programs to integrate learning experiences that develop students' ability to use and critically evaluate these tools and the content they produce. This descriptive case study examines the pedagogical challenges of introducing AI-based technologies in an online Information Science and Technology course. It explores the instructor's efforts to balance students' engagement with AI tools while addressing ethical concerns like privacy, accuracy, bias, and intellectual property – all issues explored throughout the course and the university's LIS curriculum. The paper describes multiple iterations of AI-based learning experiences and adjustments made based on student behaviors and feedback. This paper will be of interest to instructors integrating AI tools to support student learning, particularly in fields emphasizing ethical information use.

Keywords: Artificial Intelligence, Generative AI, Library and Information Science, LIS Education

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Introduction

As the use of artificial intelligence (AI) continues to evolve, library and information professionals play an increasingly important role in ensuring that information seekers will have the knowledge and skills necessary to critically evaluate AI-generated content and to ensure that concerns over the ethical use of AI are mitigated whenever possible. Library and information science (LIS) is a field concerned with the organization, management, access and dissemination of information in a variety of formats (Bassey & Umoh, 2021), and preparation for careers in libraries and information organizations emphasizes principles related to intellectual property, credibility, privacy, and equity of access.

While the relationship between AI technologies and libraries is still evolving, Bassey and Owushi (2023) point out that AI application in libraries already spans critical areas such as information retrieval, cataloging, classification, user services, data analysis, and knowledge management. Kalbande and colleagues (2024) suggest that AI also plays an important role in digital preservation and providing access to historic materials. As awareness of generative AI tools such as ChatGPT, Gemini, and Copilot continues to build, libraries will be expected to support information-seekers in using and evaluating content produced by these tools to meet the needs of their communities. Competencies related to digital literacy and ethical use of information are an integral part of LIS education, but as the use of AI becomes more ubiquitous, educational programs will need to ensure that graduates are well-prepared for an evolving information landscape that includes AI tools.

Integrating AI tools into existing LIS curricula presents several challenges. Like many students, LIS faculty may be unfamiliar with the ever-changing array of AI tools and have limited experience with evaluating AI-generated information and thinking critically about the ethical issues associated with its use. At this point, many higher education institutions have not adopted definitive guidelines on AI use, allowing individual instructors to develop their own approaches and policies (Spivakovsky et al., 2023). Faculty may be faced with educating students about AI tools and related ethical concerns as they are also working to build their own understanding.

Another challenge related to integrating AI tools into LIS curricula involves navigating students' varying perceptions related to AI. Students completing coursework focused on information credibility, equity, and access may be especially concerned as accepted measures of these qualities are disrupted by changing information retrieval and dissemination practices. Peer review publication models that have been a reliable measure of credibility and scholarship don't apply when instant generation of content using large language models can lack even basic attribution of sources, and yet that information may have value. Kizhakkethil and Perryman (2024) found that although LIS students recognize AI's potential to enhance learning, they still have significant concerns about reliability, lack of transparency, and overreliance on the technology. As libraries continue to discover the many ways that AI systems can be used to streamline services – whether "back end" functions like materials acquisition and cataloging or forward-facing services like reference and instruction – students planning careers in librarianship have valid concerns about the rapid growth of AI and potential automation of functions traditionally performed by librarians. In engaging students with AI-related topics, LIS faculty may therefore struggle to facilitate meaningful exploration of AI tools and the issues surrounding their use in ways that won't reinforce students' negative perceptions, but will, instead, promote an openness to learning and to developing critical analysis skills needed to be effective AI users and guides.

Recognizing that integrating AI into the LIS curriculum presents unique challenges, the author identified a course that should reasonably include AI-related topics. Once identified, the instructor sought to build understanding of students' existing perceptions and attitudes while also taking incremental steps towards revising the course to better prepare LIS students for future careers that will be significantly impacted by the use of AI. While research addressing the use of AI in education has increased in recent years, and there is a growing body of literature discussing the application of AI tools in the context of libraries and information organizations, there are a limited number of studies that relate to AI tools, policies, and practices in LIS education. In reporting on the results of this effort, the author hopes to support the work of LIS faculty in finding effective ways to help students adapt to the advancement of AI technologies while also reinforcing foundational principles of library and information science.

Like all classes in the University of Rhode Island's Graduate School of Library and Information Studies (GSLIS) program, LSC 508 (Introduction to Information Science & Technology) explores key principles of information science. But this course also provides students with an opportunity to explore and discuss various technology tools that are relevant to library and information organizations. Throughout the seven weeks of the course, students typically raise ethical issues about the use of artificial intelligence as it relates to information – particularly during the final weeks that address the future of libraries and information professions. This course therefore seemed to be an appropriate choice for introducing students to AI tools while also recognizing concerns about information-related ethical issues that may color students' willingness to build knowledge and experience in this area.

Although the university has established an AI Task Force to examine AI integration as it relates to teaching and learning as well as other key domains, AI adoption varies, with individual instructors determining their own class policies and pedagogical approaches to integrating AI tools. The university offers a centralized resource aimed at fostering faculty exploration and pedagogical innovation related to AI, but GSLIS has not developed specific departmental guidelines for integrating AI into LIS courses.

Within GSLIS, LSC 508 is a required course that introduces fundamental theories of information science and information technology while also building practical skills in using technologies relevant to library and information organizations. The course covers a wide range of skills – from formatting text in Microsoft Word to building a web page using Google Sites, with a bit of html coding and graphic design between. Like all GSLIS courses, LSC 508 is taught in an accelerated online format, with each seven-week section typically enrolling 15–20 students. This study reflects insights gained from students' perceptions about AI while also outlining changes made to the course to introduce AI topics and tools. Data was collected from nine sections of the course taught over fifteen months, beginning in Summer 2023. The study proposes to answer a few basic questions: RQ1: How do students enrolled in LSC 508 perceive and discuss the use of AI in the context of library and information science? RQ2: What recurring themes or concerns emerge from students' discussion and use of AI tools? RQ3: How can faculty integrate AI tools and topics to foster critical thinking and ethical use in LIS Education?

Methodology

For this study, the author analyzed student responses to specific discussion prompts and specific assignments from all sections of LSC 508 taught over five semesters. A timeline of

AI integrations is shown in Table 1. The period to be studied began in Summer 2023 and continued through Fall 2024. This period included nine sections of LSC 508, with a total enrollment of 156 students. Identifiable information was removed from students' reflective responses, and all reporting was conducted in aggregate.

Table 1: Timeline of AI Integrations

Term	Module	Type	Status	AI Tool
SU 2023 – SU 2024	Week 7	Discussion Board prompt	Optional	ChatGPT
FA 2024	Week 5	Lab assignment exercise	Required	ChatGPT
FA 2024	Week 6	Lab assignment exercise	Required	Prezi AI

Students in LSC 508 have increasingly brought up AI and the issues surrounding its use in discussion forums, especially during Week 6, which focuses on the future of technology and the information profession. Based on apparent interest in this topic, in Summer 2023 the instructor introduced an optional ChatGPT exercise as part of an existing discussion board prompt for Week 7. In the original prompt, students were asked to re-read an article by Vannevar Bush (1945) about the future of technology in an information society, then reflect on whether the article's predictions have been manifested in today's society. In the revised version, students were also asked to use ChatGPT to generate an answer to the same question, then compare the AI-generated response to their own. The exercise was made optional because some prior students had expressed ethical concerns about using AI. Offering choice was intended to provide an active learning opportunity for those who were open to experimenting with generative AI, while also allowing those who had concerns to simply learn from reflections shared by peers.

To explore students' existing perceptions of AI (RQ1), all responses that mentioned AI were collected and analyzed for the Week 6 discussion questions. A grounded qualitative approach was used to analyze student responses which were classified as positive, negative, or mixed/neutral. To explore students' perceptions after using an AI-based tool, responses to the enhanced Week 7 prompt were also collected and analyzed. Participation in the optional exercise was tracked along with data reflecting the nature of students' reflections (positive, negative, or mixed/neutral). The author chose to collect data from responses by students who did not choose to complete the optional ChatGPT exercise so any perceptions about AI that may have influenced their choice to abstain would also be represented.

In Fall 2024, the optional ChatGPT exercise in the discussion board was replaced with two required AI-based lab activities in Week 5 and Week 6. The Week 5 lab assignment was essentially the same as the previous discussion board exercise (but no longer optional), with the addition of a lesson on constructing effective prompts for ChatGPT. The Week 6 lab assignment was a modification of an existing assignment that required students to create an online presentation using Prezi. The revised exercise asked students to also use the "Create with AI" function built into the Prezi application to generate a second presentation on the same topic. In their reflection, students were asked to compare the AI-generated presentation with their own work.

To determine the common themes or concerns that stemmed from students' use of AI tools (RQ2), student reflections after completing the lab assignments in Week 5 and Week 6 were

collected and analyzed. Voyant Tools (Voyant Consortium, 2024), a web-based text analysis platform, was used to develop an open list of keywords capturing student concerns about AI in the context of library and information science. All mentions of AI, artificial intelligence, ChatGPT, or chatbots were coded and categorized.

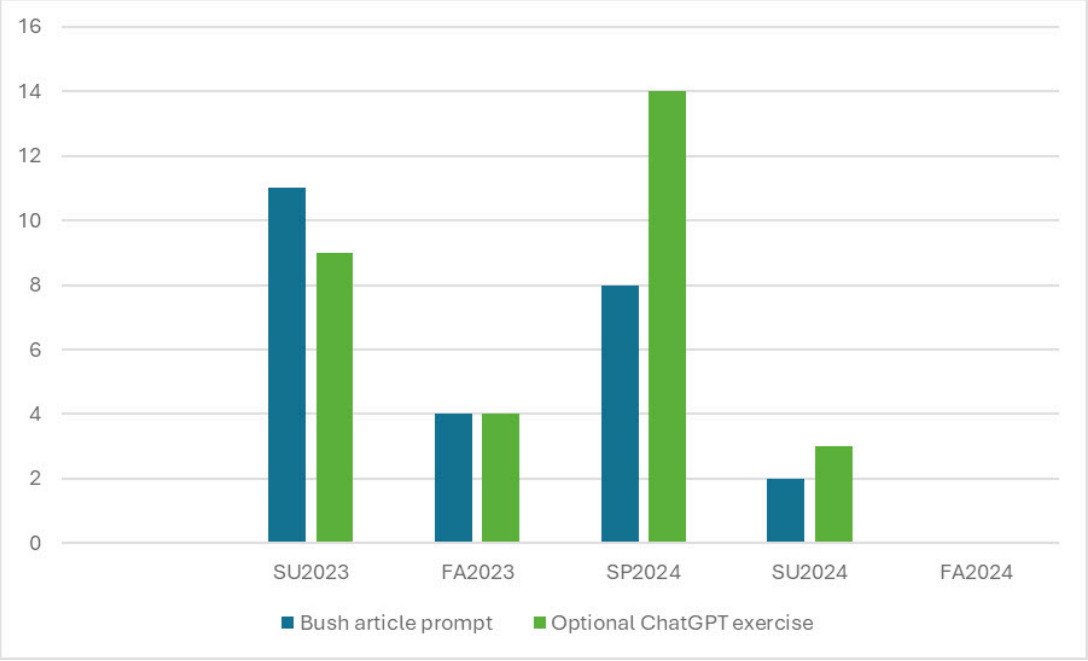
Results

These findings show how students enrolled in LSC 508 perceive the use of AI tools in the context of library and information science. They also document common concerns expressed by students using AI tools to complete course assignments. Student response to AI integrations within the LSC 508 demonstrates how an iterative approach to integrating AI into existing coursework can begin to prepare future information professionals to approach AI in effective and ethical ways.

The discussion board for Week 6 included students' spontaneous mentions of AI in response to prompts that were not focused on AI. Three discussion board questions related to the future -- of technology, of the information professions, and of LIS curricula. While AI is not mentioned in any of the prompts, student responses over the period studied included 85 mentions of AI. Of these mentions, six reflected positive perceptions of AI, 13 reflected negative perceptions of AI, and 66 reflected mixed or neutral perceptions of AI.

Between Summer 2023 and Summer 2024 (when the optional ChatGPT exercise was replaced with required lab assignments), 55 students responded to the Week 7 discussion board prompt. Of the 55 students who responded, 30 chose to complete the optional ChatGPT exercise and 25 did not. In all responses, AI was perceived positively through nine mentions, negatively through eight mentions, and in a mixed/neutral manner through 20 mentions.

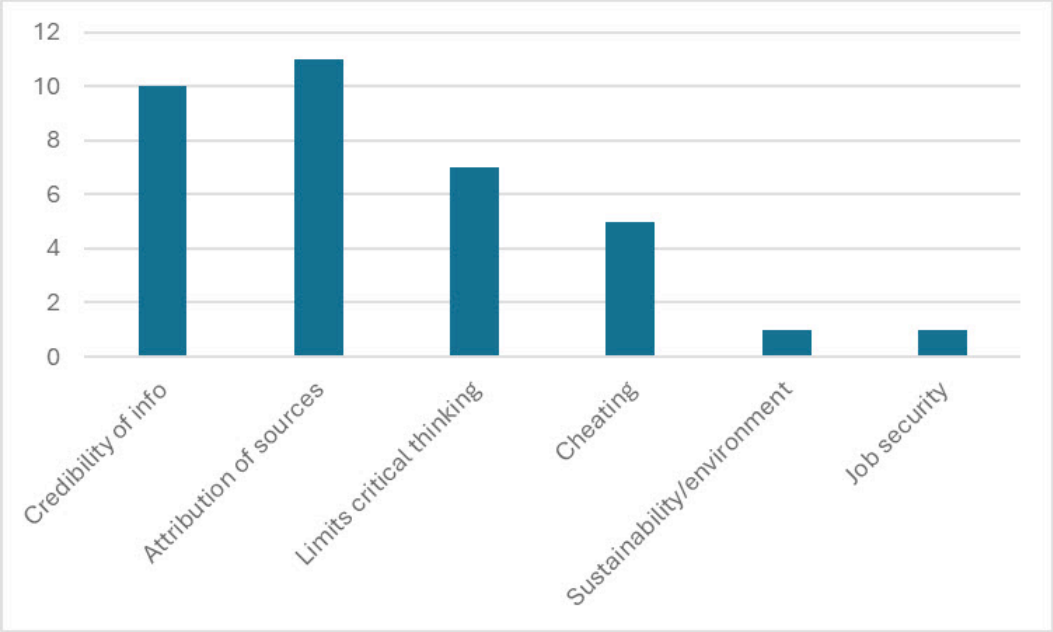
Figure 1: Students Completing Optional ChatGPT Exercise



After completing the required AI-based lab assignments that were introduced in Fall 2024, student reflections identified key concerns with using AI. The Week 5 lab assignment asked students to analyze an article, then use ChatGPT to do the same analysis and compare the two

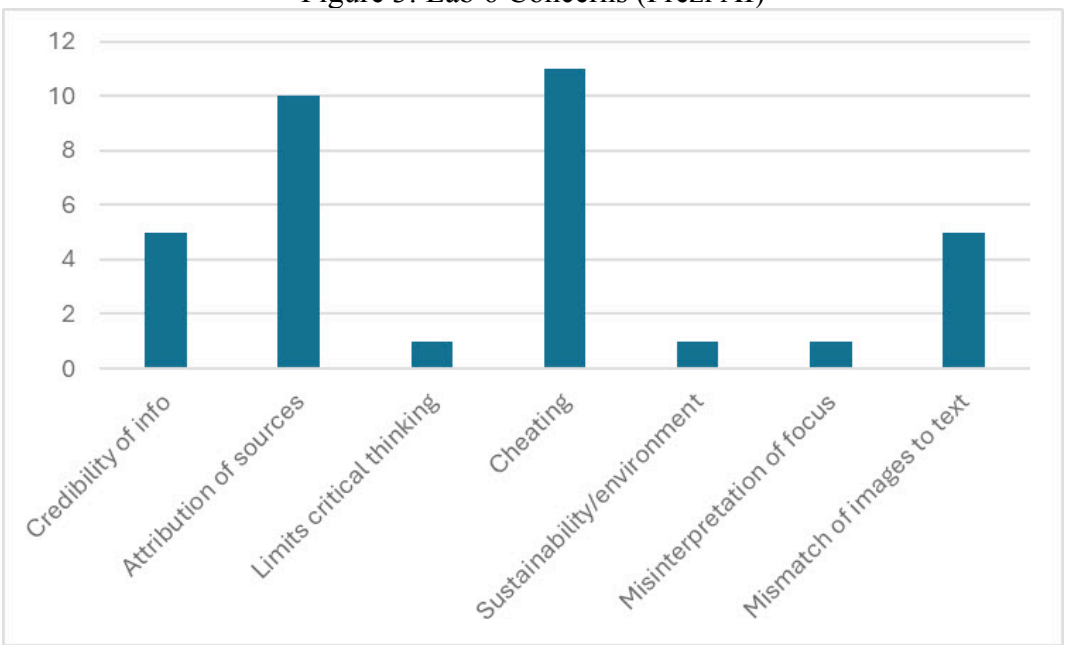
responses. Students discussed differences in terms of content but also reflected on the use of ChatGPT for learning. Student reflections identified four primary concerns with using ChatGPT: credibility of information, attribution of sources, limits to critical thinking, and potential for cheating. Job security and sustainability were also mentioned but not frequently.

Figure 2: Lab 5 Concerns (ChatGPT)



After completing the Week 6 lab assignment, which required students to create an online presentation using Prezi, then also use Prezi's "Create with AI" function to generate a presentation on the same topic and compare the two, student reflections identified four primary concerns with using AI: potential for cheating, attribution of sources, credibility of information, and mismatch of images to text. Limits to critical thinking, sustainability, and misinterpretation of focus were also mentioned to a lesser degree.

Figure 3: Lab 6 Concerns (Prezi AI)



Discussion

Library and Information Studies (LIS) students may exhibit a heightened sense of caution when engaging with AI tools, largely due to ethical concerns surrounding the information such tools provide. These concerns align closely with the ethical principles emphasized across the curriculum of URI's Library and Information Studies program, as well as those in similar LIS programs at other institutions. This alignment suggests that LIS students' exposure to ethical discussions in various courses may enhance their awareness of issues related to information and technology. In other words, coursework in library and information science is a strong basis for critical evaluation of the ethical use of AI tools and the information these tools generate.

In seeking to understand the nature of students' perceptions of AI, the author found that while some comments were clearly positive or negative, most mentions of AI reflected mixed or neutral attitudes. Within a single discussion board response, a student might highlight significant benefits offered by AI tools while also expressing deeply held ethical concerns that influence their willingness to use these tools. Through multiple sections of the course, there was no obvious trend in terms of student perceptions. In every section of the course, most mentions of AI reflected mixed or neutral perceptions, but the balance of negative and positive mentions varied with no clear pattern from section to section of the course.

Student reflections highlighted a range of ethical concerns, with some students expressing strong opinions that led them to consider abstaining from completing an assignment. Students who admitted reluctance to complete the ChatGPT assignment due to ethical concerns ultimately chose to proceed for the sake of learning, but these reactions underscore the need to recognize apprehensions which can impact both learning and professional development.

In considering how faculty might integrate AI tools and topics to foster critical thinking and ethical use in LIS Education (RQ3), the author looked at overall student interaction with course modifications introduced over time. While the incremental integration of AI into the LSC 508 course did not result in an obvious shift in student perceptions, there was change in the proportion of students who chose to complete the optional ChatGPT exercise after its introduction in Summer 2023. In Fall 2023, the number of students who participated was equal to the number who did not, but in Spring and Summer 2024, more students opted to do the ChatGPT exercise than those who did not. This change was likely due to the growing awareness of generative AI and ChatGPT in general, but student discussion also indicated a building sense of curiosity and a recognition gaining a better understanding of AI will be beneficial in their future careers. The increased uptake of the optional exercise, along with evidence that students were willing to override their reluctance for the sake of learning, implies that gradually introducing AI learning opportunities into coursework, and doing so in ways that allow students to explore and reflect, can be an effective way to build AI-related knowledge and skills while respecting students' individual perspectives.

Overall, students demonstrated a rigorous approach to evaluating AI-generated content, providing thoughtful critiques and recommendations for user education on potential issues. When analyzing ChatGPT outputs and AI-generated presentations in Prezi, students identified both overt and nuanced deficiencies, articulating how these shortcomings could influence their adoption of such tools in professional contexts. For example, students described the language in the Prezi AI-generated presentations as "generic" and "corporate," and one student observed that the article analysis generated by ChatGPT had "flattened"

distinct ideas into an overly simplistic summary. These insights, stemming from course discussion and learning activities, help demonstrate that LIS students have the potential to effectively apply information literacy principles and practices in using and guiding the use of AI tools in their future careers.

As students considered how they might guide information seekers in using AI tools, they showed recognition of the librarian's role in educating users about AI-generated information and best practices for using it ethically. Despite some reservations, students expressed willingness to increase their knowledge about AI tools to help foster AI literacy within their communities. This finding highlights the importance of incorporating AI literacy into LIS curricula to equip future librarians with the skills to navigate and teach about emerging technologies.

This study collected information about students' perceptions of AI but only from one class in one LIS program. As LIS programs evaluate how to best integrate AI into their curricula, it will be important to explore additional opportunities for addressing AI-related issues which are aligned with core competencies supported through the LIS education. Data about students' prior technological backgrounds was not collected, leaving a gap in understanding about how such experiences may shape student perceptions about AI. LSC 508 coursework has typically shown that students' familiarity with technology varies significantly, and this variance could certainly influence students' comfort level and approach to using AI tools, a factor that warrants further investigation.

Conclusion

This study highlights the critical need for integrating AI literacy into Library and Information Science (LIS) education to prepare students for the challenges and opportunities that AI brings to information professions. Findings from the LSC 508 course reveal that while LIS students approach AI tools with caution, they also demonstrate a willingness to critically engage with these tools to better understand their implications. Students' reflections illustrate their ability to evaluate AI-generated content rigorously, applying core information literacy principles to assess credibility, ethical considerations, and potential applications in information seeking.

Despite the prevalence of mixed and neutral perceptions about AI, students recognized the inevitability of its integration into professional practice and expressed a growing curiosity about its potential uses. By incorporating AI-related topics and tools into the curriculum, faculty can support students in developing the critical thinking skills and ethical frameworks necessary to navigate this rapidly evolving technology. This approach also ensures that LIS graduates are well-equipped to educate information seekers about responsible AI use, fostering broader AI literacy within their communities.

However, the study's limited scope—focusing on a single course within one LIS program—underscores the need for further research. Expanding the investigation to other courses and programs, as well as examining how students' technological backgrounds influence their perceptions, will provide a more comprehensive understanding of how best to integrate AI into LIS education. Additionally, exploring standardized approaches to AI literacy across LIS curricula could help ensure consistency and effectiveness in preparing students for the future of the profession.

As AI continues to transform the information landscape, LIS educators have a unique opportunity to promote ethical use of AI tools. By addressing student apprehensions and emphasizing the alignment of AI literacy with foundational LIS principles, educational programs like the one offered at the University of Rhode Island can ensure that future librarians remain a critical resource in a world increasingly shaped by artificial intelligence.

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

In preparing this paper the author used ChatGPT to improve the language and readability of selected sections. After using this tool, the author reviewed and edited the content as needed and takes full responsibility for the content.

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"POP THE CAP!" Pathways of Possibilities for Transforming Higher Education

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Abstract
Institutions of higher education are seeking different ways to address declining enrollment, weak graduation completion rates, and increasing concerns with widening equity gaps. In response, initiatives targeting affordable learning solutions have been gaining traction for reducing instructional material costs, while simultaneously improving retention rates and closing equity gaps. In this panel presentation, we will address the use of Open Educational Resources (OER) to enhance student learning with inclusive and immediate access, and provide data related to student success with our POP THE CAP courses. As part of our Department of Education Funds for the Improvement of Post Secondary Education (FIPSE) grant award, our presentation will focus on our collaborative pipeline from the California Community College (CCC) to the California State University (CSU) system, in establishing pathways of possibilities for transforming higher education. We address how we "POP THE CAP" with the use of OER adoptions for our 8 Curriculum Alignment Project (CAP) courses, highlighting challenges and successes with this intersegmental project for underrepresented and underserved student populations in our local region.

Keywords: Open Education Resources, Equity Gaps, Student Retention Rates

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Introduction

Across the USA, institutions of higher education appear to be seeking different ways to address declining enrollment, weak graduation completion rates, and increasing concerns with widening equity gaps while administrators attempt to reframe and extol the benefits of securing university degrees. Several institutions have recognized the importance of changing their approaches by adopting basic needs funding models, offering internships, dual certification courses recognizing high school and community college credits, as well as focusing on service-learning opportunities that promote high impact teaching practices to address potential employability concerns of students (Leavitt & Leigh, 2023). At the same time, university advancement units continue to create rebranding campaigns that shift the focus from a traditional model of philosophical teaching and learning in education to emphasizing marketability with greater attention to competency and skill-based training (Sturgis & Casey, 2018). As these shifts continue to target enrollment concerns and focus on the value of higher education in a high paced, technology enhanced, digitally driven working environment, the ongoing challenge for institutions of higher education continues to remain the issue of affordability.

As part of a Department of Education Funds for the Improvement of Post Secondary Education (FIPSE) grant award, our "POP THE CAP" project focuses on creating a collaborative pipeline from the California Community College (CCC) to the California State University (CSU) system, by establishing educational pathways of possibilities for transforming higher education for students in our region. We address the use of Open Educational Resources (OER) to enhance student learning with inclusive and immediate access to course materials on or before the first day of classes.

We examine how the use of OER adoptions can reduce the excessive burden on underrepresented and underserved student populations in our local region that negatively impacts them from reaching the finish line to earn their degree. In response to these concerns, Affordable Learning Solutions initiatives have been gaining traction for reducing instructional material costs, while simultaneously improving retention rates and closing equity gaps (Colvard et al., 2018; Hilton et al., 2014). Our focus on the eight Curriculum Alignment Project (CAP) courses in Child Development (outlined in CSUB's Pathways for Success) serve as the foundational transfer-baring courses that are aligned between the Community College and CSU system in California that students must complete for their associate's degree, leading to their bachelor's degree. In this paper, we highlight the challenges and successes with this intersegmental project for underrepresented and underserved student populations in our local region. We provide data related to student success with our POP THE CAP curriculum alignment courses and offer qualitative feedback from student surveys.

We believe that students should not be burdened with excessive debt because of the soaring costs associated with completing an undergraduate degree. Furthermore, the opportunities and benefits from successfully completing a degree should ensure that students can advance in the workforce, eventually changing the trajectory of their lives through education. For students in our region, education is a vehicle for mobility and socio-economic stability (UC Davis Center for Regional Change, 2017). Therefore, affordability and ease of access to course materials are imperative for student success.

Our attention and focus on integrating Open Educational Resources in lieu of textbooks were further endorsed with the active collaboration of our Community College partners on a Department of Education FIPSE grant. Our project is entitled Pathways of Possibilities for Transforming Higher Education Curriculum Alignment Project, better known as "POP THE CAP". This project has California State University, Bakersfield serving as the lead investigators with 4 sub-awardee partners: Antelope Valley College, Bakersfield College, Porterville College and Taft College. The structure of how our institutions operate enables our community college partners to offer the CAP aligned courses for transfer credit towards an undergraduate degree. As several of the students who enter university are transfer students, having earned an associate's degree that will count towards the first two years of a four-year degree, it was imperative that consistency across these transferable courses was achieved. To meet alignment and consistency in course content and materials, our collaboration focuses on trying to create a pipeline of OER from the community college to the California State University system.

Local Context

Our institutions are located within the interior of California, in more rural and desert areas. For example, California State University, Bakersfield is the only 4-year public institution of higher education within a 100-mile radius. Porterville College and Taft College share a similar positioning as institutions in rural areas, with Antelope Valley College located in the western Mojave Desert. Bakersfield College is the largest Community College in Kern County, serving over 40,000 students (Bakersfield College Educational Master Plan, 2023). At all five institutions of higher education, there are large numbers of first-generation students (students who are the first in their family to attend college and/or university). All the institutions are designated as Hispanic-serving institutions (HSIs) and Minority-serving institutions (MSIs) (UCOP, 2024). Given the regional context and local industries of agriculture and oil, there are large pockets of migrant workers earning minimum or less than minimum wage, contrasting with large groups of people working within the oil industry, where high salaries can be earned with limited education. It is worth noting that while the State of California is considered politically liberal, there remain pockets of places within the state, such as the Central Valley, and rural outlining areas that are politically very conservative. Despite the regional industries, the population demographics reflect higher rates of individuals categorized as low income with limited resources, encountering food insecurity, and housing instability (US Census Bureau, 2023).

Open Educational Resources (OER) and Student Learning

Open Educational Resources consist of openly licensed and distributed learning materials that are free of charge (UNESCO, 2019). Zero Cost Course Materials consist of materials that are free and have no cost to access or obtain and are available to all students (CSU AL$, n.d.). Some examples of OER are open electronic textbooks, open access journal articles, faculty-created course readers, and even materials that are created by students that are openly accessible. It is important to define the parameters around what constitutes and what would not be classified as OER. For example, photocopying from books or journal articles is not OER, even if these materials are distributed to students with no charge. Additionally, materials that have not been vetted but are available on the internet for free are not automatically designated as OER. While there may be concerns around the number of individuals required to assess materials that are designated as OER, the primary focus of the OER designation is that there has been a scholarly level of review of the materials by

qualified individuals in the field to ensure that the content has been verified, and that copyright and ADA compliance of OER materials have been thoroughly checked and/or vetted.

Theoretical Framework: The 5R's of OER

Outside of the cost savings that students enjoy with the integration of OER in lieu of textbooks, are the benefits of OER as an overall philosophy in teaching and learning. The 5 R Framework of OER demonstrate what individuals can do with OER (Wiley, 2014) and serves as our theoretical framework. For example, 1) Retain – Make and own copies of materials, 2) Reuse – Use material content in a wide range of ways, 3) Revise- Adapt materials by modifying, and improving on the originals, 4) Remix – Combine two or more pieces together, and 5) Redistribute – Share new materials with others. This philosophy of OER starts with the premise of an open shared space for learning to move forward by working with others to advance the educational enterprise by ensuring that education is open and accessible to all. In this way, the focus of OER is not 'ownership of knowledge' but rather a shared process of contributing to and enhancing our funds of collective knowledge.

Specifically in California, the attention to reducing educational costs with affordable learning initiatives has rendered additional funding support through the California Compact with the California State University system. As the largest system of higher education in North America, the initiatives that are identified in California pertaining to cost saving measures for students have also generated interest by other states across the USA. Governor Newsom's Compact with the California State University system requires the 23 universities within the CSU system to reduce educational costs by 50% by 2025. With adherence to the compact, the CSU will receive additional public funding as promised. This initiative has been central to the establishment of an Affordable Learning Solutions Initiative (AL$) at each of the 23 CSU campuses to address ways to reduce educational costs for students to meet the compact agreement. Several of the university initiatives have creatively worked to reduce costs through free or low-cost course materials, along with basic needs initiatives intended to drive down educational costs.

The value of OER for reducing costs must also be considered in terms of access to materials, especially when dependent on digital devices. The Digital Equity Act helps close the digital divide to ensure everyone in the United States, including the covered populations (i.e., racial/ethnic minorities, people with disabilities, aging populations, veterans, people with language barriers, low-income, incarcerated, and inhabitants in rural areas) have access to affordable, reliable internet services (Digital Equity Act, 2021). Digital divides were further illuminated and exacerbated during the pandemic with millions of Americans not using the internet at broadband speeds, and/or having any access to the internet (Internet for All, n.d.). We consider how OER assists to reduce textbook costs, with instructors and students developing OER materials to increase retention to graduation and reduce equity gaps by focusing on ensuring inclusion through access, and equity, which fosters justice for all students through learning and use of new rapidly evolving technologies.

Critical discussion for the use of OER to generate viable and sustainable solutions are needed. We must consider the context of inequities when thinking about what we mean when we refer to learning with OER as "open". How "open" is open? For example, the cost of access remains a central issue of concern. While practitioners are beginning to shift their educational paradigms from utilizing traditional textbooks to embracing Open Educational

Resources (OER) for supporting course instruction, some inequities continue to persist. For example, the context of inequities needs to be examined. Two specific areas that require review are the type of digital access that is available, and the how access is used (Pinsent-Johnson & Sturm, 2020).

One way to illustrate the impact of inequities with digital access and use is highlighted in this infographic.

Figure 1: Equity in Digital Access

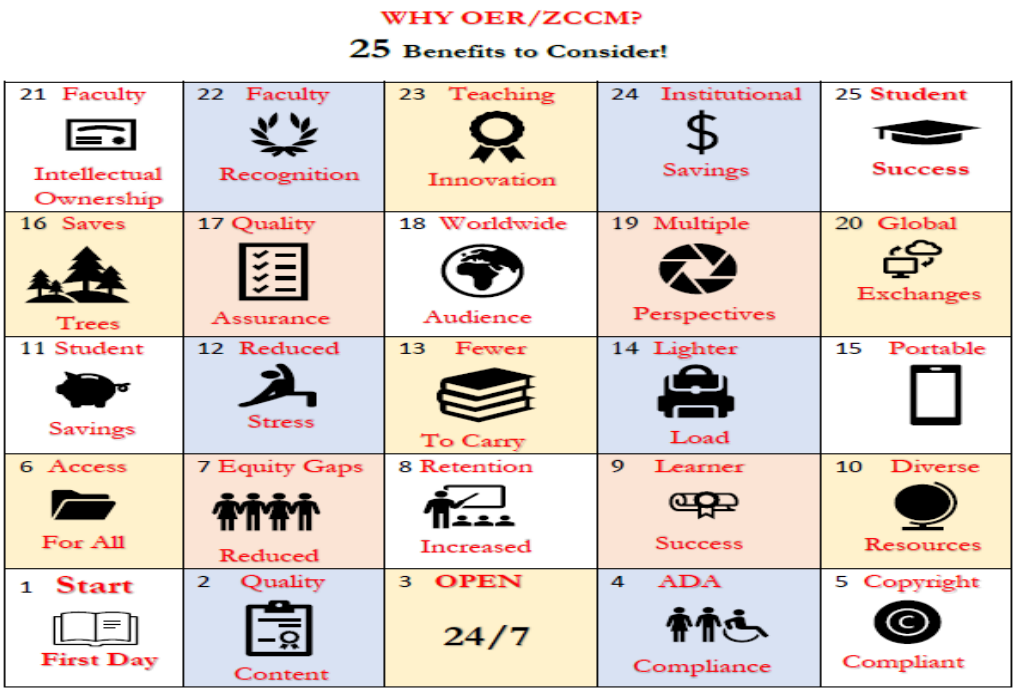
Source: Pinsent-Johnson, C. & Sturm, M. (2020). Ontario's Digital Divide: A Spotlight on the Differences in Online Connection, Activity and Benefits [Research Brief]. AlphaPlus. https://alphaplus.ca/resources/the-impact-of-ontarios-digital-divide/ [alphaplus.ca]

As indicated, typically, those with fewer resources, and limited finances encounter greater delays and less time to avail of the benefits of digital services. The differences in a day for an individual with seamless access are significantly more imposing and inconvenient on those with less financial means to access and use digital services. It is therefore important to consider what seamless access means, compared to limited access. In higher education, we have effective policy levers to remove many barriers that historically close doors to students like those served by institutions in rural or low-income areas. As indicated, we must first understand the role of faculty with new technologies in enhancing educational equity, and secondly, learn practical strategies for implementing zero-cost courses.

For faculty, while OER might be considered valuable, there remains resistance due to time constraints, no additional pay, workload concerns, limited guidance and or support, and continued skepticism about the quality of OER materials (Green, 2018). Whereas for students, the three most pressing concerns remain affordability, academic quality, and degree completion rates (Colvard et al., 2018).

As an example of the practical benefits of OER, here are 25 benefits that address justice, access, equity and inclusion with the use of OER.

Figure 2: Why OER/ZCCM



Source: Correa, E. (2023). Why OER/ZCCM? CC BY-NC-SA 4.0

Concerns about the lingering residual impact of structural inequities as simultaneously technological advances continue to soar invoke questions of: What does it mean to be truly OPEN for the use of Open Educational Resources (OER) and Open Educational Practices (OEP)? Institutional survey data is examined with a focus on improving how faculty seek, curate, expand, and promote OER/OEP adoption of free, culturally relevant, digitally inclusive affordable instructional materials and pedagogies. Educators must be mindful to avoid solely replicating Eurocentric content and pedagogies in their OER/OEP selection. Geographical location of the first author in open education articles can reveal the demand and use of which OER's are used and how often diversity in the selection of OER is considered (Ramírez-Montoya & Lugo-Ocando, 2020). Through reflective exploration of collaborative opportunities and challenges of influential technologies we explored how changes have impacted our goals and approaches to justice, access, equity, and inclusion. We engaged actively with our partners to gain insights into the complexities of adapting to transformational shifts in teaching and learning. Candid discussion on lessons learned navigating innovative pathways with the intersection of new technologies and OER were discussed.

Practitioners are beginning to shift educational paradigms to address equity, access, justice, and inclusion as seen by shifting educational paradigms from utilizing traditional textbooks to embracing Open Educational Resources (OER) for supporting course instruction and Open Educational Pedagogies (OEP). Often OER and OEP are aligned as strategies to help encourage and increase student engagement (Varma & Ren, 2023).

We ask the broad question of what does it mean to be OPEN? By interrogating the following areas, practitioners can reflect on the nature of open as it pertains to their OER materials.

Questions:

1) What are the current Policies for OER? – Do these policies make OER Open to everyone?
2) Is the OER SPACE really OPEN?
3) Are there barriers to ACCESS? Is Access OPEN?
4) Are Faculty and Administrators open to new ways of thinking and using diverse resources and materials?
5) How open is your institution to different values and different ideas?
6) How open is your institution to change and finding new spaces outside the defined contexts?
7) How open is the space to individual identities and differences?
8) How open are institutionalized practices to different experiences and alternative pathways?
9) How open is your institution to teaching and learning differently?

When thinking about the concepts of OPEN, we must not lose sight of the realities for those with limited resources, as they endure the financial crunch of trying to make ends meet. In terms of obtaining what is needed, we cannot automatically assume that everyone and every home has a digital device and programs (Reid & Correa, 2021). Not all students have digital literacy skills to navigate online access seamlessly. Also, those who have multiple working commitments will experience limited time to be able to access and navigate resources they need and have obtained. As discussions continue about reducing equity gaps and increasing retention to graduation rates, the revolutionizing power of OER and OEP is undeniable. However, we must recognize that three layers of digital divide must be considered for underserved and/or underrepresented populations. We must consider how they will "Get connected", what their "regular use" would entail, and "how they will obtain what is needed" (Ragnedda & Ruiu, 2017). For example, To get connected – is there stable WIFI and appropriate broadband speed? Cost cannot be ignored when considering regular use. Also, what is needed for students in terms of time, and use must be considered at the forefront of any discussion related to the terms of "Use", - how will use be paid for by those on fixed or limited incomes? Educators must continue to have expectations and advocate for high quality, efficiency and speed, along with lower costs as these are all fundamental components to OER that must be examined to ensure that the concept of OER as truly OPEN.

Conclusion: Practical Strategies

Based on the work of David Wiley, the use of OER in teaching and learning can encourage the production of increased scholarship with students taking ownership over their own production of OER materials. Wiley and Hilton's (2018) suggestions are helpful in addressing different ways faculty can create assignments that engage students in assignments that serve as "living works" that extend beyond the timeframe of the course or classroom. Additionally, increasing attention to the importance of equitable access to educational resources greater participation of students from underserved and underrepresented populations can increase.

These are a couple of ways in which students contribute to creating an educational pathway that is innovative, increasing opportunities for justice, access, equity, and inclusion for all. For example, have students contribute to OERS that are already available, including course readers and open-source articles (Wiley & Hilton, 2018).

Another strategy that can be employed is creating non-disposable assignments. The value of providing students with opportunities to complete non-disposable assignments enables students to contribute to discussions that can be built upon in the next semester as these discussions are written by students from the previous term/semester, serving as a building block for the next new student cohort. Additionally, students can work on Wikipedia pages or contribute to existing OERs. The message is clear, that anything is possible.

In conclusion, OER and OEP can level the playing field, when the concept of OPEN extends beyond simply using open-source materials, and actively including students into their own learning, by seeking materials, including diverse perspectives and engaging global content that reflects an array of knowledge. As institutions are faced with declining enrollment, graduation completion rates, and equity gaps, the implementation of OER and OEP serves as an effective strategy to enhance accessibility, affordability, and inclusivity. Through our "POP THE CAP" initiative, we have demonstrated how strategic partnerships between community colleges and universities can foster curriculum alignment, ensuring a seamless transfer pathway that reduces financial and academic barriers for students.

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