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Message from the Editor-in-Chief

Editors' Note

The January 2026 issue of The Turkish Online Journal of Educational Technology (TOJET) presents a comprehensive and globally representative collection of scholarly studies that explore the intersections of educational technology, artificial intelligence, digital pedagogy, inclusive education, leadership, and learner engagement. The contributions in this issue collectively reflect how technology-enhanced learning environments are reshaping teaching practices, learner experiences, institutional leadership, and educational policy across diverse cultural and national contexts.

A significant number of studies in this issue focus on the pedagogical, cognitive, and behavioral implications of artificial intelligence and emerging digital technologies. The article "Exploring the Effectiveness of AI-Generative Tools in Improving Vocabulary and Engagement among Elementary School Students in Oman" by Fatma Al Naabi and Maimoona Al Abri provides empirical evidence demonstrating how AI-supported instructional tools positively influence vocabulary development and student engagement at the primary education level. Extending this discussion to higher education, "Acceptance of Artificial Intelligence Tools among Undergraduates: An Application of the Technology Acceptance Model" by Edwin Osmil Coreas-Flores examines undergraduate students' perceptions, attitudes, and behavioral intentions toward AI-based tools through the lens of the Technology Acceptance Model (TAM), offering valuable insights into the factors influencing AI adoption in university learning environments. Complementing these empirical perspectives, "Understanding How Generative AI Cultivates Self-Directed Learning Capabilities" by Guo Shouchao, Xu Ningjie, and Xu Zhenguo offers a conceptual framework that situates generative AI within the historical evolution of digital technologies, highlighting its role in promoting learner autonomy and lifelong learning competencies.

Digital and blended learning environments constitute another prominent theme of this issue. The study "Hong Kong Students' Perception of Providing Students with Digital Learning Materials Improves Learning Experience" by Hon Keung Yau, Wai Keung Chiu, and Yu Jin Cheah investigates students' perspectives on digital learning resources and their impact on learning satisfaction and effectiveness. Similarly, "The Development of Blended Teaching Using Learning Platforms in College English Education under the Influence of AI" by Yan Xinli and Naruemon Thepnuan examines how AI-enhanced learning platforms support blended instructional models in higher education language teaching.

Issues related to inclusion, equity, and learner diversity are addressed through multiple empirical and experimental studies. The randomized controlled trial "The Effect of an Inclusive Education Course Delivered Through a Flipped Learning Approach on Pre-Service Teachers' Self-Efficacy" by Yogaranee Sakthivel provides strong evidence that flipped learning designs can significantly enhance pre-service teachers' confidence and preparedness for inclusive educational practices. Complementing this focus on inclusive learning environments, "Application of Strategies for Conflict Resolution for First-Year Undergraduate Students in Yunnan Province, China" by Yanyan Fan and Thosporn Sangsawang explores instructional strategies aimed at developing interpersonal and conflict resolution skills among university students, emphasizing the role of educational interventions in fostering social and emotional competencies in higher education.

The issue also highlights digital inclusion, leadership, and governance in education. The comparative policy analysis "Contrasting National Strategies for Digital Inclusion in Education: A Comparative Analysis of Mauritius and Singapore" by Karolina Radyńska-Cenkier offers valuable insights into how national-level strategies shape equitable access to educational technologies. At the institutional level, "An Examination of the Views on the Technological Leadership of School Administrators Working in Primary Schools in North Cyprus" by Gamze Dağ and Sonay Dericioğlu underscores the importance of visionary and competent leadership in the effective integration of technology within schools.

The social and psychological dimensions of digital culture are critically examined in "The Unseen Observer: The Psychology of Silent Following in Social Media Culture" by Ferhat Atik, which sheds light on passive participation, visibility, and engagement in online social environments. In a related vein, "Examination of University Students' Perceptions of Online Social Capital" by Gönül Şener explores how digital platforms influence social interaction, trust, and academic collaboration among university students.

Teacher education and quality assurance emerge as another key thematic strand. “Core Quality Components in Contemporary Teacher Education Systems” by Jafar Jafarov presents a strategic and institutional perspective on quality frameworks in teacher education, emphasizing sustainability, leadership, and systemic improvement in higher education systems.

Language learning and collaborative digital practices are addressed in “Arabic Learners’ Perceptions of Google Docs-Mediated Small-Group Collaborative Writing” by Maher Abdel Alkhateeb, highlighting the pedagogical value of collaborative technologies in supporting language development and learner engagement. Finally, “Enhancing Vocational Graduate Employability through Mobile Applications on Advanced Quantitative Modeling of Skills and Partnerships” by Yang Wang and Thosporn Sangsawang focuses on vocational education, demonstrating how mobile learning applications can strengthen employability skills and industry–education partnerships.

Taken together, the articles in this issue reflect TOJET’s ongoing commitment to advancing high-quality, interdisciplinary research on educational technology, artificial intelligence, inclusive education, leadership, and digital transformation. We believe that the theoretical perspectives and empirical findings presented in this issue will offer valuable insights to researchers, educators, practitioners, and policymakers seeking to design more inclusive, effective, and future-oriented learning environments.

On behalf of the editorial board, I extend my sincere appreciation to all authors and reviewers for their scholarly contributions and dedication. We hope that this issue will stimulate further research, dialogue, and innovation in the rapidly evolving field of educational technology.

Call for Papers:
TOJET welcomes academic studies in the field of educational technology. Submitted articles may address topics such as the use of technology in classrooms, the impact of technology on learning, and the perspectives of students, teachers, administrators, and the community on educational technology. Such studies will enhance the quality of theoretical and practical approaches in educational technology.

Article Submission Criteria:
Submitted articles must be original, unpublished, and not under consideration by another publication.
Articles may cover a wide range of topics, including assessment , attitudes and beliefs, curriculum design, equity, applied research, learning theories, sociocultural issues, and educational practices for special populations.

Warm regards,

Editor-in-Chief
Prof. Dr. Aytekin İŞMAN
Sakarya University
Prof. Dr. Teresa Franklin
Ohio University
The Turkish Online Journal of Educational Technology (TOJET)
January 2026

Editorial Board

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An Examination of the Views on the Technological Leadership of School Administrators Working in Primary Schools in the North Cyprus

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ABSTRACT
The purpose of this study is to evaluate the views of school administrators working in primary schools affiliated with the Ministry of National Education of the Turkish Republic of Northern Cyprus regarding technological leadership. A qualitative research approach was employed in the study, and within this framework, a case study design was adopted. The study group consists of school administrators (principals and vice principals) working in public primary schools under the Primary Education Department of the Ministry of National Education of the TRNC. For this purpose, the researcher employed a semi-structured interview method and developed an interview form consisting of eight semi-structured questions. This interview form was used as the data collection tool. Content analysis was applied to analyze the qualitative data.
The findings indicate that school administrators largely associate the concept of technological leadership with competence in "using technology accurately and effectively" and "possessing sufficient technological knowledge." In addition, perceptions of technological leadership behaviors emphasize openness to innovation, guiding teachers in the use of technology, and directing groups toward effective use of technology. The study further reveals that the majority of administrators consider the existing technological infrastructure and equipment inadequate, and that the current infrastructure and schools' socioeconomic conditions directly affect administrators' technological leadership roles.
Based on the study's results, it is recommended that practical technology training programs be organized for teachers and school administrators, that budget allocations be increased and infrastructural deficiencies addressed, that equal technological resources be provided to schools, and that the effective use of educational technologies in teaching be expanded.
Keywords: School administrator, technology, leadership, technological leadership

INTRODUCTION

In the modern era in which we live, technology is regarded as advanced and continues to develop daily across many fields. The rapid advancement of technology affects all institutions, including educational institutions. In this process of change and transformation, it is of great importance for educational organizations to be successful and to use their resources effectively (Gülmez, 2021).

The effective use of educational technologies in schools necessitates the education of individuals equipped with the competencies required by the information society. In this context, it is of great importance that not only teachers but also all stakeholders working in educational institutions—particularly school administrators—can adapt to this technological transformation (Özmen, 2022). School administrators are expected to closely follow developments in the field of technology and to integrate innovations into teaching and learning processes in the most appropriate manner. This integrated process, which requires planning and integrating technology use in parallel with changes in educational environments arising from the continuous development of technology, as well as providing the necessary infrastructure, professional development, and support services for educational components, brings the importance of technological leadership in education to the forefront (Anderson, 2005).

School administrators should enhance the quality of instructional processes by ensuring the effective and efficient use of educational technologies; at the same time, they should assume a guiding role in developing the knowledge and skills of teachers and other educational staff in this field (Başaran, 2000). In this context, the technological leadership demonstrated by school administrators emerges as a decisive factor in enabling educational staff to develop their technological competencies and to adapt to processes of change.

According to Durak (2022), an individual who can be described as a technological leader is expected to use technology effectively and to motivate individuals working within the organization to engage in the use of technology. Within this framework, it is of great importance that school administrators possess the competence to use educational technologies effectively and have developed basic literacy skills related to information technologies. Individuals in administrative positions are expected to create environments that enable students and educational staff to integrate technology efficiently into the educational process. Furthermore, monitoring technological innovations, adapting these developments in accordance with the structure of the school, and implementing them in practice should be considered among the technological leadership competencies that a school administrator is expected to possess.

The purpose of this study is to evaluate the views of school administrators working in primary schools affiliated with the Ministry of National Education (MoNE) of the Turkish Republic of Northern Cyprus (TRNC) regarding technological leadership. In this context, based on the main research question, the sub-objectives of the study can be listed as follows:

1. How do school administrators define the concept of leadership?
2. How do school administrators define the concept of technological leadership in the current century?
3. What are school administrators' views regarding their technological leadership self-efficacy in the institutions where they work?
4. What are school administrators' opinions about the quality of the existing technological infrastructure and technological equipment in their schools?
5. What behavioral characteristics related to technological leadership should school administrators possess?
6. How do school administrators think that the information technology infrastructure of schools affects their technological leadership competencies positively or negatively?
7. How do school administrators think that the economic level or environment of the schools in which they work affects their technological leadership competencies positively or negatively?
8. What are school administrators' recommendations for expanding the use of educational technologies at the primary education level in the country?

METHODOLOGY

Research Design

This study was designed in accordance with the qualitative research method. In qualitative research, the primary focus is on gaining an in-depth understanding of the phenomenon under investigation within its own context. The qualitative research approach emphasizes understanding different perspectives, conducting descriptive analyses, and interpreting the data obtained. The research process progresses in a natural flow, and the findings are interpreted by being associated with theoretical frameworks in order to reach conclusions (Balcı, 2016).

In this study, the case study design, which is one of the qualitative research methods, was preferred. Case studies are regarded as one of the research methods used to describe the details influencing the formation of a phenomenon, to develop possible explanations related to the phenomenon, and to evaluate the relevant case (Büyüköztürk et al., 2023).

Study Group and Sampling

In qualitative research methods, the study group consists of individuals whom the researcher interviews or observes to collect data, and it is determined in accordance with the research questions and objectives. In qualitative research, the primary concern is to collect in-depth data from participants who are aligned with the research questions. Therefore, in qualitative studies, selecting participants who are relevant and appropriate to the research is considered more important than having a large number of participants (Yıldırım & Şimşek, 2021).

The study group of this research consists of a total of 45 school administrators (principals and vice principals) working in primary schools affiliated with the Ministry of National Education of the Turkish Republic of Northern Cyprus during the 2024–2025 academic year. In determining the participants, the maximum variation sampling method, which aims to include individuals with diverse characteristics in the study, was preferred. As stated by Yıldırım and Şimşek (2021), the main purpose of maximum variation sampling is to reflect the widest possible range of differences in the characteristics of individuals who may participate in the research. Accordingly, in the process of forming the study group, attention was paid to ensuring diversity in the sample by considering various demographic variables such as participants' years of experience, age range, and educational background.

Data Collection Tool

In this study, the interview technique was employed as a qualitative data collection method. As the data collection instrument, a semi-structured interview form developed by the researcher was used. The interview form, which

was developed based on a review of the relevant literature and expert opinions, consists of eight open-ended questions. The interview form was tested through pilot applications conducted with three school administrators.

In qualitative research, interview instruments are generally designed with a flexible structure and include open-ended questions that allow participants to express their thoughts in detail (Merriam, 2013). These questions are posed to interview participants in the same order, and participants are allowed to express their responses with the level of detail and scope they prefer (Yıldırım & Şimşek, 2021). In this study, a semi-structured interview form was prepared to examine the views of school administrators working in primary schools in the TRNC regarding technological leadership was used, and participants were provided with the opportunity to freely express their own experiences.

Data Collection Process

To conduct interviews with 45 school administrators working in the TRNC, written permission was obtained from the Primary Education Department of the Ministry of National Education of the TRNC (Appendix 1), and an application was submitted to the Ethics Committee of the Institute of Social Sciences at Akdeniz Karpaz University, where all required documents were duly provided.

The study group consists of principals and vice principals working in primary schools located in the districts of Nicosia, Famagusta, Kyrenia, Güzelyurt, İskele, and Lefke, which are affiliated with the Primary Education Department of the Ministry of National Education of the TRNC. During the research process, primary schools were visited, and interviews were conducted with the participants. Throughout the interviews, a semi-structured interview form consisting of questions prepared by the researcher for school administrators was used. The study was conducted after obtaining ethical approval from the Institute of Social Sciences at Akdeniz Karpaz University. The interviews commenced in the spring semester of the 2024–2025 academic year and were completed in May.

Data Analysis

In this study, a semi-structured interview form was used as the data collection tool, and the content analysis method was preferred for the analysis of the data obtained. Content analysis is an analytical technique that involves the process of coding data and interpreting the relationships among these codes. The main objective of this method is to identify explanatory concepts derived from the collected data and to reveal the relationships among these concepts. The analysis process consists of data coding, the formation of categories, the identification of themes, the organization of categories and themes, and the interpretation of the findings (Yıldırım & Şimşek, 2021). The information obtained from the analysis process may provide potential hypotheses and research areas for future studies, thereby offering new directions for scientific research. While the analysis results enable researchers to develop new ideas and approaches for addressing existing problems, they also contribute to the literature (Büyüköztürk, 2011).

To ensure confidentiality, the participating school administrators were assigned different pseudonyms. Codes such as (P1, P2, …) were used for principals, and (VP1, VP2, VP3, …) for vice principals. During the research process, responses to the interview questions were recorded in written form, and an in-depth analysis was conducted on these responses. In line with the main purpose of the study, the responses obtained from participants were grouped under specific themes. These themes were organized according to similarities and differences in participants' responses. Subsequently, the grouped responses were coded in accordance with the progression of the analysis. During the coding process, tables were prepared to facilitate a clearer understanding of the responses.

Validity and Reliability

Qualitative research is based on the researcher's objective and unbiased examination of the phenomenon under investigation. In this study, various strategies were employed to ensure validity and reliability throughout the qualitative data collection and analysis processes.

Kirk and Miller (1986) define *validity* as the researcher's ability to present the observed events and the collected data objectively. In order to ensure validity, the researcher employs various methods to verify the accuracy of the collected data and the resulting findings. Some of these methods include additional verification processes, such as obtaining feedback from participants or peers.

In qualitative research, it is acknowledged that realities may vary due to personal perceptions and environmental conditions. Therefore, repeating the same study with different groups or under different conditions does not always yield identical results. Reliability is a critical concept in terms of the robustness and replicability of a qualitative study. The consistency of the data collected by the researcher and the systematic conduct of the research are important factors that enhance reliability. While the methods used to ensure reliability may differ between

qualitative and quantitative research, in qualitative research, reliability is grounded in the researcher's stance toward neutrality and objectivity (Yıldırım & Şimşek, 2021).

Various methods can be employed to ensure reliability in qualitative research. The involvement of more than one researcher, as well as conducting data analysis at different times and through retrospective comparisons, contributes to enhancing reliability. In addition, consulting expert opinions during the data analysis process and conducting a thorough review of the literature while reporting the data support both the reliability and validity of the study.

Findings

Table 1. Demographic Characteristics of the Participants

Variable	**Category**	**f (n)**	**%**
Gender	Female	29	64.4
	Male	16	35.6
Position	Principal	24	53.3
	Vice Principal	21	46.7
Age	36–40 years	10	22.2
	41–45 years	10	22.2
	46 years and above	25	55.6
Educational Background	Graduate of Atatürk Teacher Academy/College	40	88.9
	Graduate of the Faculty of Education (Primary School Teaching)	2	4.4
	Graduate of the Faculty of Education (Special Education Teaching)	3	6.7
Undergraduate Degree	Primary School Teaching	38	84.4
	Preschool Teaching	4	8.9
	Special Education Teaching	3	6.7
Postgraduate Education	M.A. in Educational Administration and Supervision	30	66.7
	Ph.D. in Educational Administration, Supervision, and Planning	3	6.7
Years of Administrative Experience	0–5 years	15	33.3
	6–10 years	13	28.9
	11–15 years	5	11.1

An examination of Table 1 indicates that 29 of the participants (64.4%) are female and 16 (35.6%) are male. It is observed that 24 participants (53.3%) serve as principals, while 21 participants (46.7%) serve as vice principals. In terms of age distribution, the majority of the participants are 46 years of age and above. Specifically, 10 participants (22.2%) are between the ages of 36 and 40, 10 participants (22.2%) are between the ages of 41 and 45, and 25 participants (55.6%) are aged 46 and above. When the educational background of the study group is examined, it is seen that 40 participants (88.9%) are graduates of the Atatürk Teacher Academy/College.

The number of participants who graduated from the Primary School Teaching departments of Faculties of Education was identified as two, while three participants were graduates of the Special Education Teaching department. Additionally, 38 participants reported having completed an undergraduate degree in Primary School Teaching, whereas four participants completed Preschool Teaching and three participants completed Special Education Teaching undergraduate programs.

A total of 45 school administrators participating in the study are employed in 21 different schools. The diversity of the schools in which the administrators work indicates that the study encompasses a wide range of schools and reflects the views of administrators from different regions and school contexts.

Table 2. Evaluation of School Administrators' Views on the Concept of Leadership

Themes	N	%
Open to innovation, understanding, fair, and trustworthy	6	13.3
Able to solve problems and demonstrate empathy	13	28.9
Visionary	8	17.8
Able to provide direction	20	44.4
Motivation-oriented	11	24.4
Ability to influence and inspire	15	33.3
Possessing team spirit and effective communication skills	16	35.6
Creating a collaborative environment and being familiar with the group	7	15.6
Taking initiative and serving as a role model	13	28.9
Eliciting respect and admiration; wise	9	20.0
Establishing and managing new structures	11	24.4
Possessing task management skills and a sense of responsibility	7	15.6
Self-confident and providing guidance	12	26.7

An examination of Table 2 reveals that school administrators' perceptions of the concept of leadership are multidimensional. The highest proportion of participants (n = 20) defined leadership as the ability to provide direction. This finding indicates a strong perception of leadership as a guiding and decision-making process. Following this, 35.6% of the participants stated that a leader should possess team spirit and effective communication skills, emphasizing that effective leadership gains meaning within a collective structure.

Table 3. Evaluation of School Administrators' Views on the Concept of Technological Leadership in the 21st Century

Themes	n	%
Encouraging the use of technology	10	22.2
Adapting to technological developments	6	13.3
Use of and proficiency in technology	8	17.8
A fundamental leadership type of the 21st century	6	13.3
Guiding technology use, following innovations, and self-development in technology	11	24.4
Supporting teachers through in-service training	7	15.6
Using technology accurately and effectively, possessing technological knowledge	17	37.8
Integration of technology into educational processes and administration	6	13.3
Utilizing technology in administration	7	15.6
Providing vision and infrastructure for the integration of education and technology	9	20.0
Lack of knowledge regarding the concept of technological leadership	7	15.6

According to Table 3, the participants evaluated the concept of technological leadership within a multidimensional framework. It is understood that the competency of "using technology accurately and effectively and possessing technological knowledge" was identified as the core element of technological leadership by the highest proportion of participants. In this context, technological leadership can be said to be associated with having technological knowledge and the ability to use technology consciously and purposefully. Moreover, by emphasizing dynamics such as guiding technology use, following innovations in the field, and continuous self-development, the participants defined technological leadership as a developmental process. Accordingly, technological leadership is perceived not as a concept limited to existing knowledge, but as a process that requires continuous improvement and guidance.

Table 4. Evaluation of School Administrators' Views on Technological Leadership Self-Efficacy

Themes	n	%
Guiding educational technologies	12	26.7
Using basic computer skills and smart devices	16	35.6
Using technology in administrative tasks and MoNE correspondence	23	51.1
Using technology in communication groups and the institution's social media sharing	7	15.6
Experiencing difficulty in keeping up with technological developments	9	20.0
Need for self-improvement in technology	6	13.3

According to Table 4, a large proportion of the participants stated that they can use technology effectively in administrative procedures and official correspondence, and it is also evident that perceptions of self-efficacy related to basic computer use and the use of smart devices are widespread. However, self-efficacy perceptions appear to be more limited in areas that require pedagogical leadership, such as guiding the use of educational technologies. Another group of participants reported using technology in social media and communication groups; however, this use can be considered relatively superficial. In addition, the presence of participants (20%) who reported difficulties in keeping up with technological developments, along with those who expressed a need for self-improvement, indicates that school administrators are aware of their competencies in this area but require support and training. This situation highlights the importance of systematic professional development programs for administrators in order to transform technological leadership competencies into institutional capacity.

Table 5. Evaluation of Administrative Perceptions Regarding the Adequacy of Schools' Technological Infrastructure and Equipment

Themes	n	%
Those who believe it is adequate	6	13.3
Those who believe it is not adequate	18	40.0
Lack of smart boards and internet connectivity problems	33	73.3
Insufficiency of technological infrastructure	16	35.6
Insufficient educational technologies	14	31.1
Availability of basic equipment	12	26.2
Appropriateness for the century we live in	9	20.0

According to Table 5, the majority of the participants stated that the technological infrastructure and equipment of the schools in which they work are not at the required level. In contrast, another group of participants considered the infrastructure to be adequate. A lack of smart boards and problems with internet connectivity were reported by a large proportion of the participants. In addition, insufficiencies in technological infrastructure and educational technologies were frequently expressed by the participants.

Table 6. Evaluation of School Administrators' Views on Technological Leadership Behavioral Characteristics

Themes	n	%
Open to innovations	21	46.7
Visionary	13	28.9
Guiding teachers and directing the group toward technology	20	44.4
Following technological developments	17	37.8
Willing to learn and conduct research	17	37.8
Using technology effectively	12	26.2
Effective communication and strong persuasive skills	4	8.9
Generating budgetary resources	4	8.9

As shown in Table 6, the participants stated that school administrators, as technological leaders, demonstrate behaviors such as being open to innovations, guiding teachers, and directing the group toward the use of

technology. While describing the behavioral characteristics of school administrators, the participants also emphasized behaviors such as following technological developments and being willing to learn and engage in research.

Table 7. Evaluation of School Administrators' Views on the Relationship Between Information Technology Infrastructure and Technological Leadership

Themes	n	%
Positive impact	18	40.0
No impact	13	28.9
Negative effects of technological infrastructure	4	8.9
Increasing administrators' motivation	3	6.7
Providing opportunities to demonstrate technological leadership roles	8	17.8

According to Table 7, a large proportion of the participants stated that information technology infrastructure contributes positively to school administrators' technological leadership. However, another group of participants reported that the existing infrastructure has no effect. Participants also expressed that the current infrastructure of schools provides administrators with opportunities to demonstrate their technological leadership roles. Overall, the findings indicate that information technology infrastructure has multidimensional effects on school administrators' technological leadership. Among the participants, the view that technological infrastructure contributes positively to administrators' ability to perform their leadership roles effectively was widely expressed. This suggests that infrastructure offers administrators opportunities to use technology and provide guidance, thereby strengthening technological leadership behaviors. On the other hand, some participants perceived information technology infrastructure as ineffective, indicating the presence of differing perceptions related to the quality of infrastructure or the ways in which it is utilized.

Table 8. Evaluation of School Administrators' Views on the Relationship Between Schools' Socioeconomic Status and Technological Leadership

Themes	n	%
Positive impact	18	40.0
Negative impact	14	31.1
No impact	13	28.9

An examination of Table 8 shows that participants offered differing evaluations regarding the relationship between a school's socioeconomic status and school administrators' technological leadership. Some of the school administrators participating in the study stated that socioeconomic status has a positive effect on technological leadership. Conversely, others indicated that a low socioeconomic level of the school negatively affects technological leadership. A considerable proportion of participants, however, reported that socioeconomic status does not affect technological leadership. Overall, these findings suggest that a school's socioeconomic status may influence school administrators' perceptions and practices of technological leadership in different ways.

Table 9. Evaluation of School Administrators' Recommendations for Expanding the Use of Educational Technologies in Teaching

Themes	n	%
Increasing budget allocation by the MoNE	17	37.8
Resolving internet connectivity problems	5	11.1
Organizing practical technology training for teachers and administrators	29	64.4
Providing equal technological equipment to schools by the MoNE	11	24.4
Addressing infrastructural deficiencies	14	31.1
Establishing cooperation with the private sector	2	4.4
Including a computer course in the primary school curriculum	2	4.4
Establishing an IT unit within schools	5	11.1
Creating an educational technology sharing platform by the MoNE	6	13.3

Themes	n	%
Enhancing teacher motivation	5	11.1

According to Table 9, school administrators put forward various recommendations aimed at promoting the more widespread and effective use of educational technologies in teaching. A large proportion of the participants considered the organization of practical technology training programs for teachers and administrators to be necessary, and this recommendation constituted the majority of the responses. When examining the views ranked second in frequency, participants emphasized increasing the budget allocated to schools by the Ministry of National Education and addressing infrastructural deficiencies. Overall, the findings indicate that administrators primarily prioritize the organization of practical technology training for teachers and administrators, perceiving this as a fundamental requirement for the effective use of educational technologies. In addition, the need for structural support, such as budget increases, the elimination of infrastructural deficiencies, and the provision of equal technological equipment to schools, is strongly emphasized. Furthermore, recommendations related to establishing IT units within schools and creating educational technology sharing platforms point to the importance of strengthening systematic support mechanisms through technological infrastructure and collaborative models.

DISCUSSION

The research findings indicate that school administrators working in the TRNC have multidimensional perceptions of the concept of leadership. It is observed that the majority of participants emphasized the ability to provide direction when defining leadership. This finding is consistent with Özden's (2006) definition of leadership as "the ability to influence followers and guide and direct them toward achieving a specific goal."

It is understood that school administrators in the 21st century regard the competency of "using technology accurately and effectively" as the core element of technological leadership. The findings obtained from this study are consistent with those reported in the literature. In his study, Can (2007) emphasized that a technology leader is an individual who uses technology correctly while mobilizing the capacities of employees. Similarly, Özmen (2022), in his study examining the technological leadership roles expected by teachers from school principals, concluded that the majority of participants emphasized the roles of effectively using technology and possessing technological knowledge.

On the other hand, it is observed that school administrators tend to evaluate their technological leadership self-efficacy positively, primarily due to their effective use of technology in administrative tasks. A large proportion of the participants stated that they can use technology effectively in administrative procedures and official correspondence, and that perceptions of self-efficacy related to basic computer use and smartphone use are also widespread. This finding is consistent with the results reported by Ölez and Kılıçoğlu (2018). In their study, Ölez and Kılıçoğlu (2018) indicated that school administrators generally use technology actively in correspondence with the relevant ministry of education. Participants also reported that they effectively utilize the internet and telephones for communication with authorities on behalf of their institutions. However, according to the study titled *Teachers' Perceptions of School Principals' Technological Leadership* conducted by Erden and Erden (2007) in the TRNC, it was concluded that school principals' technological leadership competencies were not perceived as high by teachers. This finding differs from the results of the present study.

According to the research findings, the majority of school administrators' perceptions of technological leadership behavioral characteristics are concentrated on being open to innovations, guiding teachers in the use of technology, and directing the group toward technology. This result is consistent with findings reported in the relevant literature. Yahşi (2020) defines the core components of effective technological leadership as knowing how to use technology to enhance learning processes, developing strategies to support teachers' technology integration, and establishing a technology team and support system within the institution to promote the sustainable use of technology.

Results and Conclusions

In this study, school administrators working in primary schools in the TRNC defined the concept of leadership primarily in terms of the ability to provide direction and guidance, while they largely explained the concept of technological leadership through the competency of "using technology accurately and effectively" and possessing technological knowledge. The findings also indicate that participants feel confident in using everyday technological tools at a basic level and that they tend to use technology mainly for administrative tasks and official correspondence.

It was concluded that the majority of school administrators consider the existing technological infrastructure and equipment to be inadequate. In particular, the limited number of smart boards and problems with internet connectivity emerged as key factors hindering the effective use of technology in educational processes.

With regard to school administrators' perceptions of technological leadership behaviors, characteristics such as being open to innovations, guiding teachers in the use of technology, and directing the group toward technology were found to be particularly prominent.

It is observed that information technology infrastructure in schools has multidimensional effects on school administrators' technological leadership. While a large proportion of participants stated that the existing technological infrastructure serves a supportive function for administrators' technological leadership roles, some administrators expressed the view that the information technology infrastructure is inadequate or ineffective.

Notable findings were also obtained regarding the impact of socioeconomic status on technological leadership. Some administrators stated that a school's high socioeconomic level positively supports technological leadership practices, noting that greater resources and opportunities provide advantages in adopting technology and pursuing innovative practices. In contrast, there are views indicating that in schools with a low socioeconomic level, technological leadership activities are constrained due to limited resources, infrastructural deficiencies, and insufficient support. Nevertheless, some participants argued that socioeconomic status is not a determining factor, suggesting that leadership attitudes and competencies can develop independently of context or be supported through alternative means.

The participants within the scope of the study primarily consider the organization of practical technology training programs for teachers and school administrators to be necessary. In addition, administrators emphasize the importance of structural support, including increasing budget allocations, addressing infrastructural deficiencies, and ensuring the provision of equal technological equipment to schools.

Recommendations

Practical Recommendations for Implementation

- It is recommended that regular, practical, and up-to-date technology training programs be organized for school administrators. These programs should aim to develop not only administrators' technical skills but also their competencies in the pedagogical and strategic use of technological tools.
- It is recommended that all schools be provided with technological infrastructure under equal conditions and in line with contemporary requirements, and that solutions be developed to address internet connectivity problems and the shortage of smart boards.
- It is recommended that school administrators support technology integration in both administrative and pedagogical contexts and serve as role models for teachers in the effective use of technology.
- In addition to providing hardware to enable school administrators to use technology effectively, it is recommended that technical support and consultancy services be offered in schools to ensure the efficient use of this infrastructure.
- In order to enhance school administrators' technological leadership roles, it is recommended that a comprehensive strategic plan be developed within the Ministry of National Education of the TRNC. This plan should include provisions for equity in technology use, continuous professional development, and infrastructural improvements, and should be supported by monitoring and evaluation mechanisms.

Recommendations for Future Research

- It is recommended that quantitative and mixed-methods studies be conducted to examine the relationship between school administrators' and teachers' technological leadership skills.
- Future studies may compare the technological leadership competencies of school administrators who have participated in in-service training programs on current technological developments and educational technologies with those who have not participated in such training.
- To evaluate the effects of technological leadership in educational settings from a broader perspective, it is recommended that similar studies be conducted with the participation of teachers and students.

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Application of Strategies for Conflict Resolution for First-year Undergraduate Students in Yunnan Province, China

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ABSTRACT
The objectives of this study were to 1) investigate the efficiency of an application based on conflict resolution strategies for first- year undergraduate students in Yunnan Province, China, 2) compare students' academic performance before and after using the application, and 3) assess students' satisfaction with the application. The sample consisted of 30 an application based on conflict resolution strategies for first-year undergraduate students in Yunnan Province, China, selected through purposive sampling. The research instruments included the conflict resolution application, a pretest, a post- test, and a student satisfaction questionnaire. The statistics used for analyzing the data were percentage, mean, standard deviation, and the t-test for the dependent sample.The research findings revealed that the application was effective in enhancing student learning, achieving an E1/E2 efficiency score of 81.40/81.23. Expert evaluations rated the content of the application as highly appropriate ($\bar{x}$ = 4.51, SD = 0.50) and the media design as excellent ($\bar{x}$ = 4.78, SD = 0.50). Students' post-test scores ($\bar{x}$ = 16.27, SD = 1.48) were significantly higher than their pre-test scores ($\bar{x}$ = 8.80, SD = 2.33), with a t-value of 20.68 at the .05 level of significance. Furthermore, student satisfaction with the application was high, with a mean score of 4.51.
Keywords: conflict resolution strategies, educational application, undergraduate students

INTRODUCTION
The pursuit of developing and promoting an academic environment conducive to reducing social conflict the inevitable conflict of social interaction requires consideration of individual identities from diverse backgrounds, values, and perspectives. Adapting to social harmony, human development, and the creation of conflict-reduction environments and strategies in higher education aim to enhance students' crucial interpersonal skills, including communication, empathy, negotiation, and problem-solving. These skills not only foster harmony in the classroom but also prepare students for future professional and social environments. Teamwork and collaboration among students are essential. Conflict is a vital and unavoidable part of human interaction, especially in educational environments where diverse opinions, academic needs, and interpersonal dynamics converge. Undergraduate students in Yunnan Province, China, face various forms of conflict, such as peer discord, group project disputes, cultural misunderstandings, and confrontations between professors and students. If left unmanaged, these conflicts can negatively impact academic achievement, mental health, and university harmony. Research on the impact of the learning environment on academic achievement at Guangdong Provincial University of Technology highlights the importance of a friendly, inclusive, and stimulating learning environment that fosters student engagement, motivation, and academic success. This research analyzed the components of a constructive learning environment, namely student unity, support, participation, collaboration, and equality. Descriptive, comparative, and correlational research methods were used to collect data from 407 students respondents. The findings indicated that age significantly impacted perceptions of student unity; gender and curriculum had no significant impact on perceptions of support, participation, collaboration, and equality. Suggestions for improvement included increasing faculty awareness and training, promoting collaborative learning, and providing ongoing support and opportunities for participation. Continuous improvement and revision are recommended to meet the diverse needs of students and promote academic and personal development (Su, C., 2024).

The integration of artificial intelligence (AI), the use of games, interactive role-playing, and peer mediation can assist undergraduate students in Yunnan Province in developing practical problem-solving skills aligned with cultural needs. Digital technology, particularly mobile applications, is used to enhance learning and skill development. However, digital tools specifically developed to teach students about conflict resolution are limited. The integration of games on language learning outcomes among Chinese students, while exploring the impact on

learner motivation, the effectiveness of games as a motivational tool, and digital literacy as a key component, provides deeper insights into individual learning experiences (Shen, Z., Lai, M., & Wang, F., 2024).

Yunnan Province, China is characterized by ethnic diversity, with over 25 ethnic groups. These groups exhibit differences in language, communication styles, and cultural values, leading to misunderstandings and inappropriate conflict resolution. Chinese students often avoid direct confrontation, posing unique challenges in conflict resolution (Hofstede, 2010). Traditional conflict resolution strategies are less effective due to Yunnan's ethnic diversity, which necessitates resolving conflicts arising from differences in language, communication styles, and cultural values. Traditional conflict resolution methods may be ineffective due to these differences. The general tendency of Chinese students to avoid direct confrontation presents challenges and mechanisms for conflict resolution. Customary law and state mediation are prevalent in areas such as Lanping County, where the Yi ethnic group relies on customary law for conflict resolution. The lack of coordination between the state and civil society contributes to disagreements and conflicts (Qi, Y., 2023). Natural multiculturalism in northwestern Yunnan is maintained through intermarriage, linguistic interaction, and shared rituals. This natural form of multiculturalism fosters empathy and unity. From the typical nation-state community model (Wu, K., 2024), cultural and educational integration and cultural and educational diversity present challenges. Integrating ethnic minorities into the broader Chinese culture poses educational challenges. Multicultural communication skills are needed to overcome cultural and communication barriers in schools, impacting the academic performance of ethnic minority students. 8. Preserving Cultural Identity: Rapid urbanization and globalization have intensified cultural conflicts in Yunnan. Efforts to preserve cultural diversity depend on respecting cultural identity and improving cultural integration. 3. Economic and Social Dynamics: Tourism and Economic Resilience: Ethnic tourism in Yunnan, driven by small family businesses, highlights the resilience and adaptability of these communities. Cultural Governance: Yunnan's cultural governance is crucial for social stability and development. The province's unique cultural characteristics, influenced by its geographical location and ethnic diversity, require appropriate management strategies to effectively manage cultural resources. Yunnan's ethnic diversity necessitates constructive conflict resolution strategies, respect for cultural differences, and the natural utilization of cultural diversity. Efforts in educational and cultural integration must consider the specific needs of ethnic minorities. Economic resilience in tourism and effective cultural governance are essential for maintaining social harmony and promoting sustainable development in the region.

Conflict resolution and compromise are essential skills, but at the undergraduate level, students in Yunnan Province lack systematic training and readily available resources to effectively manage disputes. Several key factors contribute to this problem, including: inadequate conflict resolution education – most colleges in Yunnan do not offer formal conflict resolution courses in their undergraduate programs; students resort to trial-and-error approaches to problem-solving, resulting in increased tension instead of successful resolution; cultural barriers to direct conflict resolution – many students in China prefer indirect communication, avoiding direct confrontation even when challenges demand resolution, leading to lingering resentment, unresolved conflicts, and heightened tension among students; a lack of digital solutions for conflict resolution training – colleges are reliant on e-learning platforms or developing dedicated mobile or online applications designed to assist students in practicing and enhancing their conflict resolution abilities; current internet-based mediation services primarily address legal or organizational issues rather than academic and social problems; diverse student demographics and linguistic challenges – Yunnan's multilingual context hinders dispute resolution, resulting in miscommunication due to language differences; adaptive learning technologies are crucial in meeting the diverse needs of students; and unsuccessful mediation and peer support mechanisms. Student counseling and dispute resolution services face challenges due to a lack of awareness and bias regarding seeking help. Digital applications can provide a sensitive, user-friendly, and dynamic platform for students to engage in self-mediation and peer negotiation. The importance of conflict resolution is highlighted, and a conflict resolution application designed for undergraduate students in Yunnan will bridge the gap between theoretical understanding and practical application of conflict resolution. It will offer engaging and immersive teaching experiences using simulations, AI-powered mediation, and gamification, providing multilingual support to accommodate Yunnan's diverse ethnic student population. Furthermore, it will enhance students' emotional intelligence, communication skills, and negotiation skills, leading to improved academic and social interactions. Undergraduate students in Yunnan often struggle with conflict management due to insufficient resources and information, resulting in miscommunication, stress, and deteriorating relationships. Therefore, developing a conflict resolution application is crucial in equipping students with the necessary skills to resolve problems constructively and foster a more harmonious and collaborative academic environment.

Given the importance of the aforementioned problems, the researchers conducted research on the application of conflict resolution strategies for first-year undergraduate students in Yunnan Province, China. They designed learning activities on conflict reduction strategies through a digital conflict resolution application game. The

content covered included: enhancing conflict resolution abilities; systematic guidance on negotiation, mediation, and problem-solving strategies; reducing academic and social stress; assisting students in managing disputes; reducing anxiety through psychology; fostering positive university experiences; facilitating multicultural communication; supporting multilingualism and culturally relevant communication strategies for equality and teamwork; approaches to dispute resolution in the academic environment; improving collaboration and efficiency; access to ongoing learning and support; counseling to reduce prejudice and promote compromise and mediation; enhancing emotional intelligence and communication skills; helping students develop self-awareness, empathy, and the ability to listen to others; preparing students for future careers; and developing negotiation and leadership skills. Therefore, conflict resolution is crucial for undergraduate students in Yunnan Province, China, yet there is a lack of systematic training and resources to help students develop these skills. The digital conflict resolution application aims to address this problem by offering interactive, user-friendly, and culturally relevant solutions. This application helps develop students' conflict resolution abilities. To foster a creative learning environment and enhance emotional intelligence; to strengthen classroom and group dynamics; to strengthen student support services; to help overcome cultural and linguistic barriers; to promote intercultural understanding; and to prepare students for work in professional environments, thereby promoting a more peaceful society and improving mental health and quality of life; and to foster self-development, academic achievement, and professional readiness for undergraduate students in Yunnan Province.

LITERATURE REVIEW

Relevant literature related to this research includes: the effectiveness of applying conflict resolution strategies; learning through the application of conflict resolution strategies for an application based on conflict resolution strategies for first- year undergraduate students in Yunnan Province, China; and the use of applying conflict resolution strategies.

Conflict Resolution Applications. This focuses on the theoretical framework, incorporating interdisciplinary theories from psychology, education, communication, and instructional technology, focusing on the design, implementation, and evaluation of a digital application aimed at enhancing students' conflict resolution abilities within academic and social contexts. Conflict Resolution of theoretical framework, shush as 1) Social constructivist theory emphasizes that knowledge and skills are constructed through social interaction and shared experiences in the context of conflict resolution. This theory highlights the importance of dialogue, collaboration, and reflection in resolving interpersonal conflicts. First-year undergraduate students transitioning from high school to university life often face diverse perspectives, cultural differences, and new social environments. Applying conflict resolution based on social constructivist theory fosters peer interaction through simulations, discussion-stimulating questions, and collaborative problem-solving tasks, enabling learners to collaboratively build understanding and develop practical conflict management skills, 2) Conflict resolution theory views conflict as a natural and potentially creative process. Effective management involves understanding the origins of conflict, recognizing different conflict types, and using appropriate strategies such as negotiation, mediation, compromise, cooperation, and avoidance. Integrating conflict reduction guidance for students and practicing strategy selection through life experiences at the Yunnan University, includes group work, dormitory life, and intercultural communication, 3) Social Learning Theory: Individuals learn behaviors and attitudes through observation, imitation, and reinforcement. Effective conflict-solving behaviors demonstrated in the application, such as respectful communication, emotional control, and empathetic listening, can influence responses to conflict. The application, role-playing, video demonstrations, and feedback mechanisms allow students to learn from demonstrated behaviors and receive reinforcement for making constructive conflict resolution choices, 4) Emotional Intelligence Theory: Emotional intelligence is the ability to recognize, understand, and effectively manage emotions in oneself and others amidst emotional conflict situations arising from stress, academic pressure, and adaptive challenges. Integrating emotional intelligence into the application framework will support students in developing self-awareness, empathy, emotional regulation, and social skills, enabling them to manage emotions constructively during conflicts, 5) Experiential learning, reflection, idea generation, and active experimentation: Presenting interactive conflict scenarios that reflect real-life situations in a university environment; engaging in decision-making processes; reflecting on outcomes; enhancing the transfer of conflict resolution skills from digital environments to real-world interactions, 6) Effective use of technology and adoption, through the design of effective applications and learning outcomes for conflict resolution within cultural contexts, ethnic diversity, and multicultural interaction (Vinokur, E., Yomtovian, A., Marom, M., Itzchakov, G., & Baron, L., 2024).

Available Digital Conflict Resolution Tools and Application of Conflict Resolution Strategies in Diverse Environments, Cultural Differences, Values, and Perspectives: Understanding how to manage and resolve conflict constructively, academic success, and positive social relationships are crucial. Technological advancements provide numerous digital tools to support conflict resolution by promoting communication skills, empathy, and negotiation. The use of software applications and platforms designed to foster understanding and

reduce individual differences, communication and mediation platforms, allows for expressing opinions, listening to others, and achieving mutual understanding. Mediation software facilitates step-by-step conflict resolution with pre-defined frameworks that promote empathy and fairness. In modern society, conflicts arising from inappropriate emotional expression highlight the fundamental importance of mediation technology in conflict resolution. The use of reasoning to clarify the role and responsibilities of mediators in developing conflict resolution skills ensures that parties are prepared to communicate objectively, reason effectively, and make sound decisions in resolving conflicts (Hnatyshyn, Y., Klishch, H., & Sas, L., 2024).

Components of the Online Mediation Platform, this digital system is designed to facilitate conflict resolution through communication, negotiation, and systematic decision-making, helping students effectively reduce dispute resolution. For first-year undergraduate students, the online mediation platform is designed to provide an accessible, flexible, and supportive environment for learning and applying conflict resolution strategies. Key components of the online mediation platform include: 1) Registration channels using student ID or verified email addresses. User profiles can include basic demographic information, role identification e.g., student, mediator, instructor, privacy settings, secure login and authentication, role-based access control, privacy protection, and data confidentiality. 2) Conflict reporting module allows users to formally report or describe conflict situations. Users can enter relevant details such as the nature of the dispute, the parties involved, duration, and desired outcome. 3) Effective communication and discussion tools for mediation. These tools support respectful and constructive dialogue among participants, including asynchronous messaging, discussion boards, private messaging and synchronous communication, chat or video conferencing. 4) Message control and conversation tracking; the message board provides guidance on mediation steps and processes, outlining procedures for identifying problems, sharing perspectives, generating alternatives, and reaching an agreement. An effective online mediation platform integrates secure user management, a structured mediation process through communication tools, and reflective learning elements. Such a platform will support constructive conflict management and skill development, particularly for first-year undergraduate students adjusting to a new academic and social environment. This study examines the modeling of conflict resolution capabilities within the context of the digital transformation of educational processes. Conflict resolution abilities impact effective collaboration and the ability to resolve complex interpersonal relationships. The study analyzes the conflict resolution capabilities of future leaders under digital conditions to achieve the objectives of analysis, synthesis, summarization, systematization, and comparison. This reveals key aspects and defines fundamental concepts of the studied issues. The model comprises knowledge, operational, and reflective components. The conflict resolution process includes the following steps: assessing foundational knowledge and skills; developing conflict resolution capabilities; identifying online resources for conflict resolution capacity building and providing technological and methodological support for effective use; planning and controlling the implementation of the conflict resolution capacity development process; and planning and managing knowledge, communication, and professional learning processes by applying digital technology for successful conflict resolution capacity development (Алькема, В., & Акініна, Н., 2025).

METHODOLOGY

This research studies the effectiveness of applying conflict resolution strategies for an application based on conflict resolution strategies for first-year undergraduate students in Yunnan Province, China, through quantitative data collection and analysis. The researcher followed a research methodology consisting of the following components. This research uses a quantitative experimental design, collecting quantitative data using a test. The researcher employed a pre- and post-test design with a single group. The design diagram is detailed as follows: Group O1 x O2 (O_1 = pre-test score measurement, x = application of conflict resolution strategies for first-year undergraduate students in Yunnan Province, China, to improve academic achievement, O_2 = post-test score measurement).

Population and sample: The population of this research consists of 500 an application based on conflict resolution strategies for first-year undergraduate students in Yunnan Province, China, in the 2025 academic year. The sample consists of 30 an application based on conflict resolution strategies for first-year undergraduate students in Yunnan Province, China, in the 2025 academic year. They were selected using purposive sampling because they are students of the researcher's advisor.

Research Instrument; Instruments for an Application on strategies for conflict resolution for an application based on conflict resolution strategies for first-year undergraduate students in Yunnan Province, China. 1) Investigate the efficiency of an Application on strategies for conflict resolution, 2) Compare an application based on conflict resolution strategies for first-year undergraduate students in Yunnan Province, China students' achievements before and after learning through Pretest and Posttest students' achievements before and after learning through digital learning according to an Application on strategies for conflict resolution, 3) Examine an application based

on conflict resolution strategies for first- year undergraduate students in Yunnan Province, China students' satisfaction with of using the satisfaction questionnaire examines students' satisfaction with using an Application on strategies for conflict resolution.

Procedure; Operational Procedure 1) Study the effectiveness of applying conflict resolution strategies for an application based on conflict resolution strategies for first- year undergraduate students in Yunnan Province, China, to improve academic achievement of an application based on conflict resolution strategies for first- year undergraduate students in Yunnan Province, China. The students 'considering the E1/E2 = 80/80 value (Chaiyong Brahmawong, 2015). (E1) is the percentage of the average score or the average of all scores students received from activities or homework such as exercises, practice, projects, and formative assessments. (E2) is the percentage of the average score or the average of all scores students received from post-tests, final exams, and evaluations. The effectiveness of applying conflict resolution strategies for an application based on conflict resolution strategies for first- year undergraduate students in Yunnan Province, China. The students to improve student academic achievement was evaluated by 3 content experts and 3 media experts. The quality of the application's content regarding conflict resolution strategies for an application based on conflict resolution strategies for first-year undergraduate students in Yunnan Province, China students, to improve student academic achievement was evaluated according to the perceptions of content experts who work in the field of conflict resolution strategy planning for students. Media professionals working in conflict resolution strategy planning, Computer technology and education, or related fields were asked to evaluate the appropriateness of the content used in the application on conflict resolution strategies for students. The researcher followed these steps; *First Step*; the evaluation in this research was developed in line with the study's hypothesis. Therefore, the questionnaire was developed based on the two theories used in this study. The study showed that the use of an application on conflict resolution strategies for an application based on conflict resolution strategies for first-year undergraduate students in Yunnan Province, China, improves the academic achievement of first-year undergraduate students in Yunnan Province, China. The questionnaire had two main parts. *Part 1*;the first part aimed to measure expert opinions on the use of technology, specifically the application on conflict resolution strategies for an application based on conflict resolution strategies for first-year undergraduate students in Yunnan Province, China, to improve academic achievement in Yunnan Province, China. This part was a closed questionnaire using a five (5) point Likert scale. Participants were asked to rate their agreement with each statement on a scale of 1-5. The interpretation of each numerical value is detailed below.

Table1: Range of mean and verbal interpretation

Range Value	Verbal Interpretation
4.50-5.00	Excellent
3.50-4.49	Good
2.50-3.49	Average
1.50-2.49	Poor
1.00-1.49	Very Poor

An open-ended questionnaire was used to ask participants to provide comments and feedback on the application of conflict resolution strategies for an application based on conflict resolution strategies for first- year undergraduate students in Yunnan Province, China, in teaching planning. *Second Step*; Three measurement and evaluation experts with expertise in education or measurement and evaluation were asked to assess the language of the questionnaire prior to evaluation. This data was used to calculate the Objective-Relevant Conformity Index (IOC). The evaluation experts assessed the content quality of the Objective-Relevant Conformity Index (IOC) and found it to be 0.93. The evaluation results are detailed below. Subsequently, the evaluation was reviewed by content experts for further evaluation. Measurement and evaluation experts assessed the outcomes as measured by the Objective-Relevant Conformity Index (IOC) and found it to be 0.93. Later, media experts conducted an evaluation to facilitate further evaluation. Therefore, a cumulative average score of the Objective-Relevant Conformity Index (IOC Index) exceeding 0.5 is considered acceptable. Objective-relevant conformity was evaluated using the following criteria, as shown in Table 2.

Table 2: Value of item objective congruence index (IOC) and verbal interpretation

+1	item is considered congruent with the objectives.
0	item is considered neutral in terms of whether it was congruent with the objectives.
-1	items are considered not congruent with the objectives.

The total mean score of the Item-Objective Congruence (IOC) Index is supposed to be higher than 0.5 for acceptable data. *Third Step*; The experts will use the assessment of content quality aspects of Application on Strategies for Conflict Resolution for an application based on conflict resolution strategies for first- year undergraduate students in Yunnan Province, China; to enhance learning achievement of an application based on conflict resolution strategies for first- year undergraduate students in Yunnan Province, China for content experts and the assessment of media quality aspects of Application on Strategies for Conflict Resolution for an application based on conflict resolution strategies for first-year undergraduate students in Yunnan Province, China a teaching for media experts.

The achievement assessment (Pretest and Posttest); a pretest and posttest shared the same items. Both contained 40 questions related to Chinese reading that they had learned in class: 20 items contained Chinese reading taught using an application on strategies for conflict resolution for an application based on conflict resolution strategies for first-year undergraduate students in Yunnan Province, China, and the other 20 items contained Chinese reading taught using a traditional teaching Approach. The students were assigned to complete the Pretest before learning Chinese through an application on strategies for conflict resolution for an application based on conflict resolution strategies for first-year undergraduate students in Yunnan Province, China and then take the posttest after learning Chinese in this approach. The researcher went through the following steps: *First Step*; The researcher selected the test types. Multiple-choice tests were chosen to use in the study, *Second Step*; The second section of the questionnaire has been developed to measure students' academic Achievement in an application on strategies for conflict resolution for an application based on conflict resolution strategies for first- year undergraduate students in Yunnan Province, China, *Third Step*; Three measurement and evaluation experts who work in the field of measurement and evaluation or education were asked to check the congruence between objectives and items in the test. The data obtained were used to calculate the Item Objective Congruence Index (IOC). The evaluation criteria were used for checking the congruence between objectives and items of the test as follows the value of item objective congruence index (IOC) and verbal interpretation of achievement assessment. The total mean score of the Item-Objective Congruence (IOC) Index is supposed to be higher than 0.5 for acceptable data, *Fourth Step*: both the pretest and posttest were administered to 30 first-year undergraduate students in Yunnan Province, China majors who had an Application on Strategies for Conflict Resolution subjects and were enrolled at an application based on conflict resolution strategies for first- year undergraduate students in Yunnan Province, China but were not part of the study sample. After the tests have been administered, they are used to determine the difficulty index, discrimination index, and reliability index of the achievement test. It was found that the difficulty index should be between 0.2 and 0.8, the discriminant index should be 0.2 or higher, and reliability should be 0.8 or higher, using Kuder-Richardson's K-R20 formula, *Fifth Step*; the pretest and posttest are used with participants to explore their vocabulary knowledge before and after learning Chinese through an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province, China.

The questionnaire on students' satisfaction with an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province, China. The questionnaire was used to gather Application on Strategies for Conflict Resolution for an application based on conflict resolution strategies for first- year undergraduate students in Yunnan Province, China. The researcher took the following steps. *First Step*; the questionnaire in this study has been developed to fit the study hypothesis. Consequently, it was developed based on both theories that have been utilized in this study. The study demonstrates that utilizing application on strategies for conflict resolution for an application based on conflict resolution strategies for first- year undergraduate students in Yunnan Province, China, as outlined in the enhances learning achievement in the teaching of Career Development and Career Planning subjects at Yunnan Province, China. The questionnaire has two main sections, each with its own aim. *Part 1*: The first section aims to measure students' satisfaction with online learning platforms. This part was a close-end questionnaire that was based on the five (5) point Likert-type scales. The participants were asked to rate their degree of agreement with each statement on a scale of 1-5. The interpretation of each Number is described as follows (5 meaning Strongly agree; 4 meaning Agree; 3meaning Undecided; 2 meaning Disagree; 1 meaning Strongly disagree).

Table 3: Range of mean and verbal interpretation

Range Value	Verbal Interpretation
4.50-5.00	Excellent
3.50-4.49	Good
2.50-3.49	Average
1.50-2.49	Poor
1.00-1.49	Very Poor

Part 2: This part was an open-ended questionnaire. The participants were asked to express their opinions and suggestions regarding learning through strategies for conflict resolution planning, in the context of Chinese subject teaching, in terms of achievements and satisfaction. *Second Step*; Before administering the questionnaire, three measurement and evaluation experts working in the field of measurement and evaluation or education were asked to review the appropriateness of the Chinese subject teaching used in the questionnaire. The data obtained were used to calculate the Item Objective Congruence index (IOC). The evaluation criteria were used for checking the congruence between objectives and items of the test as follows value of item objective congruence index (IOC) and verbal interpretation of questionnaire on teacher's satisfaction. The total mean score of the Item-Objective Congruence (IOC) Index is supposed to be higher than 0.5 for acceptable data. *Third Step*; The participants will use the questionnaire to explore their satisfaction with learning through an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province, China, as in the questionnaires were applied to first-year undergraduate students in Yunnan Province, China.

Data collection;1) Introduce students to an application based on conflict resolution strategies for first-year undergraduate students in Yunnan Province, China to enhance learning achievement at Yunnan Province, China, 2) Administer the teacher's Pretest to receive the score, 3) Conduct learning activities with students by utilizing lessons through an application based on conflict resolution strategies for first-year undergraduate students in Yunnan Province, China, following in Strategies for Conflict Resolution Planning subject teaching. 4) Administer a post-test to students after they have studied an application based on conflict resolution strategies for first-year undergraduate students in Yunnan Province, China and analyze the scores using statistical methods.

Data and Statistical Analysis; The researcher conducted the data analysis using the following procedures. 1) Find the efficiency of an application based on conflict resolution strategies for first-year undergraduate students in Yunnan Province, China enhance the learning achievement of first-year undergraduate students in Yunnan Province, China, as indicated by E_1/E_2 = 80/80 (Chaiyong Brahmawong, 2015). (E1) is the percentage of the average or means of all scores the students earn from their activities or assignments, such as drills, exercises, project work, etc., or other types of formative evaluation. (E2) is the percentage of the average or means of all scores the students earn from their posttest, final examinations, and other summative evaluations. 2) Compare the achievement test results before and after using an application based on conflict resolution strategies for first-year undergraduate students in Yunnan Province, China to enhance the learning achievement of first-year undergraduate students in Yunnan Province, China, using a dependent t-test, and 3)Study the satisfaction of students in an application based on conflict resolution strategies for first-year undergraduate students in Yunnan Province, China to enhance the learning achievement of first-year undergraduate students in Yunnan Province, China, using mean and standard deviation. The 5-Level Likert Scale; 5 meaning Strongly Agree; 4 meaning Agree; 3 meaning Neutral; 2 meaning Disagree; 1 meaning Strongly Disagree.

Data Interpretation (Criteria); in research, the mean is often used to summarize the overall picture, using the following class interval formula (4.21 – 5.00: Highest level; 3.41 – 4.20: High level; 2.61 – 3.40: Medium level; 1.81 – 2.60: Low level; 1.00 – 1.80: Lowest level).The basic statistics in data analysis are the formula for calculating the arithmetic mean ($\bar{x}$) is:

The formula (1) $$\bar{x} = \frac{\sum x}{N}$$

Whereas
$\bar{x}$ = Average or Arithmetic Mean
$\sum x$ = Sum of all score results
N = Number of students

The formula for calculating the standard derivation (SD.) is:

The formula (2) $$SD. = \sqrt{\frac{\sum(x-\bar{x})^2}{N}}$$

Where
SD. = Standard derivation
N = Number of students
$\bar{x}$ = Mean value
x = Teachers' score

The formula used to determine the quality of the instruments was: In finding content validity of the achievement test, we conducted the IOC formula (Item Objectives Congruence) by following the formula below:

The formula (3) $IOC = \frac{\sum R}{N}$

Whereas
- IOC = Index of correspondence between the test and the objective
- $\sum R$ = Sum of individual expert's value
- R = Expert's rating
- N = Number of experts

The formula used in finding the difficulty index of the achievement test were

The formula (4)

$$P = \frac{R_H + R_L}{N_H + N_L}$$

Whereas
- P = difficulty level
- RH = the Number of people who chose the highest option rate
- RL = the Number of people who chose the lowest option rate
- NH = the total Number of people in the high group
- NL = the total Number of people in the low group

Table 5: Range of difficulty index and verbal interpretation

Difficulty Index	Verbal Interpretation
0.00-0.20	Very Difficult
0.21-0.40	Difficult
0.41-0.60	Average / Moderately Difficult
0.61-0.80	Easy
0.81-1.00	Very Easy

The formula for calculating the item discrimination of the achievement test is:

The formula (5) $r = \frac{R_H - R_L}{N_H or N_L}$

Whereas
- r = Discrimination index
- R_H = Number of correct responses in the high group
- R_L = Number of correct responses in the low group
- N_H = Total Number of students in the high group
- N_L = Total Number of students in the low group

Table 6: Range of discrimination index and verbal interpretation

Discrimination Index	Verbal Interpretation
0.40 and above	Very Discriminating / Very Good Item
0.30 to 0.39	Discriminating / Good Item
0.20 to 0.29	Moderately Discriminating Item
0.10 to 0.19	Not Discriminating / Marginal Item
Below 0.10	Poor / Questionable Item

The formula for calculating the reliability of the achievement test K-R#20 by Kuder-Richardson is:

The formula (6)

$$rtt = \frac{k}{k-1}\left[1 - \frac{\sum pq}{s^2}\right]$$

Whereas
- rtt = Reliability Index
- k = Number of test items
- p = The proportion of the correct answer
- q = The proportion of the incorrect answer
- $S2$ = The variation of the entire test

The formula for calculating the variability of the achievement test is:

The formula (7) $S2 = \frac{n\sum fx^2 - \left(\sum fx^2\right)}{n(n-1)}$

Whereas $S2$ = Variance
n = Number of students
x = Achievement test score
f = Data of frequency

The formula used to verify the hypothesis was: The formula used in analyzing the differences in achievement scores using the dependent t-test was:

The formula (8) $t = \frac{\sum D}{\sqrt{\frac{n\sum D^2 - (\sum D)^2}{n-1}}}$

Whereas $\sum D$ = Sum of variance score of achievement test
$\sum D^2$ = Sum of different squares of achievement test scores
$(\sum D)^2$ = Sum of variance score of the square test
n = Number of students
D = Difference between pretest and posttest scores

RESEARCH RESULT

Table 7: The report on the efficiency of an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province, China.

n=30

Items	score	score	Standard	Percentage	E1/E2
Ongoing	100	85.10	80	81.40	82.40/81.33
Posttest	20	14.22	80	81.23	

From Table 1, The study found that the average mean score of ongoing assessments was 82.40, while the mean score of posttests was 81.23. These results suggest a significant improvement in learning outcomes through implementing an Application on Strategies for Conflict Resolution for first- year undergraduate students in Yunnan Province, China. The study focused on an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province, China. The findings indicate that the efficiency ratio of E1 to E2 was determined to be 81.40 to 81.23. In summary, this study focuses on developing an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province, China. The program adheres to the standard criterion of 80/80 as established.

Table 8: The evaluation report of an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province, China from three content experts.

Evaluation Items	$\bar{x}$	SD.	Result Interpretation
1. Content on Strategies for Conflict Resolution learning objective consistency.	5	.00	Excellent
2. Content on Strategies for Conflict Resolution is intriguing.	4.5	.00	Excellent
3. Content on Strategies for Conflict Resolution and activities are learner-friendly.	4.67	.58	Excellent
4. Content on Strategies for Conflict Resolution is appropriate for each activity.	4.55	.58	Excellent
5. Content on Strategies for Conflict Resolution sorting is appropriate.	4.38	.58	Excellent
6. Content on Strategies for Conflict Resolution accuracy.	5.00	.00	Excellent
7. Content reading on Strategies for Conflict Resolution is appropriate for learners.	5.00	.00	Excellent
8. Activities are consistent with the content on Strategies for Conflict Resolution.	5.00	.00	Excellent
9. A presenting approach engages students for Strategies for Conflict Resolution.	4.67	.58	Excellent
10. The overview of the content on Strategies for Conflict Resolution is complete.	5.00	.00	Excellent

Total	4.78	.23	Excellent

Table 8 an application based on conflict resolution strategies for first-year undergraduate students in Yunnan, China from three content experts. The Evaluation comprises a set of ten items, which have been developed and approved by three subject matter experts. This section represents the content experts' opinions using a 5-point rating scale. Each criterion rating is specified as depicted in the table provided below. The experts examined the quality evaluation of an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province, China. Quality was consistently high ($\bar{x}$= 4.78, SD =.23). Findings indicate excellent content consistency, interest, accuracy, appropriate English subject teaching, consistent activities, and complete overview ($\bar{x}$ = 5.00, SD. =.00).

Table 9: Results of Evaluation of an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province, China by three media experts.

Evaluation Items	$\bar{x}$	SD.	Result Interpretation
1. Learning through an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province, China	4.67	.58	Excellent
2. The sequence of activities and content is appropriate for an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province, China	4.53	.58	Good
3. Easy to use, uncomplicated for an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province, China	4.85	.58	Excellent
4. The images are consistent with the content appropriate for an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province, China	4.42	.58	Good
5. The images convey the meaning for . The images are consistent with the content adorate for an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province, China	4.33	.58	Good
6. The activities are appropriate for first-year undergraduate students.	4.64	.58	Good
7. Interesting content an Application on Strategies for Conflict Resolution.	4.00	.00	Good
8. Interest in Learning for first-year undergraduate students.	4.33	.58	Good
9. Makes it possible to understand the content more for an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province, China	4.33	.58	Good
10. The details are clear and easy to understand for first-year undergraduate students.	4.85	.58	Excellent
Total	4.50	.58	Good

Table 9: an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province, China. The 10-item evaluation form is from three media experts. This section assesses media professionals' thoughts on a 5-point scale. The table below rates each criterion. Three media specialists analyzed the media quality assessment of an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province, China. Overall, quality was outstanding ($\bar{x}$= 4.50, SD. = .58). According to an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province, China is straightforward to comprehend, utilize, and has precise details ($\bar{x}$=4.85, SD. =.58).

Table 10: Compare students' achievements before and after learning through an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province, China

Items	**n**	$\bar{x}$	**SD.**	***df***	**t-test**	**Sig. (2-tailed)**
Pretest	30	8.80	2.33	29	20.86	.05
Posttest	30	16.27	1.48			

**p< .05

Table 10 presents the learning achievement of an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province, China. The mean score of pretests was 8.80, and the standard deviation (SD.) score was 2.33. The result after using an Application on Strategies for Conflict Resolution for

first-year undergraduate students in Yunnan Province, China, which translated into a high posttest of 16.27 and standard deviation (SD.) of 14.8 and t-test analysis before and after the treatment of 20.86 which demonstrated a considerable difference was statistically significant at the .05 level.

Table 11: Examine students' satisfaction with an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province, China

Evaluation Items	$\bar{x}$	SD.	Result Interpretation
1. The Function of an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province, China	4.60	.50	Strongly Agree
2. Rich learning resources are available for . The images are consistent with the content adorate for an Application on Strategies for Conflict Resolution for first-year undergraduate students.	4.40	.51	Strongly Agree
3. Computer use benefits from computer application knowledge on Strategies for Conflict Resolution for first-year undergraduate students.	4.50	.51	Strongly Agree
4. Basic IT applications can collaborate and communicate on Strategies for Conflict Resolution for first-year undergraduate students.	4.43	.50	Agree
5. Basic computer application allows for immediate feedback and Evaluation.	4.50	.51	Strongly Agree
6. blended teaching online according to the Super Star Learning Pass model on Basic computer applications can get multimedia teaching tools.	4.53	.51	Strongly Agree
7. Teaching blended teaching online according to the Super Star Learning Pass model on Basic computer applications can have to learn management and tracking.	4.53	.51	Strongly Agree
8. according to an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province, China, blended teaching online can be an innovative teaching method.	4.67	.48	Strongly Agree
9. according to . The images are consistent with the content adorate for an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province, China, blended online teaching can be intercultural teaching.	4.37	.51	Agree
10. blended teaching online, according to . The images are consistent with the content adorate for an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province, China can be rethought and improved.	4.57	.50	Strongly Agree
Total	**4.51**	**.50**	**Strongly Agree**

Table 11 shows the results of the Evaluation of students' satisfaction with an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province, China by 30 students. The overall students' satisfaction was a strongly agreeing level ($\bar{x}$=4.51, SD. = .50). When considering each item, it was found that an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province, China was strongly agreeing level ($\bar{x}$= 4.67, SD. = .48) and. combined teaching online according to an Application on Strategies for Conflict Resolution was strongly agree level ($\bar{x}$= 4.60, SD. = .50), respectively.

CONCLUSION AND DISCUSSION

There are three primary objectives in the study of the effect of an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province, China.The research instruments consisted of (1) investigating the efficiency of an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province, China, (2) comparing students' achievements before and after learning through an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province, China,

and (3) examine students' satisfaction with an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province, China. The conclusion, discussion, and suggestion of the research are the discussion of the study on an application based on conflict an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province, China is as follows (1) Study the efficiency of using an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province, China. (2) Results of evaluation efficiency of an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province, China. The average mean score of the ongoing score was 81.40, and the mean score of posttests was 81.23, which indicated a substantial improvement upon an application based on conflict resolution strategies for first-year undergraduate students in Yunnan, China. The result revealed that the value of efficiency of E1/E2 was 81.40/81.23. To summarize, this an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province, China is developed according to the standard criteria 80/80 defined because there is a process for finding the effectiveness of lessons that are consistent with the research process that is accurate and clear. Results of Evaluation of an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province, China by three content experts and three media experts. The results of the content quality assessment of We must meet all indices. The fifth stage is a pre- and post-test to assess vocabulary proficiency before and after an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province, China. Based on the study hypothesis, three measurement and Evaluation specialists created and administered the questionnaire to evaluate teaching on Strategies for Conflict Resolution. Researchers assessed data alignment with aims using an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province, China evaluated by three content experts. The overall quality was excellent level ($\bar{x}$=4.78, SD. = .23). When considering each item, it was found that consistency between content and learning objectives, the content is interesting, content accuracy, the language used in the range is appropriate for the learners, activities are consistent with the content and the overview of the content is complete were excellent level ($\bar{x}$= 5.00, SD. = .00), respectively. The results of the media quality assessment of an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province, China were evaluated by three media experts. The overall quality was excellent level ($\bar{x}$=4.50, SD. = .58). When considering each item, it was found that learning through an Application on Strategies for Conflict Resolution for first-year undergraduate students teaching is easy to understand, easy to use, uncomplicated and the details are clear and easy to understand were excellent level ($\bar{x}$= 4.85, SD. = .58), respectively. This may be due to the quality assessment process of We must meet all indices. The fifth stage is a pretest and posttest to assess vocabulary proficiency before and after an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province, China. The study examined student satisfaction with technology integration in an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province, China. and processes systematically through quality assessment from experts with actual specific There are the correct procedures knowledge.

Compare students 'achievements before and after learning through an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province, China. They presented the learning achievement of an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province, China. The mean score of pretests was 8.80, and the standard deviation (SD.) score was 2.33. The result after using an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province, China translated into a high posttest of 16.27 and standard deviation (SD.) of 14.8 and t-test analysis before and after the treatment of 20.68, which demonstrated a considerable difference was statistically significant at the .05 level. This may be due to blended teaching online according to th an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province, China a that enable participants to learn at their own pace and help learning achievement goals. Study the satisfaction of teachers who use an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province, China. The results of the Evaluation of students' satisfaction questionnaire on learned with an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province, China in China by 30 students. The overall students' satisfaction was a strongly agreed level ($\bar{x}$=4.51, SD. = .50). When considering each item, it was found that an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province, China was a strongly agree level ($\bar{x}$= 4.67, SD. = 0.48) The fifth stage is a pre-and posttest to assess vocabulary proficiency before and after an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province, China. The study examined student satisfaction with an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province, China. The students' satisfaction with online learning platforms and their attitudes toward using IT for Education. Based on the study hypothesis, three measurement and Evaluation specialists created and administered the questionnaire to evaluate teaching an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province, China. Researchers assessed data alignment with aims using the IOC. Using questionnaire data, an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province,

China will determine whether student satisfaction with IT-based Learning can get rich learning resources was strongly agreed on level ($\bar{x}$= 4.60, SD. = .50), respectively.

CONCLUSION AND DISCUSSION

The analysis result of the above an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province, China.1) Results of evaluation efficiency of an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province, China. The average mean score of the ongoing score was 81.40, and the mean score of posttests was 81.23, which indicated a substantial improvement in an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province, China. The result revealed that the value of efficiency of E1/E2 was 81.40/81.23. To summarize, this online Learning based on an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province, China is developed according to the standard criteria 80/80 defined.2) Results of Evaluation of an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province, China by three content experts. The results of the content quality assessment of an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province, China were evaluated by three content experts. The overall quality was excellent level ($\bar{x}$= 4.78, SD. = .23). When considering each item, it was found that consistency between content and learning objectives, the content is interesting, content accuracy, the language used in the range is appropriate for the learners, activities are consistent with the content and the overview of the content is complete were excellent level ($\bar{x}$= 5.00, SD. = .00), respectively.3) Results of Evaluation of an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province, China from three media experts. The results of the media quality assessment of an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province, China were evaluated by three media experts. The overall quality was excellent level ($\bar{x}$=4.50, SD. = .58). When considering each item, it was found that learning through an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province, China is easy to understand, easy to use, uncomplicated and the details are clear and easy to understand were excellent level ($\bar{x}$= 4.85, SD. = .58), respectively.4) Comparison of average scores before and after of the teachers using the an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province, China. The mean score of pretests was 8.80, and the standard deviation (SD.) score was 2.33. The result after using an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province, China into a high post-test of 16.27 and standard deviation (SD.) of 14.8 and t-test analysis before and after the treatment .20, .68, .08, which demonstrated a considerable difference was statistically significant at the .05 level. 5) Study students' satisfaction using an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province, China. The results of the Evaluation of students' satisfaction with an application based on conflict resolution strategies for first-year undergraduate students in Yunnan, China by 30 students. The overall teachers' satisfaction was strongly agree level ($\bar{x}$=4.51, SD. = .50). When considering each item, it was found that an Application on Strategies for Conflict Resolution for first-year undergraduate students in Yunnan Province, China can be innovative teaching methods was strongly agree level ($\bar{x}$= 4.67, SD. = .48) and, blended teaching online according to Super Star Learning Pass model on an Application on Strategies for Conflict Resolution can get rich learning resources was strongly agree level ($\bar{x}$= 4.60, SD. = .50), respectively.

RECOMMRNDATION

Integrating conflict resolution education into orientation programs, this project applies conflict resolution strategies to first-year undergraduate students in Yunnan Province, China. The aim is to mitigate the challenges of new academic pressures, navigating diverse peer groups, and understanding a changing social environment. This transformative experience fosters conflict reduction in both personal and academic relationships, enabling students to manage conflict constructively.

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Arabic Learners' Perceptions of Google Docs-Mediated Small-Group Collaborative Writing

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ABSTRACT
This study explored the perceptions of Arabic as a Foreign Language (AFL) learners regarding the use of Google Docs for small group writing tasks in three AFL classes at two U.S. universities. Utilizing an exploratory single case study design, the research gathered survey data from twenty students to examine their experiences with technology-mediated collaborative writing. The findings suggest that students viewed Google Docs as a flexible and user-friendly tool that facilitated collaboration and enhanced their writing process. Students also had a positive perception of small group collaborative writing, which contributed to the improvement of their final written texts, provided them with opportunities to observe and learn from their group partners' writing styles, and enhanced their vocabulary and grammar knowledge. However, the study's small sample size and reliance on self-reported survey data limit the generalizability of the results and do not fully capture students' interactions during the writing process.
Keywords: Arabic as a Foreign Language, collaborative writing, Google Docs, technology integration, student perceptions

INTRODUCTION

Collaborative learning in second language (L2) classes is an important pedagogical practice that has been shown to improve L2 acquisition (Swain & Lapkin, 1998). One form of collaborative learning that is increasingly utilized in L2 contexts is collaborative writing. Research has identified many benefits of collaborative writing for L2 learners, such as providing learners with the opportunity to pool their linguistic knowledge and resources (Donato, 1994; Elola & Oskoz, 2010; Storch, 1999, 2005), which can lead to improvements in writing quality and accuracy (Elola & Oskoz, 2010; Storch, 2005; Wigglesworth & Storch 2009; Woo, Chu, & Li, 2013). Additionally, collaborative writing gives learners a sense of audience (Alwaleedi, 2017), and increases students' attention to structure, grammar, and vocabulary use during the writing process (Swain & Lapkin, 1998).

Advancements in technology that facilitate collaboration processes have gained the interests of L2 teachers, researchers, and practitioners. As Kessler and Bikowski (2010) noted, “the evolution of collaborative writing may be intrinsically connected with the iterations of technology” (p. 43). One of these technologies that has been found to facilitate the collaboration process is web 2.0 tools (e.g., wikis, blogs, Google Docs). Various studies have shown the benefits of integrating web 2.0 technologies into L2 instruction. For example, these technologies enable a group of learners to co-construct, view, and edit texts both synchronously and asynchronously in ways that are not possible in paper-based collaborative writing (Bikowski & Vithanage, 2016; Godwin-Jones, 2018), which increases L2 learner’s exposure to the target language beyond the walls of traditional classrooms and allows teachers and researchers to access the writing process history, including every user's participation (Arnold, Ducate, Lomicka, & Lord, 2009; Arnold, Ducate, & Kost, 2012; Elola & Oskoz, 2010; Godwin-Jones, 2018). Teachers can also monitor the writing process without the need to collect drafts from the students (Kessler, Bikowski & Boggs, 2012), while learners can track who has viewed and edited the document, helping the learners to monitor their progress throughout the writing task (Godwin-Jones, 2018).

This study aims to explore the perceptions of Arabic as a foreign language (AFL) students regarding the integration of a Web 2.0 tool (Google Docs) into a small-group writing task in advanced Arabic Language courses at two universities in the USA.

LITERATURE REVIEW

L2 studies examining learners’ perceptions of small-group writing, with or without technology support, have revealed mixed results. Some research has found that learners hold positive attitudes toward online technology-supported collaborative writing because it provides learners with flexibility and ability to work on a shared document without the need to be in the same place at the same time (Bikowski & Vithanage, 2016; Strobl, 2014).

For example, in Bikowski and Vithanage's (2016) study, 56 English as a second language (ESL) students reported that using wiki facilitated collaboration, allowing multiple students to work synchronously on the same document. Similarly, Strobl (2014) reported that German as L2 learners had positive attitudes toward using Google Docs for collaborative writing, highlighting the ability to write at their own pace and space as a major advantage.

Other studies have indicated that small group writing provides learners with a sense of ownership and shared responsibility, encouraging students to work collaboratively, and resulting in a higher quality written text (Lee, 2010; Lund, 2008). Additionally, research has highlighted the benefits of peer feedback in technology-supported collaborative writing. In Lin and Yang's (2011) study of a university-level English reading and writing course in Taiwan, students reported that receiving and providing feedback was among the most important benefits of wiki-supported writing. One participant in Lin and Yang's study noted that learning how to use the past tense correctly was one of the benefits. Similarly, in Elola and Oskoz's (2010) study, students reported that correcting each other's grammatical mistakes significantly helped improve their grammar knowledge. Caruso's (2014) study found that English as a foreign language students perceived improvements in vocabulary and grammar through collaborative writing.

Although small-group writing activities offer many benefits, some studies have reported that students have negative perceptions of these tasks. For example, Nelson and Carson (1998), in a case study of four ESL students at a U.S. university, found that students did not trust peer feedback as much as teacher feedback. Bikowski and Vithanage (2016) also reported that participants preferred receiving feedback from teachers over peers. Some students also felt uncomfortable editing or changing their peers' writing (Lin & Yang 2011). Additional challenges include issues with work distribution within groups. For instance, Strobel (2014) identified "free rider" issue during group synthesis writing tasks, where some members contributed minimally or did not participate in the collaborative task. Stroble also reported that some students expressed a preference for individual writing to avoid potential disagreement with peers and maintain their own writing pace.

Rationale for this Study

While many studies have examined collaborative writing in English as a second language (Arnold, Ducate, Lomicka, and Lord, 2009; Bikowski & Vithanage, 2016; Kessler, Bikowski, Boggs, 2010; Kessler, 2009; Mak & Coniam, 2008; Lai, Lei, & Liu, 2016; Lin & Yang, 2011; Lund, 2008; Woo, Chu, & Li, 2013), and some studies have been conducted in the German (Arnold, Ducate, & Kost, 2012; Kost, 2011; Strobl, 2014), and Spanish contexts (Elola and Ozkoz, 2010), there is a lack of research on technology-supported collaborative writing in less commonly taught languages such as Arabic and Turkish.

This study aims to fill this gap by investigating students' perceptions of completing a small-group writing task in a technology-mediated environment, specifically using Google Docs as the collaborative writing platform in advanced Arabic language Courses. This study seeks to answer the following questions:
How do AFL students perceive the use of Google Docs as a collaborative tool?
How do AFL students perceive a small group writing task?

METHEDOLOGY

This study is part of a larger project that utilized an exploratory, holistic, single case study design to understand how AFL learners approach a Google Docs-mediated writing assignment at two public universities in the USA. Specifically, this paper reports on students' perceptions of technology-mediated small group writing using a survey instrument. Survey items were developed based on relevant literature on collaborative writing and technology integration in L2 contexts (e.g., Storch, 2017; Kessler, 2009).

According to Yin (2009) defines case study as "an empirical inquiry that investigates a contemporary phenomenon in depth and within its real-life context" (p.18). Yin also argues that one of the reasons for the use of case study is "to examine contemporary events when the related behaviors cannot be manipulated" (p.11).

Participants

Twenty students enrolled in three third-year Arabic language classes at two research universities in the United States participated in this study. The distribution of participants was as follows: Five students were enrolled in one class at the first university, seven students and nine students in two classes at the second university. The students were instructed to self-select their writing partners to work on a shared writing assignment using Google Docs. Because of the uneven number of students in each class, students formed pairs and small groups. Table 1 displays the demographic information of the participant students.

Table 1. Demographic Information of the Participant Students

Variable	Category	Number
Gender	Male	6
	Female	13
	Other	1
Native language	Arabic	1
	English	16
	English &Arabic	2
	English& Spanish	1
Number of academic semesters studying Arabic language	5	2
	5.5	1
	6	12
	7	1
	8	4

As shown in Table 1, most participants identified as female (n = 13), while six identified as male and one identified as "other." In terms of native language, most students reported English (n = 16) as their native language, with one student reporting Arabic, two students reporting both English and Arabic, and one student reporting both English and Spanish. Regarding Arabic language study, nearly all participants had studied Arabic for at least five semesters, with twelve students having completed six semesters and four students having completed eight semesters of study. This indicates that the participants had substantial prior exposure to Arabic language learning, making them suitable for participation in a technology-mediated, small group writing assignment in an advanced AFL context.

Procedures

As an Arabic language instructor, I piloted the survey in one of my second year Arabic language classes to assess the feasibility of using Google Docs for collaborative writing and to evaluate the clarity and validity of the post-study perception survey items as suggested by Dörnyei (2003).

After obtaining Institutional Review Board (IRB) approval for this study, I visited the participating classes to deliver a PowerPoint presentation explaining the purpose of this study and to distribute consent forms to both students and teachers. Then I revisited the classes to collect the signed consent forms. While participation in the survey was voluntary, the Google Docs-mediated writing assignment was a required component of the course and was completed by all students as part of their regular coursework. Following the completion of the writing assignment, the survey was administered in the students' classes. In total, twenty students completed the survey.

The survey consisted of four sections. The first section collected demographic information related questions (see methodology section). The second and third sections measured students' perceptions of using Google Docs and the small group writing assignment, using on a 5-point Likert scale. The fourth section included five open-ended questions to elicit insights into the students' experiences and opinions.

To assess the internal consistency of the Likert-scale items, Cronbach Alpha coefficient was calculated, yielding a value of 0.93. According to Dörnyei (2003), Cronbach Alpha coefficient of 0.70 or higher is considered a good indicator of internal consistency. Frequency analyses of Likert-scale data were conducted using SPSS Statistics. Responses to the open-ended questions were analyzed thematically through iterative reading to identify emerging patterns and insights relevant to the research objectives.

FINDINGS and DISCUSSION

Perceptions of Google Docs as a Collaborative Tool

Nine statements addressed students' perceptions of using Google Docs as a collaborative tool. The statements measured the students' perceptions on a 5-point Likert scale ranging from "strongly disagree" to "strongly agree".

Table 2. Students' Perceptions of Using Google Docs as a Collaborative Tool

Statements	N	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
1.Google Docs provided me with greater flexibility regarding time and place of working with my group members.	20	10%	0%	0%	35%	55%
2.Google Docs facilitated the collaboration process during this writing assignment.	20	`0%	10%	0%	35%	55%
3.Google Docs was easy to use.	20	0%	0%	5%	25%	70%
4.I liked using Google Docs as a collaboration tool in this Arabic language class	20	5%	5%	5%	25%	60%
5.I would like the option to complete more small-group writing assignments using Google Docs in the Arabic language classes.	20	20%	0%	45%	30%	5%
6.I would have performed better on this writing assignment if it had been handwritten.	20	20%	20%	40%	5%	15%
7.Typing in Arabic using Google Docs was easy.	20	5%	35%	20%	35%	5%
8.Typing in Arabic using Google Docs was beneficial.	20	5%	0%	30%	50%	15%
9.Overall, I had a positive experience completing this writing assignment using Google Docs.	20	5%	0%	5%	60%	30%

Overall, students have positive perceptions of using Google Docs as a collaborative tool for completing group writing tasks in AFL classes. As shown in Table 2, most students (90%) agreed or strongly agreed that Google Docs provided flexibility in terms of time and place and facilitated collaboration among group members. Similarly, 95% of students agreed or strongly agreed that Google Docs was easy to use, and 85% reported that they enjoyed using it as a collaborative tool. These findings are consistent with previous studies (Bikawski & Vithanage, 2016; Strobl, 2014), which reported that flexibility and asynchronous nature of accessing web 2.0, such as Wiki and Google Docs, among the most perceived benefits. Suwantarathip and Wichadee's (2014) study also showed that majority of participants perceived Google Doc as either easy or very easy to use for English collaborative online writing assignments.

Although the students have positive views of Google Docs as a collaborative tool, their responses were more mixed regarding their preference to use Google Docs more frequently for future writing assignments. While 35% agreed or strongly agreed that they would like more assignments using Google Docs, 45% of students were neutral, suggesting uncertainty toward using Google Docs as a writing platform. Additionally, students also expressed neutral perceptions (40%) about whether handwritten assignments would be better than those completed via Google Docs. This neutrality may be related to challenges with typing in Arabic, as indicated below.

Responses indicated some challenges related to typing in Arabic. While 65% of students agreed or strongly agreed that typing in Arabic using Google Docs was beneficial, their perceptions of the ease of typing were divided: 40% agreed or strongly agreed that typing in Arabic was easy, whereas 40% disagreed or strongly disagreed. These findings suggest that although students have viewed typing in Arabic as beneficial, many still find it a challenging skill to learn.

Finally, students generally viewed the use of Google Doc positively, with 90% indicating that they had a positive experience completing the collaborative writing assignment using Google Docs. These findings echo those of

Nasri, Habali, and Adam (2022), who also found that ESL students perceived Google Docs as an effective tool that encourages collaboration and improves writing skills.

Perceptions of Small-Group writing

Sixteen statements addressed students' perceptions of small-group collaborative writing. The statements measured the students' perceptions on a 5-point Likert scale ranging from "strongly disagree" to "strongly agree". Table 3 below is a frequency analysis of the students' perceived opinions.

Table 3. Students' Perceptions of Small Group Writing

Statements	N	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
10.Writing in small groups in this Arabic course increased my motivation to write.	20	10%	0%	20%	50%	20%
11.Writing in small groups in this Arabic course helped me generate more ideas.	20	5%	5%	15%	50%	25%
12.Writing in small groups in this Arabic course helped me organize my ideas.	20	5%	5%	20%	45%	25%
13.Writing in small groups in this Arabic course provided me with opportunities to observe how other students write.	20	0%	0%	5%	55%	40%
14.Writing in small groups using Google Docs in this Arabic course helped me produce a better text than what I would have achieved writing alone.	20	5%	10%	15%	40%	30%
15.Writing in small groups in this Arabic course using Google Docs made me pay closer attention to my writing.	20	5%	5%	25%	35%	30%
16.Writing in small groups in this Arabic course enhanced the lexical (vocabulary) variety of our written text.	20	5%	10%	0%	50%	35%
17. Writing in small groups in this Arabic Course helped me understand some of the grammatical mistakes I make.	20	5%	0%	0%	70%	25%
18. Writing in small groups in this Arabic course helped me improve my vocabulary knowledge.	20	5%	0%	0%	75%	20%
19. Writing in small groups in this Arabic course helped me improve my grammar knowledge.	20	0%	5%	5%	60%	30%
20.I felt comfortable correcting my peers' mistakes.	20	10%	5%	0%	65%	20%
21.I felt comfortable commenting on my peers' writing.	20	0%	0%	0%	70%	30%
Table 3 (continued)						
22.My Arabic language proficiency made me confident editing my peers' writing.	20	5%	20%	15%	40%	20%
23.It was easy to agree with my peer(s) on the ideas to include in the text.	20	0%	0%	0%	50%	50%
24.Writing in small groups in this	20	5%	5%	0%	50%	40%

Arabic course enhanced the overall quality of the text.						
25.Overall, I enjoyed writing in small groups for this Arabic writing assignment.	20	0%	0%	20%	50%	30%

Students' responses regarding their perceptions of small-group writing in the Arabic course were generally positive. As shown in Table 3, 70% of students agreed or strongly agreed that writing in small groups increased their motivation to write in Arabic. Similarly, more than 70% of students reported that small-group writing helped them generate more ideas and organize them effectively within the shared text.

One of the most significant benefits highlighted was exposure to peer writing. Nearly all participants (95%) agreed or strongly agreed that small-group writing provided opportunities to observe how other students write in Arabic. In addition, 70% indicated that working collaboratively helped them produce a better written text than what they would have achieved individually. These findings align with previous research (Elola & oskoz, 2010; Nasri, Habali, & Adam, 2022), which reported that students perceived collaborative writing as beneficial for improving text quality, particularly in terms of content development and organization.

Regarding linguistic development, students reported substantial learning gains. More than 80% of students agreed or strongly agreed that small-group writing enhanced their vocabulary and grammar knowledge and helped them become more aware of their grammatical errors through peer interaction and correction. Similarly, 90% indicated that collaborative writing contributed to improvements in their grammar knowledge. These findings echo Bikawski and Vithanage (2016), who also reported that majority of the participants indicated that collaborative writing helped them improve their grammar. Likewise, Elola and Oskoz (2010) found that writing collaboratively increased learners' awareness of their grammar usage and led to more accurate writing.

Empirical evidence from previous studies supports these findings. Storch (2005), for example, compared texts written individually with texts written collaboratively and found that paired texts scored higher regarding grammatical accuracy and structure complexity among ESL learners. Other studies (Caruso, 2014; Hsu & Lo, 2018) have also reported that ESL learners' texts produced in pairs scored higher in terms of accuracy and complexity than those written individually, which reinforce the positive impact of collaborative writing on linguistic development.

Students also expressed high levels of comfort engaging in peer feedback. More than 85% of students agreed or strongly agreed that they felt comfortable correcting and commenting on their peers' writing, and that they were able to reach consensus with their group members regarding which ideas to include in the text. These results are consistent with Nasri, Habali, and Adam's (2022) study which revealed that students felt comfortable working collaboratively and editing their team member's written contributions. However, a study by Lin and Yang (2011) showed contrasting results, with participants reporting discomfort editing and changing their peers' writing.

Finally, 80% of students agreed or strongly agreed that collaborative writing enhanced the overall quality of the final product and enjoyed the experience.

Open-Ended Questions

In response to the question, "How would you describe the group you worked in? Did you all contribute in a balanced way?", students 35% of students reported varied experiences with group member contribution. About 35% indicated they contributed to the writing assignment in a balanced manner. For example, one student noted, "Both contributed in a balanced and equal way." Another 20% attributed balanced contribution to dividing the assignment into subtasks, with each group member responsible for a specific portion. As one student stated, "Yes—we split up the work evenly and didn't run into any issues." Another 35% reported that while contributions were generally balanced, one student took on a greater role due to advanced Arabic proficiency or being a native speaker. For instance, a student shared, "We all contributed, but we had one native speaker who did most of the editing of grammar and word choice." These findings are consistent with previous research by Bikawaski and Vithange (2016), where majority of the participants indicated a successful collaboration. Stroble (2014) also reported similar results where most of the participants noted that the collaboration between group members went well. However, 10% of students reported that although contributions appeared balanced, one member tended to dominate the writing process. As one student explained, "Yes, I think we all contributed in a balanced way, but one group member deleted the section I wrote because they said they had new ideas and wanted to write it instead". This implies that disagreement between group members could be an issue in collaborative learning activities. Similar concerns were reported in Stroble' (2014) study, who found that some students have negative opinions about writing in groups or pairs and prefer to write individually to avoid such conflicts.

In response to the question, "Did you learn any skills from doing this writing assignment in pairs/small groups that you will use in future individually assigned Arabic writing assignments? If yes, please provide examples, 90% of students indicated that they had learned beneficial skills for future assignments, while 10% reported not gaining new skills from this experience. Frequently cited skills included typing in Arabic, developing new writing strategies and planning techniques, improving sentence structure, and identifying grammatical errors. For example, one student wrote, "I learned how to better type in Arabic and how to fix grammatical mistakes."

In response to the question, "What are the advantages of the small-group writing assignment using Google Docs?", students highlighted several benefits, including the ability to collaborate asynchronously without the need to meet in person, the opportunity to share and expand ideas, exposure to peers' writing styles, learning new vocabulary, having additional reviewers to catch errors, and the ability to track changes easily. As one student stated, "More ideas, you get to learn new vocabulary and have another set of eyes on mistakes that you might not notice, you get to see changes that peers make in Google."

Regarding disadvantages, students' responses to the question, "What are the disadvantages of the small-group writing assignment using Google Docs?", indicated that typing in Arabic was challenging and time-consuming, particularly without access to a standard Arabic keyboard. Additionally, the use of online translation tools such as Google Translate sometimes led to inaccurate word choices. Students also noted that using written comments to share ideas was less effective than face-to-face discussions. Other reported challenges included difficulties in coordinating schedules, combining ideas coherently, and dealing with group members who dominated the writing process and made changes without consulting others.

In response to the final question, "What do you suggest to improve pair/small group writing assignments using Google Docs in Arabic language classes?", students made several recommendations: providing training on Arabic typing, ensuring access to computers with Arabic keyboards, requiring at least one face-to-face meeting for planning and discussion, allowing more time for assignments, and offering detailed feedback on the first draft rather than general comments.

CONCLUSION

The findings showed that students perceived both Google Docs and collaborative writing positively. Most students valued flexibility, ease of use, and collaboration opportunities that Google Docs provided. Small-group writing was also seen as beneficial for increasing motivation, generation and organizing ideas, and improving vocabulary and grammar knowledge. These results echo the findings of previous research that highlighted the pedagogical benefits of technology-mediated collaborative writing.

Despite the benefits, the study identified several challenges and concerns related to collaborative writing via Google Docs. Some students expressed uncertainty about using Google docs in future assignments. A significant concern was the difficulty of typing in Arabic, especially without access to Arabic keyboards. Other challenges related to task management and group dynamics, such as unequal participation and difficulties in coordination.

This study contributes to field of language education by focusing on Arabic as a less commonly taught language. The findings suggest that implementing Google Docs in collaborative writing tasks offers many pedagogical affordances for AFL learners. The results also suggest that Arabic language educators should consider providing Arabic typing training and clear instructions on how to access Arabic keyboards. It is also highly recommended to include rubrics with criteria to organize students' group work and support more equal participation.

LIMITATIONS

This study employed an exploratory single case study design with a sample of twenty students across three Arabic as a Foreign Language (AFL) class. Therefore, the findings of this study may not be generalizable to broader AFL learner populations due to the small sample size and the specific instructional contexts in which the study was conducted.

Additionally, the study relied solely on student surveys to collect data, which may not fully capture the dynamics of students' interactions during the collaborative writing process. Including additional data sources, such as classroom observations or post-study interviews, could provide a more comprehensive understanding of students' collaborative behaviors and experiences.

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Contrasting National Strategies for Digital Inclusion in Education: A Comparative Analysis of Mauritius and Singapore

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Abstract
This study examines the national digital inclusion strategies in Mauritius and Singapore associated with the integration of information and communication technologies (ICT) in education, especially for learners with specific learning difficulties, such as dyslexia and dyscalculia. While Mauritius, as a small island developing state, faces challenges related to infrastructure, teacher training and fragmented policy implementation, Singapore has long-term national planning that has led to the development of a highly digitised economy in which ICT integration is embedded. This study employed a qualitative comparative document analysis approach, which involved reviewing academic publications by Mauritian scholars, UNESCO and World Bank reports and the Mauritian and Singaporean national education frameworks. Thematic analysis was employed to identify the key digital inclusion and policy implementation patterns in both countries. It was found that Singapore has a model that emphasises system-wide inclusion through a coherent alignment of policies, professional teacher development and digital infrastructure. Mauritius, however, is further behind. While it has potential, more coordinated, sustained strategies are required. This analysis contributes to the literature by addressing a gap in comparative studies between small island developing states and advanced digital economies, and offers policy-relevant insights for countries seeking to design effective, equitable ICT strategies.
Keywords: digital inclusion, ICT in education, Mauritius, Singapore, special educational needs, comparative education

Introduction

Driven by the rapid integration of information and communication technologies (ICT), there has been a profound transformation in education over the past two decades. The development of digital tools has reshaped student learning, instructional design and delivery and institutional teaching and assessment. Learners can now engage using adaptive platforms, participate in online courses and access global digital libraries, all of which reduce the traditional barriers to education of time, cost and geography (UNESCO, 2023). Similarly, open universities and online learning platforms have expanded the opportunities for lifelong learning and flexible higher education participation.

Despite these global advancements, there are significant disparities in the methods being used to design and implement digital inclusion strategies. While international research has confirmed the transformative potential of ICT, it has also emphasised the persistent socio-economic, geographical and disability-related divides (OECD, 2023; UNESCO, 2024; World Bank/EdStats, 2023). Therefore, the critical question is whether technological integration can ensure equitable participation for diverse learners, particularly those with specific learning difficulties, such as dyslexia and dyscalculia.

Unfortunately, compared to highly digitised economies, there is limited comparative evidence on how this question is being addressed in small developing island states (SIDS). Despite national commitments to expand ICT use in education in Mauritius, for example, there are continuing challenges related to infrastructure, teacher training and resource allocation. In contrast, Singapore has become a global leader through its Smart Nation initiatives and systematic integration of digital technologies into both mainstream and inclusive education (Tan, 2020; Ministry of Education Singapore, 2020).

This study addresses this research gap in fostering digital inclusion in education by comparing the national strategies of Mauritius and Singapore, with particular attention paid to learners with dyslexia and dyscalculia, the needs of whom are frequently overlooked in policy documents. Through our analysis of both countries' approaches, we examine the strengths and limitations and identify lessons that could assist policymakers seeking to design effective and equitable ICT strategies in other regions.

Literature Review

Digital inclusion in education research has emphasised the transformative potential of ICT in expanding access, improving quality and fostering equity (UNESCO, 2020; OECD, 2022). However, while previous studies have consistently highlighted persistent access and usage gaps across income, geography and disability status, there have been few studies on the use of ICT applications for students with learning difficulties, such as dyslexia and dyscalculia (Espina, 2023). While adaptive learning technologies and assistive tools have become increasingly available, their adoption varies widely depending on national contexts and policy priorities.

In this article, we use the term special educational needs (SEN) to cover a wide spectrum of learning differences, which includes specific learning difficulties such as dyslexia and dyscalculia (UNESCO, 2020).

Several key institutions and frameworks in Singapore are focused on inclusive education and technology-enhanced learning. For example, its national digital literacy program (NDLP) promotes digital competence for both students and teachers, and its student learning space (SLS) provides an online national learning platform that allows for differentiated instruction (MOE Singapore, 2023).

The Early Childhood Development Agency and Dyslexia Association of Singapore (DAS) also play a vital role in early screening, intervention and teacher training (DAS, 2024).

Singapore aligns its approach with the universal design for learning principles, which promote the use of assistive technologies such as text-to-speech (TTS) and speech-to-text (STT) tools.

In Mauritius, comparable efforts are coordinated under its Education Digital Learning Programme, which focuses on equitable access to ICT and professional teacher development (Ministry of Education, Mauritius, 2023).

Therefore, to better understand the inclusive support ICT provides for SEN learners, this study situates its comparative analysis within these institutional and policy frameworks.

SIDS are under-researched in comparative education studies. Recent work in Mauritius has underscored the importance of school leadership and teacher preparedness in overcoming the barriers to ICT integration (Ittea, Bahadur, & Goolaub, 2022). In contrast, Singapore's comprehensive digital education policies are strongly supported by institutional capacity and systematic teacher training (Tan, 2020; OECD, 2022). The lack of comparative studies between such diverse conditions is an important justification for this research.

While previous studies have explored ICT integration in education, most have focused on high-income countries or general digital literacy frameworks rather than inclusive education for learners with specific learning difficulties. However, there has been little comparative research on inclusive digital policy in SIDS and the influence of contextual factors. While existing studies on Singapore have highlighted its structured approach to ICT-supported inclusion (Yong et al., 2021; Lim & Tan, 2020), there is little evidence on the use of these practices in emerging countries such as Mauritius. Therefore, there is a need for comprehensive comparative analyses to identify the ICT strategies, barriers and opportunities in diverse socio-economic contexts. This study addresses this gap by comparing national frameworks, teacher preparedness and assistive technology integration in Singapore and Mauritius.

Methodology

It is adopted a qualitative, desk-based comparative research design to examine ICT integration in the inclusive education policies and practices in Singapore and Mauritius. Specifically, the analysis focused on identifying the similarities and contrasts in the national strategies, institutional frameworks, teacher training programmes and use of assistive technologies to support learners with specific learning difficulties, such as dyslexia and dyscalculia.
The primary data sources were government policy documents, strategic reports and publications from international organisations, such as UNESCO, UNICEF and the World Bank, as well as peer-reviewed academic studies indexed in Scopus and ERIC. A thematic content analysis procedure was employed to identify any recurring concepts related to digital inclusion, accessibility and pedagogical innovation.

To understand the contextual and cultural differences between a high-income digital economy (Singapore) and a small island developing state (Mauritius), Bowen's document analysis framework (Bowen, 2009) was employed, which emphasises interpretive synthesis rather than quantitative measurement. This methodological approach allows for the integration of evidence from diverse policy and research sources while acknowledging that, as a desk-based investigation, there is no primary empirical data. For transparency, approximately 35 policy documents, strategic frameworks, and international reports were analysed for Mauritius and 40 for Singapore.

Documents were cross-checked across multiple sources (national ministries, UNESCO, World Bank, OECD) to validate thematic consistency and reduce policy bias. Nonetheless, this analysis approach provides a solid foundation for future empirical research on ICT-supported inclusion in education.

This study employed a comparative document analysis approach focused on national education policies, strategic frameworks, digital inclusion and SEN reports. A systematic review and interpretation of policy texts and international reports (UNESCO, World Bank, national ministries) was conducted to identify the common themes, divergences and contextual factors that have and are shaping ICT implementation in inclusive education. Therefore, to generate interpretative insights rather than measurable outcomes, the analysis followed a qualitative comparative logic rather than conducting a statistical comparison.

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The document selection was based on the following inclusion criteria: relevance to national ICT strategies, focus on inclusive or special education and published between 2015 and 2025. To identify the recurring patterns, strategic priorities and contextual differences, each document was examined using thematic content analysis, after which the emerging themes were compared across both national contexts to highlight the similarities, divergences and implementation gaps.

Policy and Systemic Framework

Mauritius has developed a policy foundation for inclusive and technology-enhanced education aligned with international frameworks such as the Incheon Declaration and Sustainable Development Goal 4, which emphasise equitable, quality education and lifelong learning. The nine-year continuous basic education (NYCBE) reform, which was launched as part of the 2015–2019 Government Program, was designed to replace the former Certificate of Primary Education examination and provide all students with nine uninterrupted years of quality basic education. The subsequent National Curriculum Framework (NCF-2015) confirmed this 'learning for all' goal by introducing a holistic and inclusive curriculum to cultivate the key twenty-first-century competencies: creativity, problem-solving and adaptability (Ministry of Education and Human Resources, Tertiary Education, Science and Technology, 2015).

Based on these principles, Mauritius now guarantees free and compulsory schooling for all from five to 16 years old, with curriculum renewal being based on a continuous, research-based process that encompasses planning, design, implementation, monitoring and evaluation. With inclusivity embedded as the guiding educational transformation principle, this cyclical approach ensures that all reforms are made as a response to changing social and technological needs.

ICT Integration and School-Level Initiatives

A cornerstone of Mauritius's ICT-in-education strategy has been its Early Digital Learning Program, which was introduced in 2017–2018 under its NYCBE agenda to promote 'twenty-first-century digital classrooms'. To foster more personalised learning pathways, the program combines device provision, curated digital content and professional teacher development (MOETEST, 2018; Digital Learning in Primary Schools, 2024). In 2014, around 24000 tablets were distributed to Form 4 students and educators through the national Tablet PC Initiative (Jugee & Santally, 2016), and in 2018, a further 26800 devices were supplied to Grades 1 and 2 as part of the India-Mauritius 'smart class' partnership (News on Sunday/DefiMedia, 2018).

Previous studies (Hurreeram, 2019; Veeraragavoodoo, 2017) have reported mixed but promising results. Teachers stated that while there was improved student engagement and differentiation, there were also ongoing training, content alignment and technical maintenance challenges. UNESCO-IITE assessments in 2021 and 2025 during and after the COVID-19 pandemic confirmed that ICT had the potential to broaden access, but highlighted the enduring gaps in assistive technologies and inclusive digital design.

At the institutional level and aligned with Ministry priorities, the Mauritius Institute of Education (MIE) is the central agency for teacher training, curriculum development, ICT integration research, professional learning and resource development (MIE, n.d.). The Ministry also maintains national online resource portals to assist teachers and students across all grade levels. While these initiatives demonstrate a steady progress towards mainstream ICT adoption, they also show that assistive technologies and SEN-focused training are critical frontiers for achieving genuine digital inclusion.

Digital Access and Teacher Capacity

In the case of Mauritius, recent data from UNESCO (2024) and the World Bank (2023) highlight substantial progress in digital infrastructure. Approximately 93 percent of primary schools and all secondary schools are now

connected to the internet, which has average broadband speeds of between 20 and 30 Mbps, and about 84 percent of households are connected; however, rural access is lower at 67 percent.

Teacher readiness indicators also reflect the ongoing improvements, with roughly 78 percent of primary teachers having completed at least one ICT-related training course, compared to 42 percent of special-education teachers and 25 percent of pre-primary educators (UNESCO UIS, 2023). While infrastructure access is nearly universal, these data indicate that further professional pedagogical learning opportunities and targeted capacity building are needed, especially for inclusive and early childhood education.

Institutional Leadership and Partnerships

The ICT integration institutional architecture in Mauritius is led by the Ministry of Education, Tertiary Education, Science and Technology (MoETEST) and actively supported by the Mauritius Institute of Education (MIE) and the Human Resource Development Council (HRDC), which funds the national ICT capacity-building programmes for teachers and technical staff (HRDC, 2023).

International partnerships have also significantly strengthened Mauritius' national capacity. UNESCO's Inclusive Digital Education for Africa project (2023-2025) selected Mauritius as a pilot country to develop accessible e-learning materials and train teachers in inclusive digital pedagogy. Similarly, UNICEF Mauritius (2022) partnered with MoETEST to expand distance-learning platforms and improve access to assistive technologies for learners with disabilities.

Despite these achievements, there are implementation gaps. For example, there are few locally developed assistive applications for learners with dyslexia or dyscalculia, and most Ministry-curated digital materials lack accessibility features, such as text-to-speech or adjustable reading levels. Ramen (2022, 2023) also found that there were ongoing leadership and sustainability challenges: constrained adaptive technology use, limited preparation, and fragmented policy coordination. Therefore, sustained investment in teacher development, the localisation of assistive tools, and systematic evaluations of digital inclusion outcomes remain key priorities.

Inclusive Education and Remaining Barriers

Since Mauritius officially endorsed Education for All in the 1990s, there has been a gradual shift from segregated to inclusive schooling; however, this transition has been uneven. Most special schools and centres for students with learning difficulties, such as dyslexia, autism or visual impairments, are still operated by non-governmental organisations that receive limited public funding. Mainstream schools also frequently lack teachers who have been trained to support SEN, and many schools still have infrastructure barriers, such as classrooms and toilets that are not accessible to students with mobility issues (UNESCO, 2021).

Mauritian schools have limited access to adaptive technologies, such as screen readers, dyslexia-friendly applications, and Braille or audio resources, and many teachers need more training to be able to effectively utilise ICT for students with learning difficulties. Veerabudren, Kritzinger & Ramasawmy (2021) found that there was a need for systematic professional development and pre-service training in inclusive pedagogy.

Overall, Mauritius' ICT-focused education attempts are paradoxical. While it has achieved near-universal digital access in mainstream education, it continues to struggle to extend these benefits to learners with disabilities. This situation highlights that digital inclusion is more than just appropriate infrastructure and devices, as the success of these is equally dependent on teacher preparation and training, content accessibility and coherent policy coordination.

The Mauritian experience highlights both the achievements and ongoing barriers to building inclusive digital education ecosystems. To contextualise these findings and offer useful points of comparison, the next section examines Singapore, which has a more mature technological framework.

Policy Architecture and Strategic Framework

Singapore's digital education strategy is embedded in its national Smart Nation agenda and the Ministry of Education's (MOE) series of ICT-in-Education Masterplans. Following three earlier phases, Masterplan 4 (2009-2014) implemented a system-wide focus on quality learning, student-centric pedagogy and responsible digital citizenship (MOE, 2023a). The most recent EdTech Masterplan 2030 extends this trajectory by outlining the ways that technology can be leveraged to enhance teaching and learning in the future decade (MOE, 2023b; Natarajan, 2021).

Singapore's policy frameworks, which are supported by strong institutional leadership and a culture of continuous improvement, have a long-term vision for technology integration across all education dimensions: curriculum, pedagogy, assessment and inclusion.

ICT Initiatives and Digital Learning Infrastructure

At the operational level, Singapore MOE's 2020 National Digital Literacy Programme (NDLP) aims to develop students' competencies across a 'Find, Think, Apply, Create' framework. The NDLP's flagship component is its personal learning device initiative, which ensures that every secondary student has access to a school-prescribed digital device for curricular use (MOE, 2023c).

Classroom learning in Singapore is supported by the national SLS, which is a digital platform that was jointly developed by the MOE and GovTech to be a central hub for online teaching and learning across all schools (MOE/GovTech, n.d.; MOE, n.d.-a). The SLS includes interactive content, assessment tools and collaborative spaces that allow for blended learning across the education system.

Infrastructure investments have also ensured universal high-speed internet and device access in all schools, which has made Singapore a global benchmark for digital education transformation.

Professional Teacher Development and Institutional Leadership

Teacher development is coordinated through the MOE and the National Institute of Education (NIE), which together define the baseline ICT competencies for educators and embed technology-enhanced pedagogies in both pre-service and in-service training (Natarajan, 2021).

A 2021 synthesis of 126 Singapore-based studies by NIE revealed that effective ICT integration depends on a coherent alignment between leadership, curriculum and assessment (NIE, 2021). These findings inform ongoing policy refinements and demonstrate how Singapore's 'research-informed governance' model bridges evidence and implementation.

Continuous monitoring loops between MOE headquarters, cluster superintendents and schools ensure regular feedback on platform use, teaching quality, and student outcomes. This data-driven governance enables rapid adaptation and supports policy sustainability.

Inclusive Education and SEN Policy Implementation

Singapore's inclusive education system provides a support continuum for learners with diverse needs from early childhood to post-primary. The MOE defines SEN as difficulties that interfere with a child's ability to learn or participate in school life, such as challenges in literacy, communication, social interaction or learning access due to sensory or physical impairment (MOE, 2024).

Support begins at the early intervention (EI) stage, which provides children aged 0–6 with structured programmes designed to strengthen their physical, cognitive, emotional, and social development. These EI services aim to reduce developmental delays, minimise secondary difficulties, and enhance school readiness. Qualified specialists provide professional assessments to identify learning needs and determine whether a child should be placed in a special education (SPED) or mainstream school (MOE, 2024).

In mainstream schools, students with mild to moderate learning difficulties also receive tailored classroom accommodation and support from trained personnel, such as allied educators (Learning and Behavioural Support). For students with more complex needs, the MOE collaborates with a network of SPED schools, which are generally operated by voluntary welfare organisations but funded and quality assured by the government. Parents are given guidance and referrals by agencies such as SG Enable, which coordinates information and access to disability-related services, and the Dyslexia Association of Singapore (DAS), which offers targeted literacy interventions using evidence-based and technology-supported approaches (MOE, 2024).

Singapore's multi-tiered framework that links early detection, specialised intervention, and strong institutional partnerships highlights its systematic inclusion approach to ensure equitable learning opportunities for all students.

Pedagogical Innovations and Classroom Practice

Singapore's commitment to inclusive digital education is also evident in its classroom practice. DAS provides a wide range of programmes from preschool to higher education for learners with dyslexia and other specific learning issues. To enhance learning engagement and accessibility, its educators combine literacy instruction expertise with creative digital technology integration.

Dyslexia, once viewed primarily as a phonological deficit, is now recognised as a complex learning difficulty that encompasses multiple cognitive challenges associated with visual and auditory processing, sequencing, timing, attention, and working memory. Baddeley and Logie's working memory model places the phonological loop as central to verbal information processing, which explains why dyslexic learners often have planning, organisation, and task sequencing difficulties. These learners may also struggle with maintaining focus and regulating their attention when asked to process large amounts of digital information. Because of these cognitive characteristics, technology-based tools, such as text-to-speech software, multisensory reading applications and structured literacy platforms, can play a vital role in supporting the learning processes of dyslexic students (Yong et al., 2021).

Effective technology use is essential when seeking to support dyslexic learners, particularly for reading, writing and memory retention tasks. While early research raised concerns that digital tools might create dependency or interfere with literacy development (Alvermann & Hutchins, 2012), more recent evidence indicates that well-designed assistive technologies can meaningfully enhance learning autonomy and literacy outcomes for dyslexic learners (Al- Azawei, Serenelli & Lundqvist, 2016). More recent research has also found that interactive computer-based programmes that combine visual, auditory and phonemic cues, such as game-based literacy interventions, can strengthen visual processing and short-term memory.

The growing emphasis on inclusive education in Singapore has also encouraged the integration of assistive technologies (AT) into classroom practice. Lewis (1993) defined AT as technologies that compensate for the difficulties experienced by people with learning challenges. Tools such as TTS, STT and spelling and grammar checkers, which are widely available on tablets and smartphones, assist dyslexic learners in completing tasks more independently. Because the use of these tools is common in classrooms, they can reduce the stigma experienced by dyslexic students and allow them to have a more equal participation with their non-dyslexic peers (Yong et al., 2021).

To personalise instruction, the teachers at DAS have adapted the Orton–Gillingham (O-G) approach, which is a structured, multisensory method that supports reading and spelling development, to technology-based resources (DAS, 2024). To support learners with dyscalculia, aligned with Singapore's broader national goals of inclusive digital education, DAS has also developed numeracy remediation programmes and adaptive digital tools that use multisensory strategies and AT to strengthen mathematical reasoning, memory and sequencing skills (DAS, 2024; MOE Singapore, 2023).

Professional teacher preparation enables instructors to more flexibly respond to diverse learner profiles and tailor the educational content to each student's pace and needs. Through consistent support and adaptive learning environments, DAS educators also act as mentors to help students build confidence, resilience and a sense of achievement.

This model exemplifies how inclusive pedagogy and educational technology can foster meaningful participation and literacy development for learners who process information differently. By embedding technology into evidence-based teaching frameworks, Singapore demonstrates that innovation and inclusion can coexist when there is a coherent, learner-centred education system.

Evaluation, Challenges and Sustainability

Singapore's education system uses real-time analytics and evidence-based reporting to continuously evaluate its policy outcomes. These school and system-level feedback mechanisms provide valuable information for refinements in pedagogy, technology use and inclusion.

Recent studies have highlighted new educational technology tensions between innovation and equity in Singapore's leading education system. Specifically, the growing influence of artificial intelligence (AI) in education has led to the need to reconsider the pedagogical beliefs and practices of teachers and policymakers. Technological change in education is shaped by complex interactions between social, political and economic forces, dynamics that researchers describe as digital education 'dualities' that can simultaneously empower and marginalise.

The framework identifies several divides that could hinder inclusion: an access divide, where learners and teachers have unequal access to digital devices or connectivity; a representation divide, where underrepresented groups are excluded from data generation; an algorithmic divide, in which biased datasets reinforce systemic inequities; an interpretation divide, where differing digital literacy and data fluency levels lead to misinterpretation; and a coding divide, where asymmetrical digital environment participation limits the capacity of disadvantaged group to accumulate social capital (Van Dijk, 2020; Selwyn, 2022).

Addressing these divides requires both infrastructure support and critical reflection on the effects of technology on power, representation and inclusion in educational ecosystems. This analysis offers valuable insights into the complex interplay between innovation and equity in Singapore's evolving digital landscape (Toh & Looi, 2024).

While the high-pressure academic culture and strong assessment focus are ongoing challenges, Singapore's case illustrates that exceptional institutional capacity, effective inter-agency collaboration and sustained investment can provide an inclusive digital transformation. Therefore, this analysis offers valuable insights for other small states seeking to balance innovation, equity and educational quality.

Comparative Analysis (Discussion)

The comparative review of digital inclusion approaches in Mauritius and Singapore highlights key convergences and divergences, particularly in policy coherence, scope and inclusivity.

Singapore has developed a highly systematic, long-term strategy that is aligned with its Smart Nation agenda, which ensures consistency. However, as Mauritius has a more general ICT strategy, its inclusive initiatives are either fragmented or running only as pilots. The teacher training in Mauritius lacks SEN-specific digital tools, whereas Singapore ensures all teachers receive this type of preparation. In contrast to Singapore's universal coverage, digital infrastructure is also uneven in Mauritius. Most notably, Singapore has implemented adaptive technologies for dyslexia and dyscalculia, whereas Mauritius is only beginning to explore such solutions.

As summarised in Table 1, Singapore's model has systematic coherence and scalability. However, Mauritius's approach is fragmented but evolving, which reflects the different stage in its digital inclusion policy.

Dimension	Mauritius	Singapore
Policy framework	National Strategy for ICT Integration (2019); fragmented, limited focus on inclusion	Smart Nation: comprehensive, aligned with the national agenda; strong monitoring
Teacher development	ICT training expanding; limited SEN-specific modules	Mandatory ICT training; inclusive education modules via NIE
Infrastructure	Progress in devices and platforms; rural disparities remain	Universal high-speed internet; full device integration
Support for SEN	Pilot projects with NGOs/UNESCO; no systemic tools for dyslexia/dyscalculia	Adaptive learning platforms and assistive technologies are widely available.
Monitoring	Weak monitoring; limited local evidence	Strong evaluation systems; policies revised based on data
Overall trend	Emerging but fragmented; strong potential	Mature, system-wide, globally relevant model

Table 1. Comparative Summary of Digital Inclusion Strategies in Mauritius and Singapore

Exam pressure and well-being support

While Singapore's education system continues to achieve globally recognised outcomes, it faces ongoing challenges related to its exam-centric culture and associated student stress. In response, the MOE has implemented a multi-tiered approach to promote socio-emotional learning and reduce excessive performance pressure. From 2019 onwards, several policy adjustments, such as the removal of mid-year examinations for Primary grades 3 and 5, and Secondary years 1 and 3, have been made to allow greater space for formative assessments and holistic development (MOE, 2023d).

At the same time, the MOE Guidance Branch and the Institute of Mental Health (IMH) have expanded teacher and school counsellor training in recognising the early signs of student distress. Singapore's Student Well-Being Framework (2021) promotes 'care, connection and competence' across mainstream and SPED schools (MOE, 2021), and the integration of well-being data into the MOE's school improvement review cycles includes feedback loops between psychological services, principals and curriculum divisions, all of which ensure that technological

innovation is aligned with student welfare. These developments suggest that Singapore's digitalisation strategy is both technologically advanced and increasingly human-centred.

Compared to Mauritius' literacy-focused support, the provisions for learners with dyscalculia are still emerging. While there are pilot numeracy interventions and visual, step-by-step maths applications, access to screening tools and ICT-based assistive software for students with numerical difficulties is limited, and SEN-focused continuing professional development in mathematics is only expanding slowly (UNESCO, 2020; MIE, 2023).

As shown in Table 1, Singapore has systematically aligned ICT integration, teacher capacity and inclusive policy evaluation, whereas Mauritius needs to strengthen its institutional coordination and accessibility frameworks. Overall, the comparison demonstrates that digital inclusion outcomes depend less on technology availability than on policy coherence, sustained teacher preparation, and embedded assistive technology frameworks.

Implications for Policy and Practice

Policymakers in both countries should prioritise continuous professional development for teachers, particularly in the use of AT for learners with specific learning difficulties. Mauritius could benefit from adopting Singapore's data-driven monitoring mechanisms and systematic inclusion frameworks, and Singapore could draw from Mauritius's experience in community-based partnerships. Regional collaboration through UNESCO and Commonwealth networks could also accelerate more inclusive digital transformations across SID to ensure more equitable access to quality education. Future research could extend this comparative perspective by incorporating empirical data from teachers and learners, which would provide a deeper understanding of how national policies are included in classroom practice. Strengthening international cooperation and knowledge exchanges between developing and developed countries could further enhance digital inclusion for learners with special educational needs.

Although this study did not include primary empirical data, the document-based comparative approach provides a robust analytical framework that guides future field-based research on inclusive digital education.

Conclusion

This study's comparative analysis of digital education inclusion policies in Singapore and Mauritius finds that ICT is now considered vital in advancing inclusive education. However, there were significant differences in their maturity, scope and systematic alignments. Based on its long-term master plans, Singapore's education system has already integrated ICT into its education, provides professional teacher training, and has AT to support learners with specific educational needs. In contrast, Mauritius, while progressing steadily, is in a developmental stage. It has promising national initiatives but is still constrained by limited resources, uneven teacher preparedness and insufficient monitoring mechanisms.

The findings indicate that while both countries recognise ICT as a driver of inclusion, Singapore's success stems from long-term governance alignment and evidence-based monitoring, whereas Mauritius' challenges arise primarily from fragmented implementation rather than lack of intent. This study reveals that the success of inclusive digital education is more than just access to technology or the development of national strategies. Rather, the success depends on the effective integration of technology into pedagogy, teacher competence and classroom culture. Continuous professional development, policy coherence and collaboration between ministries, schools and specialist institutions, such as the Dyslexia Association of Singapore, are critical enablers of equitable learning opportunities. This comparison also reveals that culturally sensitive adaptations are essential; therefore, if transferring the good practices from Singapore to Mauritius, contextual factors, such as infrastructure, teacher support and linguistic diversity, must be considered.

Ultimately, inclusive education in the digital age requires technological innovation and empathy, responsiveness and a commitment to diversity. Our findings suggest that future research should focus on the lived experiences of the students and teachers who are using AT, particularly in SIDS, where inclusive digital transformation has the potential to reduce educational inequalities and promote sustainable development.

While this study is based on a comparative document analysis, to validate and expand on the findings presented here, a follow-up empirical investigation is planned to gather field data from educators in Mauritius and Singapore.

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Core Quality Components in Contemporary Teacher Education Systems

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Abstract
The rapid digitalisation of education, the expansion of artificial intelligence, and the global shift towards competence-based pedagogies have fundamentally transformed the priorities of modern teacher education systems. This study aims to develop a multi-level analytical framework for evaluating the quality of teacher education by integrating global policy models, national education reforms in Azerbaijan, and institutional practices at Azerbaijan State Pedagogical University (ASPU). A qualitative-analytical research design was employed based on document analysis of international frameworks (OECD, UNESCO, World Bank, ESG, CAEP), national strategic policy documents, and institutional quality assurance instruments at ASPU.
The findings indicate that teacher education quality is shaped through the interaction of five core dimensions: digital competence, research-oriented pedagogy, personalised learning design, outcome-based curricula, and sustainable internal quality assurance mechanisms. At the national level, Azerbaijan's education reforms demonstrate a strong transition towards competence-based governance, professional accountability, and digital transformation. At the institutional level, ASPU operationalises these reforms through PDCA-based quality assurance, STEAM-integrated teacher training, digital learning platforms (LMS, Moodle, virtual laboratories), and multi-criteria academic staff evaluation systems.
The study concludes that digitalisation and AI alone do not guarantee improved teaching quality; their effectiveness depends on institutional culture, leadership capacity, professional development ecosystems, and transparent quality indicators. The ASPU case confirms that future-oriented teacher education requires systemic coherence, strong governance, and a sustained culture of quality.
Keywords: *teacher education, quality assurance, AI, quality components, higher education reform*.

1. Introduction

In the modern era, the rapid digitalisation of education systems, the expansion of artificial intelligence, and the global transformation of learning environments make teacher education a strategic priority. These changes are moving the teaching profession away from its traditional role as a “transmitter of knowledge” toward a new professional identity as a pedagogical designer, data analyst, and organiser of the learning ecosystem, with broader functional responsibilities (OECD, 2019; UNESCO, 2021). The growing attention in the academic literature to the quality of teacher education indicates that digital competence, personalised teaching approaches, research-oriented pedagogy, and outcome-based curricula have become key drivers of transformation in teacher education (López-Núñez et al., 2024; Basilotta-Gómez-Pablos et al., 2022).

Research shows that this transformation is not happening evenly across national education systems. While some countries are making progress in terms of digital infrastructure and quality assurance, others face institutional constraints in implementing the normative framework (World Bank, 2022). This picture suggests that teacher education is shaped not only by pedagogical changes, but also by technological, institutional, and managerial factors.

The article aims to analytically reveal the gaps between global and national policy documents and the actual practices of educational institutions, and, in particular, to present a multi-level model of the quality of contemporary teacher training based on the example of the Azerbaijan State Pedagogical University (ASPU). This model aims to make a new methodological contribution to both academic discourse and educational policy.

2. Aim

The main goal of this study is to systematically analyse the quality components of contemporary teacher training in the context of global trends, national education reforms, and institutional practice. The Hypothesis is that the interaction of global standards, national policies, and institutional reforms creates a multi-level model of teacher education quality.

3. Significance

The scientific and practical significance of this study lies in its reframing of the current discourse on the quality of teacher education with a multi-level analytical approach. Previous studies have typically examined either global trends, national strategies, or institutional practices in isolation. This article integrates these three levels and shows that the quality of teacher education depends not only on pedagogical skills but also on governance mechanisms, digital infrastructure, quality assurance, and institutional culture.

From a scientific perspective, the research strengthens the systems approach to teacher education. It provides a broad theoretical framework for concepts such as digital literacy, AI-based pedagogy, and outcome-oriented curriculum. From a practical perspective, this work advances current transformative directions in Azerbaijani education policy through academic analysis and presents a transferable institutional model based on the ASPU example.

The main innovation of this study is that it explains teacher preparation through an ecosystem approach and shows that quality is shaped not only by normative documents but also by institutional strength, managerial efficiency, and the real application of digital skills. This is a valuable new contribution to both the literature and the policy discourse, as well as to practical teacher preparation.

4. Theoretical framework

In the new twenty-first-century knowledge economy, teacher education has emerged as essential to national development. The Fourth Industrial Revolution, characterised by artificial intelligence, big data, automation, and digital platforms, is not only changing how knowledge is created but also transforming how it is learned and taught. In this new model, the traditional role of the teacher as merely a content transmitter is no longer sufficient. Teachers are more than just facilitators of traditional learning pathways; they are now being recognised as designers of dynamic learning environments, facilitators of personalised learning pathways, and advocates of higher-order thinking, creativity, and lifelong learning (Jafarov, 2016). International organisations consistently emphasise the importance of teacher quality as a school-linked determinant of student achievement, equity, and long-term social progress. OECD (2019) identifies improved early-career teacher preparation and training, and support for early-career teachers, as among the strongest policy tools to improve national education institutions. Similarly, UNESCO's (2021) humanistic education framework positions the teacher as the primary agent of sustainable social development. In contrast, the World Bank (2022) identifies teacher effectiveness as the strongest factor in eliminating "learning poverty" internationally. However, in the present world, teacher quality cannot be reduced to mere content knowledge or traditional pedagogical skills. The recent rapid digital transformation has introduced new layers of professional competence. Digital competence is increasingly a significant aspect of contemporary teachers' professionalism and is evidence-based in its association with teaching effectiveness and student achievement (Basilotta-Gómez-Pablos et al., 2022; Revuelta-Domínguez et al., 2022; López-Núñez et al., 2024). It has been shown that the pedagogically meaningful use of digital tools, learning platforms, and data-informed instruction enhances teaching practices and learning results. Simultaneously, recent scholarship emphasises that the sustainable growth of these skills depends on cohesive institutional strategies rather than fractured professional development efforts. For instance, Trujillo-Juárez et al. (2025) demonstrate that aligning university teachers' digital competence with the DigCompEdu standards significantly contributes to the development of micro-courses and modular professional learning programs. Consistent with this perspective, Betancur-Chicué (2023) provides evidence that microlearning frameworks offer substantial pedagogical benefits for integrating digital tools into university teaching. This implies that digital transformation in teacher education requires long-term, system-wide planning rather than isolated technological initiatives.

In addition to these skills, the current perspective on teacher education quality is viewed as a composite comprising competence-based curriculum development, research-based pedagogy, continuous professional development, and institutional quality assurance systems (López-Núñez et al., 2024; Basilotta-Gómez-Pablos et al., 2022). This shift is likely to lead to a transition from input-based teacher education to outcomes-based, performance-oriented frameworks, with a focus on classroom impact, graduate employability, and a culture of quality.

Many national education systems continue to face inherent challenges in aligning traditional teacher-training practices with contemporary global norms, despite widespread agreement. This issue is particularly severe in rapidly changing and technologically advancing societies. Teacher education reform in Azerbaijan is a cornerstone of enhancing human capital; however, aligning international quality standards with national governance structures, institutional capacities, and labour market expectations remains a challenging and continuously evolving process. In Azerbaijan, academic literature is increasingly framing this concept in terms of quality. Sharifov (2022) provides evidence that staff rating and performance evaluation systems strongly influence the professional behaviour, academic productivity, and pedagogical performance of university professors. In line with this view, Sharifov and

Mammadzade (2022) emphasise that integrative institutional evaluation systems are increasingly important for improving governance efficiency and accountability, and promoting a quality culture in higher education. These studies suggest that the quality of teacher training cannot be separated from overall institutional governance and internal quality improvement frameworks.

At the policy level, digital transformation and teacher qualifications are evident in Azerbaijan's national education strategy, legislation, and laws. The strategic orientation of teacher education is clearly stated in the "State Strategy for the Development of Education in the Republic of Azerbaijan" (President of the Republic of Azerbaijan, 2013), which highlights the enhancement of teacher selection, quality of teacher preparation, continuous professional development, university-school collaboration, and the infusion of new technologies into teaching practice as national priorities. These strategic directions were also consolidated in the "Azerbaijan 2030: National Priorities for Socio-Economic Development" (President of the Republic of Azerbaijan, 2021), which identifies highly qualified human capital, modernisation of the education system, and the establishment of flexible, innovation-driven education systems as important national priorities. Simultaneously, the national teacher certification framework (Cabinet of Ministers of the Republic of Azerbaijan, 2020) has established an organised mechanism for sustaining professional accountability by linking pedagogical competence, measuring and evaluating teachers' performance, and promoting teachers' professional advancement to well-defined, harmonised quality standards. Concurrently, recent curriculum reform, aligned with the competency-based education model, is increasingly focusing on learning outcomes, digital literacy, and interdisciplinary integration. In this policy framework, the conception of teacher education is slowly shifting from fragmented training interventions to a holistic approach to quality development that integrates digital competence, professional ethics, innovative pedagogy, institutional responsibility, and sustainable organisational growth. Despite these developments, the teacher education system in Azerbaijan still faces an intricate structural challenge: harmonising international quality frameworks (OECD, UNESCO, ESG, CAEP) with modern digital-age competencies, long-standing educational traditions, governance mechanisms, and evolving labour-market needs. Without holistic alignment between policy narratives and institutional implementation, there is a risk of systemic fragmentation unless this is addressed through a coordinated, sustained agenda for change. To address this challenge, this study seeks to:

- focus on global trends regarding contemporary teacher education, including digital competence, competence-based pedagogy, research-oriented instruction, and international quality assurance frameworks.
- analyse the reform initiatives in national teacher education in Azerbaijan, focusing on the evaluation mechanisms of institutions, certification processes for teachers, digital transformation procedures, and the growth of quality governance models.
- draw the institutional quality model of Azerbaijan State Pedagogical University (ASPU) as an illustration of system-level alignment of global, national, and institutional standards with national and local strategy and institutional actions, illustrating how internal quality assurance, digital infrastructure, STEAM integration, and school–university partnerships collectively influence the sustainability of teacher education quality.

The article adopts a comprehensive theoretical perspective and integrates international and national institutional investigations to analyse contemporary teacher education practice through a multi-tier framework, which is a coherent, interrelated, multi-faceted, holistic, and systemic quality system and model rather than multiple, isolated practice elements.

Global challenges and emerging trends in contemporary teacher education. Global education systems have undergone profound structural and pedagogical changes over the last decade and a half, driven by technological, social, and economic transformations. Recent studies by the OECD, UNESCO, and the World Bank have demonstrated that new challenges exist for teacher training in the global education context. The OECD's "Future of Education and Skills 2030" conceptual learning framework on student agency (OECD, 2019) suggests that teachers should have not only subject knowledge but also a complex of cognitive, social-emotional, and technological skills. UNESCO's 2021 report "Reimagining our futures together: A new social contract for education" (International Commission on the Futures of Education, 2021) assesses teachers as key actors in social development and highlights the transition to a humanistic educational model. The World Bank's "State of Global Learning Poverty: 2022 Update Conference Edition" policy research working papers (World Bank, 2022) indicate that teacher quality is the most important determinant of student achievement. The common conclusion of these reports is as follows:

The contemporary profile of the teacher extends far beyond the traditional function of instruction. The modern teacher must design effective learning environments, understand educational data, meet the needs of individual learners, and integrate digital technologies intentionally into pedagogical practice. This is an educational

revolution: it is not about the transmission of subject knowledge as it used to be, but about creating and planning a learning context during instruction. The modern teacher:

- analyses the arguments presented by students,
- guides them to work with various information sources,
- forms a culture of questioning,
- investigates multi-stage, complex problems together with the student.

According to UNESCO's ICT Competency Framework for Teachers (2018), digital literacy is no longer perceived merely as a set of technical skills; instead, it is conceptualised as an integral pedagogical competence embedded in modern teaching and learning practices.

A contemporary teacher also needs to be able to embed digital resources into lesson planning, support the development of visualisation, simulation, and interactive learning environments, enhance students' digital competence, and lead e-learning workflows. Modern educational contexts are shifting towards a hybrid instructional model, in which learning occurs in both conventional classroom settings and digital environments. Teachers play a dual role, providing quality instruction both in person and online. Under UNESCO's 2030 vision for education, rigid, uniform teaching models must be replaced with flexible models that are responsive to learners' varied abilities and needs (Jafarov, 2019). Under these circumstances, personalised teaching involves teacher-led, systematic diagnosis of students' prior knowledge, interests, and developmental paths, and the purposeful planning and delivery of learning tasks, resources, and projects aligned with a particular level of knowledge. Such a method not only supports students' autonomy in decision-making but also supports different learning styles.

At the same time, recent advances in generative artificial intelligence have begun to reshape educational practices at multiple levels. As highlighted by the World Bank's analytical report on artificial intelligence in education (Molina et al., 2024), AI-based systems are increasingly shaping instructional design, assessment practices, and teacher professional development. Review identifies four primary areas of impact of AI for teachers:

1. AI as a "mentor" for teachers,
2. AI-based feedback for professional development,
3. Support for lesson plans/content creation,
4. Automation of administrative routines.

Therefore, today's reality is that artificial intelligence can help the 21st-century teacher:

- to design tests and assignments,
- create differentiated resources,
- prepare a lesson plan and a process implementation mechanism,
- creating visual aids and simulations for the lesson,
- analyse the quality of lessons with analytical reports provided by artificial intelligence,
- to improve their methodology,
- It saves the teacher's valuable time by supporting them in tasks such as following international methodological trends, etc. This reduces the teacher's resource fatigue and allows them to focus on more creative processes.

Another interesting aspect of the teaching and learning process is artificial intelligence for learners:

- facilitates individual learning,
- plays a guiding role in strengthening weak skills,
- gives suggestions, new ideas,
- summarises the lesson material, etc.

AI does not replace the teacher; rather, it strengthens, enhances, and deepens the teacher's effectiveness and analytical capacity.

These global trends indicate that teaching is no longer merely a profession; it is among the most strategic in the modern world. The central driving force behind this transformation is the standard of teacher preparation itself. One of the most critical challenges currently confronting global education systems is the growing shortage of well-qualified teachers. This challenge is no longer confined to developing regions alone but has become increasingly pressing for countries with advanced economic structures, including members of the OECD and the European Union.

It is sometimes argued that the teaching profession is no longer as attractive to young people as it once was in the global labour market. This is due to factors such as the digital sector's attraction of young people with higher salaries and flexible working hours, the high emotional burden and stress of teaching, the increasing public expectations of the education system, and the further complexity of the teaching process following the pandemic. This reality is now a key strategic issue determining the future of education.

For this reason, contemporary teacher education increasingly prioritises STEM-based instructional methodologies, the use of digital laboratory environments, and the pedagogical integration of simulation technologies, coding, and robotics. In parallel, modern teachers are expected to cultivate students' problem-solving abilities, project-based learning competencies, and research skills, which collectively foster essential 21st-century competencies. This also indicates that teachers with STEM competencies are becoming the most strategic cadre in teacher training worldwide.

The global teacher shortage trend and the radical transformation of the teacher image show that:

- The teaching profession needs to be redesigned,
- teacher training should be based on new skills,
- university-school cooperation should be further strengthened,
- The modern teacher profile should be digital, integrative, and research-oriented.

In this context, curriculum innovation, quality assurance, research orientation, and digital transformation, in light of ASPU's reforms to teacher training, align with the country's strategic needs.

In modern times, quality assurance in teacher training is no longer just an internal control procedure, but also a key indicator of international competitiveness. When we consider reforms implemented worldwide, three major trends stand out.

Today, the assessment of the quality of pedagogical education programs has gone beyond the classic "document review" approach.

The standards put forward by international organisations, especially the EU ESG (European Standards and Guidelines), the CAEP (Council for the Accreditation of Educator Preparation), which evaluates teacher training in the United States, and the YÖKAK (Higher Education Quality Council), which is the leading institution for quality assurance in higher education in Turkey, show that:

- Universities should not just have a curriculum, but also think about and implement how the curriculum works;
- Realistic measurement of learning outcomes is required in teacher training.
- Assessment of students' practical training based on specific indicators has become a key requirement.
- educational institutions must demonstrate a functioning mechanism for continuous improvement of their systems;
- Graduate employment rates, feedback from school principals and mentors are now accepted as objective evidence in accreditation.

The ESG (European Standards and Guidelines) standards emphasise that quality in higher education is not only about the outcome, but also about ensuring transparency in the process.

The new standards of the Higher Education Commission of Azerbaijan are grounded in strategic management, internal quality culture, and internationalisation. These trends indicate that teacher training has become part of a global accreditation system rather than a national one.

Thus, quality assurance in teacher training in the world is formed in three main centres:

1. International harmonisation of accreditation standards;
2. Practical training based on university-school integration;
3. Flexible and competency-based curriculum design.

Universities that implement these three trends not only produce high-quality teachers but also establish themselves as competitive institutional actors in the global education space.

National reforms in teacher education in Azerbaijan: policy, certification, and curriculum innovation. Azerbaijan is among the countries that have implemented large-scale reforms in its education system over the past decade. Against the backdrop of globalisation, digital transformation, and changing labour-market demands, teacher training has become a strategic priority of state policy.

The work undertaken is presented across four main areas: strategic documents and the regulatory framework; educational reforms implemented in 2021-2026; the teacher recruitment and certification system; and curriculum reforms.
The approach to teacher training in the Republic of Azerbaijan has been shaped in recent years not only in the field of education, but also as an integral part of the country's long-term socio-economic development strategy. Several fundamental documents have established a conceptual framework for improving the quality of teacher training.

The "State Strategy for the Development of Education in the Republic of Azerbaijan", approved by the Decree of the President of the Republic of Azerbaijan dated October 24, 2013, proposes a new model in teacher training and identifies five critical priorities:

1. Improving the quality of teacher selection and training;
2. Creation of a system of continuous development of pedagogical staff;
3. Strengthening university-school cooperation;
4. Improving assessment and certification mechanisms;
5. Application of technology and innovation in education.

This document emphasises that the quality of pedagogical education is shaped not only in higher education institutions but also at the ecosystem level, through interactions among schools, the ministry, universities, and society.

The document "Azerbaijan 2030: National Priorities for Socio-Economic Development", approved by the Decree of the President of the Republic of Azerbaijan dated February 2, 2021, characterises teacher training as one of the main pillars of the development of the country's human capital (President of the Republic of Azerbaijan, 2021). Two important directions stand out here:

1. Enriching the educational process with modern technologies,
2. Formation of a competitive, flexible and creative teacher training system.

The content of teacher training in the Education Law was reframed around the principle of "competency-based pedagogical training". These changes include:

- phasing of teachers' professional development,
- strengthening practical components,
- shifting the educational process towards results-oriented instruction.

A new stage of teacher training began in Azerbaijan in 2021. These reforms are grounded in the principles of international benchmarking, digital transformation, and the strengthening of human capital.

As a result of changes made in the last 3 years, the admission score for pedagogical specialities has increased, and the share of experience-based learning has increased.

The digital infrastructure in teacher training in Azerbaijan has been significantly strengthened, especially with the widespread implementation of the "Digital Skills" project, the creation of virtual laboratories, the integration of hybrid and online lesson design into pedagogical training, and the use of electronic assessment platforms, which have given a serious impetus to improving quality in this area.

Certification is one of the primary mechanisms for quality assurance in Azerbaijani education. It is implemented in accordance with the Rules approved by the Cabinet of Ministers Resolution No. 155 dated April 30, 2020 (Cabinet of Ministers of the Republic of Azerbaijan, 2020). The purpose of certification is to objectively assess teachers' pedagogical and methodological skills, stimulate their continuous professional development, and foster quality-based human resource management in schools. This model aligns with international practice and ultimately increases transparency, strengthens the culture of professional development, and establishes uniform standards for teacher activities.

Azerbaijan's general education system has transitioned to a curriculum-based approach since 2006, and in recent years, further steps have been taken to adapt it to contemporary requirements.

Dear colleagues, these reforms place greater responsibility on higher education institutions, including a specific mission for the Azerbaijan State University of Education, which is the leading university in training pedagogical personnel in our country.

Institutional implementation of teacher education quality at ASPU: digital transformation, quality assurance, and research-oriented training. ASPU is a higher education institution with a history of 104 years. This university, which began operations in 1921 with several faculties and a small number of teachers, quickly became a leading centre for pedagogical education in the country. Against the backdrop of the ideological and political changes of the 20th century, ASPU remained a fulcrum for the training of pedagogical personnel and continues that mission with honour today.

Today, the vast majority of teachers working across the country are graduates of the Azerbaijan State University of Education. The 100,000 teachers who graduated from the university over the past century constitute the main human capital of the Azerbaijani education system. Teachers who hold children's first textbooks in their hands, leading school principals of the country, academicians and scientists were formed in the scientific and pedagogical environment of the Azerbaijan State University of Education.

The importance of ASPU to national education lies in its role in training teachers and educating individuals who shape society's future. In this sense, each ASPU graduate is a key contributor to the country's intellectual security and sustainable development.

ASPU maintains its status as the country's leading teacher-training university not only through its historical traditions but also through a modern management model, innovative approaches, and adaptation to new-generation pedagogical technologies. In addition, ASPU is no longer merely a "teacher training university" but a leading force in innovation, research, and a culture of quality in modern education.

In the 21st century, a teacher's digital skills are integral to their professionalism. ASPU has taken the most advanced steps in this direction:

- The e-learning platform has been expanded, and the LMS system and MOODLE platform are actively used for all teachers and students.
- Virtual laboratories for physics, chemistry, biology, and STEAM have been put into operation.

One of the most critical reforms at ASPU is the restructuring of the quality assurance system. The university now has an internal quality system based on the PDCA cycle (Plan – defining strategic goals; Do – implementing activities; Check – monitoring and evaluating; Act – implementing corrective actions). In this context:

- A 3-year tracer study is being conducted on graduates.
- Multi-criteria evaluation of teacher performance is applied in all faculties.
- Student satisfaction surveys regarding the teaching process are conducted, and the results are presented to the faculty.
- The annual activity plans of the structures are measured with objective indicators.

As a result, the quality culture at ASPU has now become a systematic mechanism.

In recent years, internationalisation has become a priority for ASPU:

- Erasmus+, Mevlana, and DAAD (German Academic Exchange Service) projects have expanded.
- Cooperation with institutions such as YÖKAK and TKTA (Agency for Quality Assurance in Education) has been further strengthened.
- The number of foreign professors and joint seminars has increased.
- Students' access to internships abroad has been increased.

5. Literature Review

Teachers' digital competence, modern teacher training models, and the transformation of global education policies have become major topics in academic discourse in recent years. The literature indicates that digital competence is a multidimensional concept that encompasses not only technological knowledge but also pedagogical innovation, research skills, and curriculum design (Basilotta-Gómez-Pablos et al., 2022; López-Núñez et al., 2024). Several systematic reviews show that there is no single model for assessing teachers' digital competence and that approaches vary significantly between countries and higher education institutions (Domínguez-González et al., 2025; Karimi & Khawaja, 2025).

Analyses by international organisations such as UNESCO and OECD present digital transformation as one of the main pillars of teacher preparation and formulate frameworks that integrate the social, cognitive, ethical and technical components of teacher competencies (International Commission on the Futures of Education, 2021; UNESCO, 2018; OECD, 2019). Recent World Bank reports highlight the impact of digital inequality and teacher competency gaps on learning outcomes and underscore the importance of structural reforms for developing countries (World Bank, 2022).

Other studies have examined the impact of digital competence on pedagogical outcomes and have shown that when teachers have high digital skills, students' academic self-confidence, engagement in learning, and self-regulation significantly increase (Luo et al., 2025). Microlearning and microcourses are emerging, flexible approaches to developing teachers' digital readiness and are widely used, particularly in higher education (Betancur-Chicué, 2023; Trujillo-Juárez et al., 2025).

Research conducted in the Azerbaijani context shows that national curriculum reforms, "Azerbaijan 2030" priorities, and teacher certification regulations support the transition to competency-based models. However, at the institutional level, problems include uneven implementation of quality assurance mechanisms, resource shortages, and the formal nature of pedagogical innovations (Sharifov, 2022). This creates gaps between global standards and national realities.

Overall, the literature shows three main results:

1. There is no single standard for defining and measuring digital literacy. Different countries use different assessment approaches.
2. Although digital transformation has a positive impact on pedagogical outcomes, for this, institutional support and sustainable development opportunities are crucial.
3. There is a lag between global policy documents and national-level implementation**,** especially in developing countries.

While the existing literature extensively describes global digital competency models, there is little research that systematically examines their integration with national reforms and university-level quality assurance mechanisms. There is a lack of empirical or conceptual research on how the implementation of global standards interacts with real-world institutional dynamics, particularly in pedagogically oriented higher education institutions such as ASPU. This article fills this gap by presenting an integrative model that links the global, national, and institutional levels.

6. Methodology

This study uses a complex, multi-level methodological framework to explain the formation of the contemporary teacher training system at the global, national, and institutional levels. The methodology combines the systematisation of theoretical concepts with the empirical, material analysis of policy and structural reforms implemented in the Azerbaijani education system over the past decade. The structure of the study covers the following analytical directions:

The study is of a theoretical-constructive nature, grounded in a qualitative, conceptual-analytical framework. The model is built on a three-level analysis structure:

1. Global level– Normative models and recommendations on teacher training from organisations such as OECD, UNESCO, and the World Bank are examined; international trends, digital transformation, and contemporary theoretical approaches to the competency-based teacher profile are summarised.
2. National level– The normative framework for teacher training in the Republic of Azerbaijan, including legislation, state strategies, certification and curriculum policies, institutional reforms, and digital transformation, is systematically analysed.
3. Institutional level– The governance model, digital transformation, STEAM integration, internal quality assurance, and structural components of teacher training implemented by the Azerbaijan State Pedagogical University (ASPU) in recent years are examined; the university example is used as an analytical framework that illustrates a practical implementation model of national policy.

The research data sources consist of four categories:

1. International documents and analytical reports: Documents such as OECD (2019), UNESCO (International Commission on the Futures of Education, 2021; UNESCO ICT-CFT), World Bank's "The State of Global Learning Poverty" (2022) and "AI in Education" (Molina et al., 2024) have been the primary sources of information for identifying global trends in modern teacher training.
2. Academic literature: International studies published in the last 5 years on teachers' digital competencies, microlearning, digital transformation and quality assurance in higher education were analysed (Basilotta-Gómez-Pablos et al., 2022; Betancur-Chicué, 2023; López-Núñez et al., 2024; Trujillo-Juárez et al., 2025, etc.).
3. National normative documents: Education Strategy (President of the Republic of Azerbaijan, 2013), the National priorities (President of the Republic of Azerbaijan, 2021), the Certification Rules (Cabinet of Ministers of the Republic of Azerbaijan, 2020), and the Curriculum Frameworks (Cabinet of Ministers of

the Republic of Azerbaijan, 2010) and other state documents were used to determine the national conceptual foundations of teacher training.

4. Institutional data on ASPU: Data on the university's structural reforms, implementation of digital platforms, internal assessment system, STEAM projects, international cooperation, and teacher performance monitoring served as the basis for the analysis of the institutional model.

The following methods were used in the study:

1. Document Analysis**:** More than 60 strategic documents, reports, legal acts, and academic sources on teacher education at the global, national, and institutional levels were systematically analysed.
2. Thematic Content Analysis: Thematic coding was conducted on conceptual categories extracted from the obtained texts - digital literacy, quality assurance, pedagogical competence, certification, university-school cooperation, outcome-oriented curriculum, etc.
3. Comparative analysis: The ASPU model was compared with international quality standards (ESG, CAEP, UNESCO ICT-CFT), and areas of compliance, gaps, and development directions were analytically identified.
4. Institutional assessment framework: ASPU's PDCA-based internal quality assurance system, teacher performance evaluation, implementation of digital platforms, and establishment of the STEAM model were examined through institutional analysis.

Since this study does not aim to collect extensive empirical data, its main limitation is its theoretical and documentary orientation. However, the study aims to systematise and present an analytical model of the relationship among global policy trends, national strategies, and institutional reforms, rather than to conduct empirical measurement. Therefore, the methodological limitation does not hinder the study's purpose but rather strengthens the conceptual explanation of the problem.

This methodological framework enables us to bridge the gap between global normative trends and national policy and institutional practices, while accounting for the multilevel and multifactorial nature of the teacher training system. Based on the synthesis of the presented approaches, the author builds an integrative quality model for contemporary teacher training and presents the ASPU example as a practical application of this model.

7. Findings & Discussion

The study's results indicate that the modern teacher training system is rapidly transforming globally, and these changes are also reflected in the institutional development of the Azerbaijani education system and ASPU. The study reveals close interactions between international documents and academic sources (Basilotta-Gómez-Pablos et al., 2022; López-Núñez et al., 2024; Trujillo-Juárez et al., 2025), as well as reforms at the national and institutional levels.

Reports from international organisations indicate that the teaching profession is shifting away from the traditional framework toward a digital, design-oriented, and research-based model. The approaches of UNESCO, OECD and the World Bank highlight three strategic lines in teacher training:

- Digital pedagogy– the ability to use technology in a purposeful, pedagogical way.
- Personalised learning– adaptation to the student's individual development trajectory.
- AI-assisted teaching– artificial intelligence ecosystems that reduce teacher workload and expand their creative possibilities.

These global changes are summarised in Table 1.

Table 1. Global contemporary teacher training trends

Global direction	Description	Mechanism of action
Digital literacy	The teacher's ability to apply technology for pedagogical purposes	Lesson planning, teaching on digital platforms, and online assessment
AI-based teaching support	Artificial intelligence helps teachers with planning, assessment, and differentiation.	Reduced workload, more opportunity for creative activity
Personalised training design	Teaching adapted to the student's knowledge level and learning style	Increased student agency and motivation to learn
Research-oriented pedagogy	The teacher's application of inquiry-based and problem-solving-oriented learning	Developing critical thinking and 21st-century skills
Hybrid teaching models	Integration of traditional and online forms of education	Lesson-design flexibility and resource expansion

Global trends indicate that teacher education is no longer merely a knowledge-transfer process but a multi-layered professional ecosystem that integrates digital competence, AI support, personalised learning, and research-driven pedagogy. Each of these directions expands the teacher's role, making them a key agent of transformation who extends beyond the classroom, fosters innovation, and strategically directs the learning environment.

The analysis shows that national documents – Education Strategy (President of the Republic of Azerbaijan, 2013), the National priorities (President of the Republic of Azerbaijan, 2021), and the Certification Rules (Cabinet of Ministers of the Republic of Azerbaijan, 2020) and curriculum reforms (Cabinet of Ministers of the Republic of Azerbaijan, 2010)– reframe teacher training with a systems approach. The main lines of the national model are as follows:

- Competency-based training– result-oriented pedagogical preparation.
- Certification and objective assessment– strengthening the professional responsibility of teachers.
- Expansion of digital infrastructure– "Digital skills", virtual laboratories.
- University-school integration– real practice-based training.

These trends are shown more clearly in Table 2.

Table 2. National policy framework for teacher training in Azerbaijan

Policy component	Main content	Expected impact
Education Strategy (President of the Republic of Azerbaijan, 2013)	Quality in teacher training, selection mechanisms, and modernisation of training	Strengthening teacher selection and efficiency in the preparation process
National priorities (President of the Republic of Azerbaijan, 2021)	Human capital, innovation, digital transformation	Adapting teacher training to the labour market
Certification (Cabinet of Ministers of the Republic of Azerbaijan, 2020)	Objective assessment of professional activity	Increasing teachers' responsibility and motivation
Curriculum reform (Cabinet of Ministers of the Republic of Azerbaijan, 2010)	Results-oriented, digital and research-based training	Development of modern pedagogical skills
Digital Development Concept (President of the Republic of Azerbaijan, 2025)	Virtual labs, LMS, and online assessment	Systematic application of digital pedagogy

These findings indicate that national policy is aligned with global trends and that a quality-centred teacher training model is emerging.

An analysis of the institutional reforms carried out at ASPU shows that a systematic quality model has been formed along three strategic lines:

1. Development of pedagogical and digital competencies: STEAM centres develop both methodological and innovative skills of students.
2. Internal quality assurance system: Reality-oriented mechanisms based on the PDCA model – teacher performance evaluation, student satisfaction, and monitoring.
3. Innovation and internationalisation
   Programs such as Erasmus+, Mevlana, and DAAD strengthen the university's integration into the global educational space.

The main components of ASPU's institutional model are summarised in Table 3.

Table 3. ASPU's institutional quality model

Quality component	Application at ASPU	Compatibility with strategy
Pedagogical competence	TRE trainings, methodological seminars	Education Strategy – Modernisation of Teacher Training
Digital literacy	LMS, MOODLE, virtual laboratories	Azerbaijan 2030 – digital transformation
STEAM and project-based learning	Interdisciplinary learning through the STEAM centre	Global Trends – 21st Century Skills
Academic performance assessment	Rating system, Scopus support program	ESG – transparency and results orientation
Quality assurance system	PDCA cycle, internal monitoring	Compliance with accreditation criteria

International cooperation	Erasmus+, foreign internship programs	Global harmonisation and institutional development

The analysis shows that the modern teacher training system is no longer a single-level or curriculum-oriented process. On the contrary, this system has been established as a multi-level ecosystem that develops in parallel, complements, and interacts at the global, national, and institutional levels. The harmonious functioning of this ecosystem becomes one of the most important factors determining the quality of teacher training.

Analysis of global models indicates that digital literacy, personalised teaching methodologies, and the integration of artificial intelligence into pedagogical practice are defining new standards for the teaching profession across the world's leading education systems. The modern teacher is no longer merely a transmitter of knowledge; they serve as a lesson designer, data analyst, organiser of learning environments, and pedagogical adapter of technological innovations. The conceptual frameworks of organisations such as UNESCO and OECD establish this new role of the teacher as a normative standard on a global scale.

At the national level, Azerbaijan's education policy provides a strategic basis for implementing these global standards. The Education Strategy (President of the Republic of Azerbaijan, 2013), the National priorities (President of the Republic of Azerbaijan, 2021), and the Certification Rules (Cabinet of Ministers of the Republic of Azerbaijan, 2020) constitute a unified quality vision for teacher training and place digitalisation, a competency-based curriculum, and objective assessment mechanisms at the centre of state policy. Thus, global trends are systematically reflected in national legislation and integrated into the education ecosystem. This process demonstrates that Azerbaijan is not only adapting to teacher training but also developing a sustainable policy framework consistent with international standards.

At the institutional level, ASPU presents the most complete practical model of this policy. The PDCA-based quality assurance system, digital learning platforms, STEAM centre, methodological training, rating and performance assessment mechanisms, and international cooperation programs implemented by the university demonstrate that the goals set in national policy documents are being translated into practice. The reforms implemented at ASPU strengthen both the culture of innovation in teacher training and the efficiency of academic management, thereby turning the university into an institution that plays a strategic role in the country's educational ecosystem.

Determining the quality indicators for teacher training and integrating them into the teaching process have become strategic priorities in higher education.

The main components that determine the quality of modern teacher training cover several strategic directions. These include the development of professional-pedagogical competencies; the acquisition of innovative and digital teaching skills; the creation of an interdisciplinary, research-oriented learning environment; internal quality assurance and objective assessment of academic performance; and systematic monitoring of graduate employment indicators. Each component determines both the content and outcomes of the teacher training process and forms the strategic development line of higher education institutions in this area.

The 1st component is the formation of professional and pedagogical competencies. A modern teacher, in addition to having in-depth knowledge of his subject, must also master the methods and psychology of teaching. The Training and Education Centre at ASPU operates in this direction. The centre organises regular training to develop the pedagogical, methodological, and digital skills of university teachers. Teachers participating in these training sessions learn to apply new teaching technologies, assessment methods, and modern lesson models, such as the 7E and 5E models. As a result, teachers demonstrate more innovative, student-oriented approaches in the training process.

The 2nd component is digital and innovative teaching skills. The STEAM Centre, operating in this direction at ASPU, aims to develop interdisciplinary thinking among students and to encourage learning through practical projects that combine physics, mathematics, engineering, art, and technology. Thanks to this centre, future teachers are armed not only with theoretical knowledge but also with project-based teaching skills. This also serves the development of "creativity and problem-solving skills", which is one of the quality indicators.

The 3rd component is an objective assessment of teacher performance. For several years, ASPU has used a teacher rating system based on specific indicators across pedagogical, research, and social domains. Through this system, a healthy competitive environment is formed among teachers, and the dynamics of their professional development are continuously stimulated. The rating results affect the university's personnel policy and, at the same time, increase academic staff's motivation for self-development. In addition, to stimulate scientific activity, teachers

receive financial rewards for articles published in the Scopus and Web of Science databases. This initiative has increased scientific productivity and enhanced the university's international image.

The 4th component is international cooperation and exchange of experience. In this regard, ASPU has established cooperative relations with several foreign universities. Teachers and doctoral students participate in internship programs at universities in Turkey, Denmark, Poland, Germany, Lithuania and other countries. This international experience creates conditions for integrating new approaches into the country's education at both the methodological and academic levels.

The 5th component reflects graduates' employment levels and their success in professional activities. In this regard, the university has monitored graduates over the past three years and conducted specific analyses. Thus, in recent years, the percentage of ASPU graduates employed in educational institutions has increased significantly. This finding indicates that the university's educational programs are aligned with labour-market requirements and that the teacher-training system delivers measurable results.

The 6th component is the formation of an internal quality culture. The measures implemented in this direction at ASPU, including monitoring the educational process, conducting student surveys, and preparing pre-accreditation self-assessment reports, are continuously being developed at the university under the PDCA (Plan, Do, Check, and Act) principle.

Modern teacher training cannot be limited to traditional theoretical knowledge. For this reason, a curriculum reform at ASPU was conducted in two directions:

The first direction is a new competency-based curriculum. All curricula have been updated in line with the competency model. In addition, the program for first-year master's students in the "Pedagogy" speciality has been fundamentally changed and redesigned in accordance with labour-market requirements since 2025.

The second direction is adaptation to international standards. The programs have been adapted to ESG requirements. Structural changes have been made in accordance with the Higher Education Commission's accreditation criteria and the TKTA. Internal and external experts have evaluated some ASPU programs through peer review. The main factor determining the quality of teacher training is real school experience. We have made significant breakthroughs in this direction over the last three years. Thus, cooperation agreements have been signed with more than 100 schools in Baku and the regions.

Overall, the parallel development of these three levels indicates that modern teacher training is no longer limited to curricular content. The concept of quality requires the formation of a digital ecosystem, the efficiency of management processes, and the creation of a culture of continuous development grounded in performance indicators. Thus, teacher training has become a multi-level, interactive and dynamic ecosystem. In this ecosystem, innovation, digital transformation, management, and quality assurance converge to shape the future profile of teachers.

Conclusion

The findings of this study show that global teacher education is no longer driven solely by isolated pedagogical reforms, but by complex power interactions between technology, policy, institutions, and human capital. While digital tools are often seen as neutral and democratic, and teacher education reforms are frequently viewed as universally promoting equality, this research indicates that the landscape of teacher education is far from level. The same international standards, national governance mechanisms, and institutional capacities do not work at the same pace worldwide. The ASPU institutional model shows that, to be fully aligned with global systems such as ESG and UNESCO, formal compliance cannot be achieved without fundamental structural change, dedicated leadership, and a sustainable internal culture of quality. Without these elements, international frameworks risk becoming merely symbolic rather than truly transformative.

Notably, the study's multi-tiered methodological framework—combining global document analysis, thematic coding of national reform policies, and institutional-level evaluation—demonstrated that quality in teacher education arises from the interplay of structural forces rather than from standalone interventions. The comparison of these layers revealed that meaningful transformation depends not only on the presence of standards but also on the institutional capacity to interpret, adapt, and operationalise them within specific sociocultural contexts. This methodological insight reinforces that reforms become effective only when they are translated into institutional practice through coherent governance and continuous quality assurance.

The study further indicates that digitalisation and artificial intelligence do not automatically ensure pedagogical equity. Conversely, teachers and institutions that lack digital skills, research-oriented abilities, and institutional support are increasingly marginalised within the evolving educational landscape. Like online communication, teacher education today reveals the underlying hierarchies of competence, access, and institutional influence. While digital platforms strengthen the capabilities of the already privileged, they expose the structural deficits of teachers and institutions undertaking this transformation in the absence of appropriate scaffolding, training, and safeguards. The real question is not so much whether there is digital transformation as who gains from it and under what institutional circumstances. As such, this study confirms that national reforms in Azerbaijan are a landmark step towards competency-based teacher training, certification-focused professional accountability, and improved digital infrastructure. However, the effectiveness of such reforms remains contingent on the institutional mechanisms which bring state policy into day-to-day academic practice. ASPU's internal quality assurance model, based on PDCA cycles, multi-criteria staff evaluation, graduate tracer studies, and international benchmarking, shows that quality is not achieved solely through regulation, but through ongoing institutional reflection. Without such mechanisms, certification risks becoming merely procedural, curriculum reform may turn formalistic, and digitalisation may remain superficial.

A key implication of this research is that teacher education cannot be designed solely as a technical system. It is inherently a social, cultural, and institutional process influenced by power relations, professional identities, and organisational cultures. The modern teacher is expected to be digital, reflective, research-oriented, ethically responsible, and adaptable. However, expecting such an ideal without robust institutional support systems in place fosters structural inequality within the profession. Therefore, institutions have an ethical duty not only to demand performance based on outcomes but also to create protective academic environments that enable teachers to develop into these complex professional roles.

Finally, this study challenges the myth that contemporary teacher education reforms automatically lead to democratic, equitable, and universally effective learning systems. Equal participation, high-quality teaching, and sustainable professional learning require well-planned, well-defined institutional rules, transparent quality indicators, and long-term investment in academic cultures. The ASPU case demonstrates that when global standards, national reforms, and institutional governance collaborate, teacher education is not only a training apparatus but an intelligent, strategically integrated, sound ecology of quality. Such an ecosystem model offers a transferable framework for other countries seeking to harmonise global teacher education standards with national priorities and institutional realities in the age of artificial intelligence and digital transformation.

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Effect of an Inclusive Education Course Delivered Through a Flipped Learning Approach on Pre-Service Teachers' Self-Efficacy: A Randomized Controlled Trial

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ABSTRACT
The discrimination and exclusion of children with special educational needs from mainstream classrooms can be attributed to inadequate preparation of pre-service teachers for inclusive teaching. Teachers' self-efficacy, which refers to beliefs about their ability to implement inclusive strategies, is widely recognized as a crucial factor in preparing pre-service teachers to perform confidently and effectively in mainstream classrooms. This article, part of a broader study exploring the mediating role of pre-service teachers' beliefs about inclusive education in the relationship between an inclusive education course intervention- delivered through a flipped learning approach- and teachers' self-efficacy, reports only the direct effects. The sample consisted of 240 Tamil-speaking pre-service teachers randomly selected from initial teacher education institutions across Sri Lanka. A randomized controlled trial with pre- and post-tests, employing an experimental design with a control group, was conducted. Data were collected using the culturally adapted Tamil version of the Teacher Efficacy for Inclusive Practices scale and analyzed through MANCOVA in IBM SPSS and PLS-SEM in SmartPLS4. The results revealed the differential impact of the intervention on the three domains of teacher efficacy: inclusive instruction, behaviour management, and collaboration, with the intervention significantly predicting these efficacy dimensions. These findings contribute to initial teacher education programs by providing structured, institution-level, course-based exposure to inclusive education through practical approaches, thereby better preparing pre-service teachers for inclusive classrooms.
Keywords: Inclusive education course, Inclusive practices, Pre-service teachers, Randomized controlled trial, Teacher efficacy.

INTRODUCTION
The global movement towards inclusive education (IE) has created significant challenges for pre-service teachers (PSTs), especially as increasing numbers of students with special educational needs (SEN) are integrated into mainstream classrooms. PSTs are expected to address long-standing discriminatory attitudes and exclusionary practices that continue to persist within inclusive settings (O'Neill, 2015; UNESCO, 2008). The adequate preparation of PSTs has become imperative, requiring the development of IE-related knowledge, practical skills, and positive professional dispositions, a concern that remains global in scope (UNICEF, 2013). Evidence from reviews of initial teacher education (ITE) programs across the Asia-Pacific region further indicates that many systems continue to face substantial challenges in equipping graduates with the essential competencies needed to manage learner diversity effectively (UNICEF, 2013). This gap can largely be attributed to ITE programs that have historically provided limited exposure to IE alongside university-based coursework, thereby leaving PSTs insufficiently prepared for the practical challenges of their future classrooms (Alazemi & Larkins, 2025; Avramidis et al., 2000; Carroll et al., 2003; Lancaster & Bain, 2010; Lucena-Rodríguez et al., 2025).

Like many developing countries, Sri Lanka has demonstrated strong policy commitments to IE. However, a considerable gap persists between policy mandates and actual practice in ITE. Despite significant efforts by ITE institutions to prepare PSTs to implement IE effectively, many of them report feeling overwhelmed by student diversity and concerned about meeting the varied needs of students with SEN. They attribute these concerns to ITE programs, perceiving them as overly theoretical and insufficiently connected to their future classroom requirements (Hettiarachchi & Das, 2014; Yogaranee, 2024, 2025). A recent nationwide survey by Peries et al. (2021) involving 705 primary teachers revealed that although most held positive attitudes towards inclusion, many did not feel prepared to identify and support students with dyslexia, underscoring the need to enhance ITE with more structured, practical experiences with students with SEN and IE. To this end, this study employs a randomised controlled trial (RCT) to examine how an IE course, aligned with the Sri Lanka Qualifications Framework and delivered via a flipped learning approach, can improve PSTs' confidence in applying inclusive methods, particularly in teaching, behaviour management, and collaboration.

LITERATURE REVIEW

Teachers' sense of efficacy (TSE), introduced in Bandura's (1997) social cognitive theory, refers to teachers' belief in their ability to achieve teaching goals. Bandura suggests that TSE is influenced by four primary sources of information: mastery experiences, physiological and emotional states, vicarious experiences, and verbal persuasion. ITE programs are expected to provide some or all of these experiences to help develop TSE. Bandura highlighted that mastery experiences are the most crucial; therefore, measures of self-efficacy should be sensitive to how such experiences during ITE affect PSTs' attitudes and confidence in supporting students with SEN.

Developing TSE for inclusive practices among teachers is a crucial endeavour, supported by evidence linking it to teachers' retention, students' academic adjustment, and teachers' professional fulfilment (Bandura, 1997; Zee & Koomen, 2016). TSE is also negatively associated with burnout, a state characterized by emotional exhaustion, depersonalization, and reduced personal achievement, which can cause teachers to leave the profession prematurely (Brouwers & Tomic, 2000). High-efficacious teachers tend to demonstrate greater resilience when facing classroom challenges. Conversely, those with lower TSE are more likely to adopt punitive, authoritarian classroom management strategies that limit student autonomy and engagement.

It is widely reported that the early years of pre-service training are the most effective time to influence PSTs' beliefs and confidence towards IE (Woolfolk-Hoy & Spero, 2005). Experts argue that this period is ideal for fostering positive attitudes and developing TSE through high-quality training (Lambe & Bones, 2007). To prepare PSTs as inclusive practitioners, ITE programs must equip them with sufficient inclusive knowledge and skills to challenge their assumptions about fairness and equity. Beyond just knowledge, teachers need to develop positive values, supportive ideals, and a strong sense of responsibility for educating all children, regardless of their diverse needs (Forlin, 2010). Without this foundation, teachers are unlikely to commit to inclusive classrooms fully, highlighting the importance of reforms that realign ITE with inclusive goals.

The shift towards fully inclusive school systems requires that ITE institutions revise their curricula to incorporate IE courses, either as standalone modules or embedded content, to prepare PSTs better (Forlin, 2010; Kurniawati et al., 2014). However, many curricula failed to fulfil their requirements, instead relying heavily on a single compulsory IE course, which offered limited opportunities for extended practicum experiences, electives, or in-depth study (Carroll et al., 2003). Consequently, many new teachers report feeling anxious about their ability to teach students with diverse learning needs and attribute these concerns to inadequate preparation for inclusive practice (Forlin & Chambers, 2011; Hemmings & Weaven, 2005; Lambe & Bones, 2007; Sharma & Nuttall, 2016; Yogaranee, 2024).

TSE in inclusive practices has been the central area of most international studies examining how courses on IE or special education influence PSTs' TSE. They consistently demonstrated that participation in a special or IE course positively impacts attitudes and TSE of PSTs (Casarez, 2013; Can, 2015; Forlin et al., 2014; Lancaster & Bain, 2007, 2010; Loreman et al., 2013; O'Neill, 2015; Sharma, 2012; Sharma et al., 2008; Sharma et al., 2015; Sharma & Nuttal, 2016; Sharma & Sokal, 2015; Woodcock et al., 2012; Zundans-Fraser & Lancaster, 2012).

Lancaster and Bain's (2007) study examined the effectiveness of three different design conditions: two involved direct experience with students with SEN, and one followed a university 'subject-only' approach. Significant improvements in TSE were seen across all groups, with no notable differences between the approaches. In their follow-up study in 2010, they compared two versions of a 13-week required IE course, one including a field placement and the other based on complex adaptive systems. Both formats led to significant gains in TSE among PSTs for inclusive teaching, with no differences between them. This indicates that well-structured alternative courses can be as effective as practicum-based experiences.

On the contrary, Nketsia and Saloviita (2013), who conducted a study on PSTs' views on IE in Ghana, found that although nearly all participants had been exposed to the concept of inclusion during their studies, only about one-third reported feeling highly or somewhat prepared to teach learners with diverse abilities. This finding highlights a gap between exposure to inclusion as a theoretical concept and the development of self-efficacy to implement IE.

Despite the growing emphasis on inclusion, research consistently indicates that PSTs often feel inadequately prepared to teach students with SEN, reporting low levels of TSE for inclusive practices (Forlin & Chambers, 2011). It has also been shown that ITE programs are increasingly including modules on IE, which tend to be theoretical and offer limited opportunities for practical application, thus restricting their impact on the development of TSE (Sharma et al., 2013). Furthermore, there is insufficient experimental evidence to determine whether structured IE courses can effectively enhance PSTs' TSE.

The current study identified several gaps, including conceptual, methodological, and statistical issues within the reviewed literature. Firstly, the targeted intervention of the IE course aimed at developing TSE is missing in the Sri Lankan context, particularly for Tamil-speaking PSTs. Secondly, empirical evidence does not demonstrate the inclusion of experimental interventions, especially in an RCT with a pre- and post-test controlled-group design. Thirdly, research examining the effect of the IE course on PSTs' TSE has consistently employed a pre- and post-test design, using various inferential statistics, such as paired-sample t-tests, one-way ANOVAs, one-way MANCOVAs, and repeated-measures ANOVAs, without employing structural equation modelling (SEM) techniques. Lastly, the study highlights the design of IE, which is widely emphasised in most studies, involving both faculty-led course-based exposure and a practicum that facilitates mastery of the experiences gained through the targeted intervention of the IE courses. However, some studies focus solely on the design of the intervention, using course-based exposure alone, which has been reported to be sufficient for improving TSE in inclusive practices.

This study addresses these gaps by investigating how effective the targeted experimental, course-based intervention of the IE course is in fostering TSE for inclusive practices among PSTs, evaluated across three areas: efficacy for inclusive instruction (EII), efficacy for managing behaviour (EMB), and efficacy for collaboration (EC). The following research questions were formulated: (1) Does the IE course lead to higher post-test EII scores in the experimental (EXP) group compared to the control (CON) group, after adjusting for baseline EII scores? Does the intervention also significantly predict post-test EII scores? (2) Does the IE course result in higher post-test EMB scores in the EXP group compared to the CON group, after adjusting for baseline EMB scores? Does the intervention also significantly predict post-test EMB scores? (3) Does the IE course generate higher post-test EC scores in the EXP group compared to the CON group, after adjusting for baseline EC scores? Does the intervention also significantly predict post-test EC scores? It was hypothesised that the IE course intervention would significantly predict improvements in PSTs' overall TSE for inclusive practices, such as EII, EMB, and EC, with the EXP group showing higher post-test mean scores than the CON group for the total Teacher Efficacy for Inclusive Practices (TEIP) scale and its three dimensions—EII, EMB, and EC—after adjusting for the corresponding pre-test scores.

The findings of this study are important in showing how targeted interventions in the IE course, especially in their design and delivery, can improve PSTs' TSE for inclusive practices. Although the IE course is an institutional-level, course-based programme, implementing it in simulated environments without enough real classroom experience notably helped boost teaching confidence, including instructional techniques, behaviour management, and collaboration among PSTs. The implication is that mastery experiences, a key source of efficacy information, can be recreated through well-structured microteaching and other simulated activities; when the course is delivered effectively, these simulated mastery experiences can enhance PSTs' TSE (Bandura, 1997; Pendergast et al., 2011). These findings show the potential of carefully designed, simulation-based IE coursework to serve as an effective alternative to direct classroom experience in preparing PSTs for inclusive teaching.

METHODS

Research Design

This longitudinal study, part of a broader project examining the mediating role of PSTs' beliefs about IE in the relationship between the IE course intervention, delivered through a flipped learning approach, and TSE, specifically investigated the direct effect of the course intervention on TSE. An RCT design with a pre- and post-test control group was selected, following the Consolidated Standards of Reporting Trials (CONSORT) 2010 guidelines (Moher et al., 2010). The RCT is considered the most rigorous method for evaluating causal effects of educational interventions, with the EXP versus CON group serving as a categorical independent variable and the TSE as the outcome variable (Moher et al., 2010; Schulz & Grimes, 2002).

Participants

The target population includes all Tamil-speaking PSTs enrolled at ITE institutions across Sri Lanka. Three institutions were randomly chosen to create a sampling frame of cohorts from the 2023/25 batches. A total of 240 teacher candidates were randomly selected from this frame as the sample. Although the relatively small proportion of male participants (24%) in the sample might raise concerns about bias, this distribution reflects the national teacher population, in which females are predominant.

Measures

Data were gathered using the Tamil version of the adapted 18-item TEIP scale (TEIP-TM), with permission from the first author (Sharma et al., 2012). The original TEIP scale assesses TSE across three domains: EII, EMB, and EC, each comprising six items, rated on a 6-point Likert-type scale, from "Strongly Disagree" to "Strongly Agree",

with total scores ranging from 18 to 108, where higher scores indicate greater efficacy. Although the TEIP scale developers reported satisfactory internal consistency for the three subscales and the total scale, with Cronbach's alpha values of .93 for EII, .85 for EC, .85 for EMB, and .89 for the overall scale, they did not include comprehensive analyses for factorial structure and construct validation. Therefore, although the 18-item TEIP demonstrates acceptable reliability, further validation is required to establish its measurement properties fully. Nonetheless, the extensive international use of the TEIP scale to assess perceived TSE for teaching in inclusive classrooms supports its relevance and practical utility, rendering it a suitable and well-established instrument for evaluating PSTs' TSE in this study.

The cross-cultural adaptation and validation of the 18-item TEIP-TM scale were undertaken using EFA in IBM SPSS (version 25) and CFA in IBM AMOS (version 23), following established guidelines by Beaton et al. (2000) and the International Test Commission (2016) to assess TSE for inclusive practices among Tamil-speaking PSTs (Sakthivel, in press). EFA, employing principal axis factoring and Direct Oblimin rotation, yielded a three-factor structure for both pre- and post-test scores, aligning with the theoretical factor structure and demonstrating that participants distinctly differentiated among the latent factors of the TEIP-TM: EII, EMB, and EC.

EFA revealed a three-factor structure of the TEIP-TM scale, consistent with the theory, with initial eigenvalues of 7.713 for EII, 2.046 for EMB, and 1.439 for EC. Parallel analysis further supported this three-factor solution. All items on the TEIP-TM scale loaded adequately onto their respective latent constructs, with loadings ranging from .646 to .742 for EII_POST, from .600 to .801 for EMB_POST, and from .592 to .794 for EC_POST, most exceeding the .70 threshold (Hair et al., 2019). Although a few items performed poorly in EFA (EII1_POST, EII3_POST, EMB1_POST, EMB2_POST, and EC1_POST), they were retained for the validation process. EII explained 40.40%, EMB 9.03%, and EC 5.41% of the variance, accounting for 54.84% in total, with EII as the dominant factor. Inter-factor correlations ranged from .454 to .617, indicating related but distinct factors and supporting the use of oblique rotation. All correlations were below .70, indicating no multicollinearity (Field, 2018).

Notably, the previous study adapted the factor structure of the TEIP-TM by including an item from EMB_POST (EMB1 - "I have confidence in my ability to avoid disruptive behaviour in the classroom.") in the EII, due to its cross-loading, while maintaining its dimensionality. This adaptation is both statistically and theoretically justified, as statistically, the primary loading value exceeds the secondary loading by more than 2.0. Theoretically, EMB1_POST is more relevant to include in the EII, as it reflects a preventive management strategy whose function differs from a punishment-oriented, response-based behaviour management strategy. It can be explained that PSTs may have perceived preventive management behaviour as part of inclusive instructional practices rather than as reactive (Sakthivel, 2025; Yogaranee, 2025).

The factorial validity of the three-factor TEIP-TM scale was confirmed using the 7-item EII_POST (including EMB1_POST), the 5-item EMB_POST, and the 6-item EC_POST, performed in IBM AMOS. The model fit indices, including CMIN/df, CFI, TLI, RMSEA, and SRMR, indicated excellent fit to the data. The standardized lambda values were significant, ranging from .615 to .806 for EII_POST, from .629 to .791 for EMB_POST, and from .603 to .793 for EC_POST.

Composite reliability (CR) indices of .877 for EII_POST, .859 for EMB_POST, and .886 for EC_POST all exceeded the recommended threshold of ≥ .70 (Hair et al., 2019; Fornell & Larcker, 1981). Cronbach's alpha values were .880 for EII_POST, .857 for EMB_POST, .884 for EC_POST, and .920 for the total scale, exceeding the ≥ .70 thresholds, indicating strong internal consistency of the scale and subscales (Nunnally & Bernstein, 1994; Hair et al., 2019; Sharma et al., 2012). The average variance extracted (AVE) values, which reflect convergent validity, were .515 for EII_POST, .551 for EMB_POST, and .564 for EC_POST, all exceeding the ≥ .50 threshold, suggesting that each construct explained more than 50% of the variance in its indicators. Furthermore, discriminant validity was confirmed through the heterotrait-monotrait (HTMT) ratio and the Fornell–Larcker (F-L) criterion in the previous study (Fornell & Larcker, 1981; Sakthivel, in press).

As all the factors and the scale met the validity and reliability criteria, it was decided to retain the items with low loadings extracted from the EFA and the adapted factor structure. Overall, previous international studies have consistently confirmed the dimensionality and psychometric soundness of the 18-item TEIP scale. The culturally adapted validation results further aligned with this evidence, supporting the TEIP-TM scale's suitability for assessing TSE for inclusive practices among Tamil-speaking PSTs in Sri Lankan ITE contexts (Sakthivel, in press).

Procedure

Participants were randomly assigned to either the EXP group (N = 120), which received the intervention, or the CON group (N = 120), which followed the standard teacher education courses. Random assignment ensured comparability between groups and minimized selection bias (Torgerson & Torgerson, 2008). Both the EXP and CON groups completed the cross-culturally translated and adapted TEIP-TM scale before (pre-test) and after the intervention (post-test). This design enabled the assessment of both within-group changes over time and between-group differences at post-test, while adjusting for initial TSE levels.

Randomization, allocation concealment, and attrition management

A random sequence was generated for 240 participants, who were randomly assigned to the EXP and CON groups using a computer-generated random number sequence in IBM SPSS (Version 25). A simple randomization method was applied to ensure an equal probability of assignment. The randomization list was prepared by an independent researcher not involved in participant recruitment or data collection. Allocation concealment was maintained through sealed, opaque, and sequentially numbered envelopes prepared by a research assistant not involved in the intervention or data analysis. The envelopes were opened only after participants consented, preventing selection bias.

To minimize contamination between the EXP and CON groups, participants were drawn from different institutions and received instruction through separate online sessions conducted on different days. Communication about course materials and activities was restricted via clear instructions and monitoring of online platforms. The intention-to-treat (ITT) principle, which emphasizes that all participants are analyzed in their initially assigned groups regardless of intervention completion, adherence, or dropout, was not applicable, as all participants completed both pre- and post-tests. Although some participants missed online sessions, make-up sessions were held in person to ensure full delivery of the intervention. Consequently, all participants were included in the analysis, and no attrition or missing data necessitated the use of ITT analysis.

The EXP group took part in a structured 30-hour, 2-credit IE course designed for this study to improve their knowledge, skills, and beliefs about inclusive practices. The course content covers the foundational ideas of IE, basic identification of children with SEN by their specific traits, how they are supported in classrooms to meet their diverse needs, IE policies and laws enacted internationally and locally, inclusive teaching methods, classroom management strategies with proactive and reactive approaches, formative and informal assessment techniques with the development of rubrics, and collaboration skills for supporting students with SEN. The course content was reviewed by IE experts using a 4-point Likert-type rating scale to assess its relevance, clarity, and comprehensiveness, thereby ensuring content validity.

Conducted by the chief investigator in a hybrid format combining in-person and Zoom sessions, the course employed a flipped learning approach. Designed in accordance with the Sri Lanka Qualifications Framework, this course can be incorporated as a standalone component into ITE programs, subject to approval from the relevant authorities. Since the practicum was institutionally determined, the intervention was limited to coursework and workshops.

The instructional intervention was carried out using a flipped learning approach in three stages. Zoom-recorded video lessons and related open-ended questions were shared before class to encourage independent exploration. Participants attended synchronous sessions, prepared to discuss and apply concepts through interactive activities such as group work, role-playing, presentations, debates, and quizzes. In-class practice focused on microteaching and simulated classroom tasks that developed key skills, like the use of teaching aids, reinforcement, classroom and behaviour management, formative assessment, stimulus variation, and questioning, which were deemed crucial for meeting the diverse needs of learners. Each session included structured peer and instructor feedback to enhance instructional competence. Simulated classroom sessions were organized in small groups to provide practical experience in applying the competencies gained through microteaching, including lesson planning, preparing teaching aids, designing behaviour and classroom management strategies, and developing formative and summative assessment methods.

Fidelity checks were carried out using a checklist, online feedback from sessions, and session observations. Specifically, participants' pre-class engagement was indirectly assessed through their written reflections and their ability to respond to guiding questions during subsequent in-class discussions. Additionally, participants' reflective learning logs and Know–Want to Know–Learned (KWL) charts, completed after each lesson, were reviewed with feedback to track their engagement with pre-class learning.

Data analysis

The hypotheses were tested using IBM SPSS (version 25) and SmartPLS 4. Descriptive statistics (means, standard deviations, and internal consistencies) were calculated for all study variables. To assess baseline equivalence, pre-test scores were compared between the EXP and CON groups across all outcome variables (EII, EMB, EC, and TEIP), as well as between the online and onsite delivery groups, to verify that the groups were comparable before the intervention. Paired-samples t-tests were used to examine within-group changes from pre- to post-tests for the EXP and CON groups across all outcome variables. Post-test scores were then compared between the EXP and CON groups and between the online and onsite groups to determine whether the intervention produced significant improvements and whether delivery mode influenced outcomes.

To test the study hypotheses, two complementary analytical procedures were employed. First, a one-way MANCOVA in IBM SPSS was performed to examine whether TEIP post-test subscale scores differed between the EXP and CON groups, controlling for baseline scores. Although independent-samples *t*-tests showed no significant pre-test differences between the groups, preliminary analyses indicated that the pre-test scores of EII, EMB, and EC significantly predicted their respective post-test scores. As a result, MANCOVA was used with each post-test score as the dependent variable, group (EXP vs. CON) as the independent variable, and the relevant pre-test scores as covariates to obtain adjusted post-test means. This study favoured MANCOVA over repeated-measures ANOVA because it accounts for baseline differences, reduces error variance, and provides a more accurate and less biased estimate of the intervention effect (Field, 2018; Dimitrov & Rumrill, 2003).

Additionally, PLS-SEM was conducted in SmartPLS4 to estimate the predictive relationships between the intervention and post-test outcomes, while accounting for pre-test scores as covariates. PLS-SEM extended the analysis by validating the measurement model (outer model) of the TEIP and by assessing standardized path coefficients, effect sizes, and explained variance (R^2) in the structural model (inner model). Together, these procedures allowed the hypotheses to be tested both at the classical group-level and within a predictive modelling framework.

RESULTS

Descriptive Statistics for Outcomes Before and After the Intervention

Table 1 presents the mean scores, standard deviations, and post-intervention gains in the mean scores for the pre- and post-test data, grouped by the EXP and CON conditions, for the overall TEIP construct and its dimensions, EII, EMB, and EC. The EXP group showed significant improvements across all outcomes after the intervention, with gains of 1.92 for EII, 1.18 for EMB, 1.31 for EC, and 1.52 for the total TEIP. The CON group showed only minor changes, with gains of .53 for EII, .17 for EMB, .08 for EC, and .29 for the TEIP. Overall, the descriptive statistics indicate that gains in the EXP group were consistently larger and accompanied by moderate variability, as reflected in the standard deviations. In contrast, the CON group showed minimal changes and greater variability. This pattern indicates that the intervention had a pronounced and relatively consistent impact on participants in the EXP group, while the CON group remained considerably stable.

Table 1. *Mean Scores and Standard Deviations for Pre- and Post-Tests by Group*

Outcome	Group	N	Pre-test Mean (SD)	Post-test Mean (SD)	Mean Difference
EII	EXP	120	3.31(.307)	5.23(.296)	+1.92
	CON	120	3.32(.335)	3.85(.398)	+0.53
EMB	EXP	120	3.20(.405)	4.38(.791)	+1.18
	CON	120	3.24(.315)	3.41(.317)	+0.17
EC	EXP	120	3.07(.450)	4.38(.739)	+1.31
	CON	120	3.07(.449)	3.15(.491)	+0.08
TEIP	EXP	120	3.20(.217)	4.72(.330)	+1.52
	CON	120	3.21(.262)	3.50(.256)	+0.29

Baseline Equivalence Checks Between Groups

EXP versus CON Groups

To ensure comparability between the EXP and CON groups before the intervention, independent-samples *t*-tests were conducted on pre-test scores for EII, EMB, EC, and TEIP. Establishing baseline equivalence is essential in experimental designs, as significant pre-intervention differences can confound treatment effects and threaten internal validity (Field, 2018; Tabachnick & Fidell, 2019). By confirming that there are no significant baseline differences, post-test results can be interpreted with greater confidence (Pallant, 2020). The results indicated that the groups were equivalent at pre-test: EII, $t(238) = –0.40$, $p = .688$; EMB, $t(224.30) = –0.82$, $p = .414$; EC, $t(238) = 0.05$, $p = .962$; and total TEIP, $t(229.98) = –0.36$, $p = .721$. In all cases, the mean differences were minimal, and

the 95% confidence intervals included zero, indicating no statistically significant differences between groups at baseline. In addition to randomization, these results support that the groups were equivalent before the intervention.

Online versus Onsite Groups

To assess baseline equivalence between the online (N = 48) and onsite (N = 72) groups, an independent-samples *t*-test was conducted to compare pre-test scores for EII, EMB, EC, and TEIP separately. The results indicated no significant differences for total TEIP_PRE ($t_{(118)} = –.856$, $p = .394$), EII_PRE ($t_{(118)} = .190$, $p = .850$), or EMB_PRE ($t_{(118)} = 1.347$, $p = .181$). However, for EC, the analysis revealed a significant difference between online ($M = 2.97$, $SD = .435$) and onsite ($M = 3.14$, $SD = .450$) modes of delivery ($t_{(118)} = −2.127$, $p = .036$), indicating that the onsite group reported slightly higher levels of EC prior to the intervention. However, the magnitude of this difference was small, and subsequent PLS-SEM analyses accounted for baseline EC differences, reducing the likelihood that this imbalance unduly influenced the intervention effects. Nevertheless, this factor should be considered when interpreting the findings.

Post-Intervention Checks Between Groups

Online versus Onsite Groups

To ensure that any observed effects could be attributed to the intervention rather than the delivery mode, an independent-samples *t*-test was conducted to compare post-test TEIP scores across its three dimensions and the overall TEIP between the online (N = 48) and onsite (N = 72) groups. With a statistically significant Levene's test, which indicated that equal variances between the online and onsite delivery groups for EII post-test scores were not assumed, $F_{(1,238)} = 13.338$, $p < .001$, the *t*-test results showed a non-significant difference between the groups, $t_{(73.43)} = −0.645$, $p = .521$, indicating that delivery mode did not influence EII outcomes.

Assumption of equal variances was satisfied for EMB post-test scores, $F_{(1,238)} = 1.149$, $p = .286$, as shown by the independent-samples t-test, which indicated no significant difference between the online and onsite delivery groups, $t_{(118)} = 1.738$, $p = .085$, suggesting that the mode of delivery did not significantly influence EMB outcomes. Similarly, the F statistic for EC post-test scores confirmed that the assumption of equal variances was met, $F_{(1, 238)} = 1.071$, $p = .303$.

The independent-samples t-test results showed no significant difference between the online and onsite delivery groups, $t_{(118)} = −0.608$, $p = .544$, indicating that delivery mode did not significantly affect EC outcomes. Levene's test supported the assumption of equal variances for TEIP post-test scores, $F_{(1, 238)} = 0.239$, $p = .626$, with an independent-samples t-test, which showed no significant difference between the online and onsite delivery groups, $t_{(118)} = 0.388$, $p = .699$, suggesting that delivery mode did not influence TEIP outcomes.

Overall, the delivery mode did not influence post-test outcomes, suggesting that participants' performance was consistent regardless of whether the IE course was delivered online or onsite. Therefore, for SEM, it is reasonable and statistically justified to collapse the delivery modes and analyze the intervention group as a whole, simplifying the model and focusing on the effect of the IE course itself.

EXP versus CON Groups

Post-intervention gains in the outcome variables within the EXP group were analyzed separately using paired-samples t-tests. The results revealed significant improvements: EII increased by 1.53 points, $t_{(119)} = 42.556$, $p < .001$; EMB increased by 1.06 points, $t_{(119)} = 21.273$, $p < .001$; EC increased by 1.17 points, $t_{(119)} = 35.896$, $p < .001$; and overall TEIP advanced by 1.27 points, $t_{(119)} = 53.591$, $p < .001$. These findings demonstrate that the intervention effectively improved participants' skills and perceptions.

In comparison, the CON group showed negligible and statistically significant gains in the mean scores with EII increased by 0.37 points, $t_{(119)} = 10.963$, $p < .001$; EMB by 0.17 points, $t_{(119)} = 6.121$, $p < .001$; EC by 0.09 points, $t_{(119)} = 3.465$, $p = .001$; and TEIP by 0.22 points, $t_{(119)} = 11.678$, $p < .001$. These results indicate that while the CON group experienced minor improvements, the intervention produced substantially larger gains in the EXP group.

Post-test comparisons between the EXP and CON groups were conducted using independent-samples *t*-tests. Levene's tests indicated that the assumption of equal variances was violated for EII and EMB ($p < .001$) but met for TEIP and EC ($p > .05$). Therefore, Welch's *t*-test was used where necessary, indicating significant differences between the EXP and CON groups across all outcome variables: TEIP, $t_{(238)} = 30.776$, $p < .001$, mean difference = 1.04; EII, $t_{(213.30)} = 24.949$, $p < .001$, mean difference = 1.14; EMB, $t_{(162.38)} = 13.090$, $p < .001$, mean difference

= 0.86; and EC, $t_{(238)} = 15.538$, $p < .001$, mean difference = 1.08. These results indicate that the intervention group outperformed the control group on all post-test measures.

Assumption Checks for MANCOVA

The normality of the post-test scores for all variables was evaluated using the Shapiro–Wilk and Kolmogorov–Smirnov tests, both of which were significant ($p < .05$); however, with large sample sizes (N = 120 per group), such significance is expected because these tests are highly sensitive and can detect trivial deviations from normality (Ghasemi & Zahediasl, 2012). An objective review of histograms and Q–Q plots showed that both groups had approximately normal distributions, with no extreme skewness or kurtosis. Since MANCOVA is robust to moderate breaches of normality assumptions, especially with large, balanced groups, the results support the assumption of approximate normality, allowing the analysis to proceed without data transformation or non-parametric alternatives (Tabachnick & Fidell, 2019).

The homogeneity of regression slopes was initially tested using a GLM by examining interactions between the independent variable (EXP_CONT) and each covariate (EII-pre, EMB-pre, EC-pre) for each dependent variable. The results showed that this assumption was violated for EII-post and EMB-post, with significant interactions observed (EII-post: EXP_CONT × EII-pre, $F_{(1,236)} = 17.24$, $p < .001$; EXP_CONT × EMB-pre, $F_{(1,236)} = 8.201$, $p = .005$; EMB-post: EXP_CONT × EMB-pre, $F_{(1,236)} = 8.201$, $p = .005$), while it was met for EC-post (EXP_CONT × EC-pre, $F_{(1,236)} = 3.525$, $p = .062$). Because regression slope homogeneity was not consistent across all outcomes, a standard MANCOVA could not be used. Although ANCOVA could be applied to EC-post, the analysis was transitioned to PLS-SEM to ensure methodological consistency across all variables and to account for baseline differences observed only for EC in the delivery method.

Main Effect of the IE Course Intervention on the EII, EMB, and EC

Hypotheses that the intervention would positively predict EII, EMB, and EC were tested using PLS-SEM in SmartPLS 4 with a non-parametric bootstrapping procedure (10,000 resamples) and two-tailed t-tests, generating robust standard errors and confidence intervals for the path coefficients. The PLS-SEM analysis allows for the simultaneous modelling of multiple dependent variables, covariates, and their interactions without assuming slope homogeneity. This offers a robust framework for examining the direct effects of the IE course on EII, EMB, EC, and the overall TEIP, using two structural models—one with covariates and one without—where the intervention (EXP = 0, CON = 1) is the independent variable and post-test scores are outcomes, controlling for pre-test scores for each construct.

An initial PLS-SEM analysis was performed by excluding pre-test scores as covariates to assess the direct, unadjusted effect of the intervention on post-test outcomes, establishing a baseline estimate before considering potential confounders. The path model and coefficients are illustrated in Figure 1. Results showed that the intervention significantly improved all three dimensions of self-efficacy. With the EXP group coded as '0' and the CON group as '1', negative coefficients indicate better performance by the EXP group: EII, $B = –1.713$, $t = 64.490$, $p < .001$, 95% CI [–1.757, –1.649]; EMB, $B = –1.296$, $t = 18.295$, $p < .001$, 95% CI [–1.425, –1.147]; EC, $B = –1.423$, $t = 19.818$, $p < .001$, 95% CI [–1.550, –1.264]. These findings confirm that the IE course statistically and significantly predicted PST's TSE across its three dimensions: EII, EMB and EC.

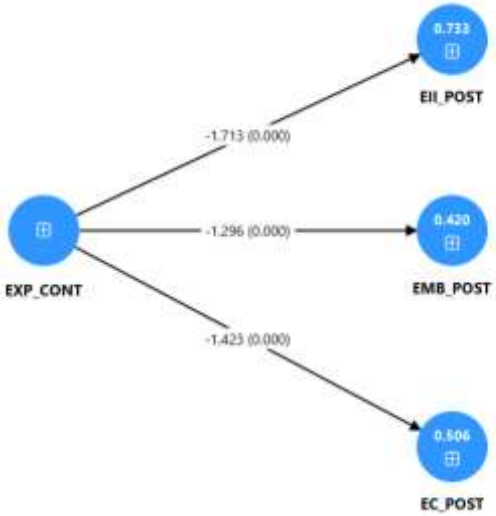

Figure 1. *The Path Model Excluding the Pre-Test Scores as Covariates*

Including pre-test scores as covariates in the PLS-SEM model showed (Figure 2) that the intervention had a significant positive effect on all TEIP dimensions, estimating the net impact adjusted for initial differences. With the EXP group coded as '0' and the CON group as '1', negative unstandardized coefficients indicate higher post-test scores for the EXP group: EII (*B* = –1.676, *t* = 41.138, *p* < .001, 95% CI [–1.779, –1.607]), EMB (*B* = –1.333, *t* = 20.204, *p* < .001, 95% CI [–1.468, –1.206]), and EC (B = –1.416, *t* = 24.286, *p* < .001, 95% CI [–1.530, –1.301). Presenting both adjusted and unadjusted results enhances transparency and interpretation of the intervention's effect.

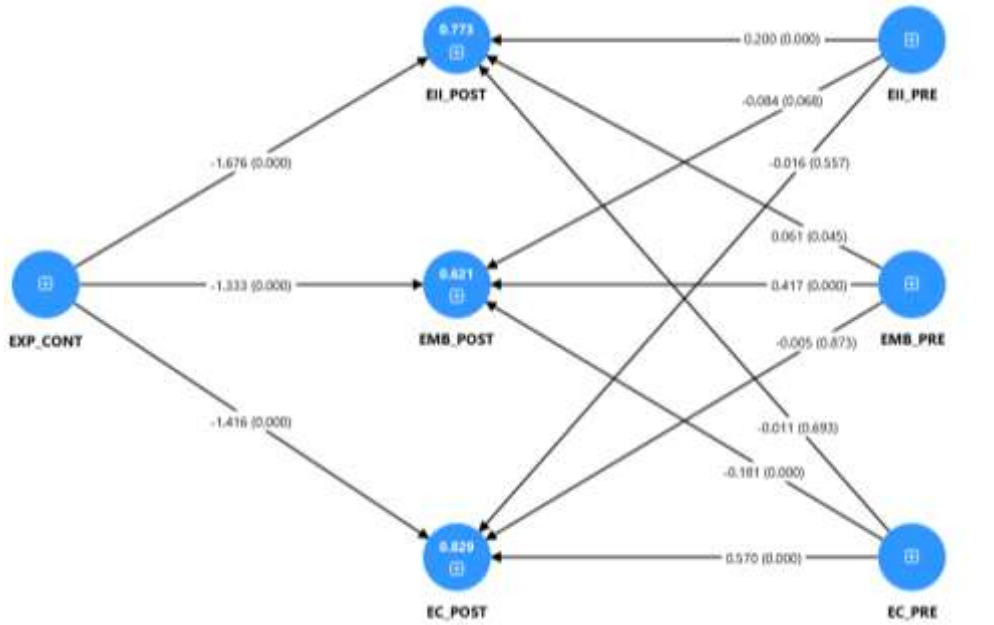

Figure 2. *The Path Model with the Pre-Test Scores Functioned as Covariates*

Furthermore, the unstandardized path coefficients indicated that pre-test scores significantly predicted their respective post-test scores, demonstrating baseline stability of each construct (Table 2). Specifically, EII-pre positively and significantly predicted EII-post (*B* = 0.200, *t* = 4.673, *p* < .001, 95% CI [0.099, 0.263]), EMB-pre positively and significantly predicted EMB-post (*B* = 0.417, *t* = 8.606, *p* < .001, 95% CI [0.314, 0.504]), and EC-pre positively and significantly predicted EC-post (*B* = 0.570, *t* = 12.295, *p* < .001, 95% CI [0.476, 0.657]). These findings demonstrate that higher baseline levels of each construct were linked to higher post-test scores for the same construct, after controlling for the intervention.

Table 2. *Path Coefficients, Significance, and 95% BCa Confidence Intervals for the Effects of the IE Course and Pre-Test Scores on Post-Test Self-Efficacy Outcomes*

Path	*B*(O)	*M*	*SD*	*t*	*p*	95%CI(BCa)
Intervention Effect						
GROUP → EII_POST	–1.676	-1.673	0.041	41.14	.000	-1.779, -1.607
GROUP → EMB_POST	–1.333	-1.333	0.066	20.20	.000	-1.468, -1.206
GROUP → EC_POST	–1.416	-1.418	0.058	24.29	.000	-1.530, -1.301
Covariate Effects of Their Own Post-Test Scores						
EII_PRE → EII_POST	0.200	0.196	0.043	4.67	.000	0.099, 0.263
EMB_PRE → EMB_POST	0.417	0.416	0.048	8.61	.000	0.314, 0.504
EC_PRE → EC_POST	0.570	0.570	0.046	12.30	.000	0.476, 0.657
Cross-Construct Pre-Test Effects						
EC_PRE → EII_POST	–0.011	-0.012	0.029	0.39	.693	-0.070, 0.045
EC_PRE → EMB_POST	–0.181	-0.180	0.033	5.57	.000	-0.247,-0.120
EII_PRE → EC_POST	–0.016	-0.015	0.027	0.59	.557	-0.070, 0.037
EII_PRE → EMB_POST	–0.084	-0.080	0.046	1.83	.068	-0.169, 0.010
EMB_PRE → EC_POST	–0.005	-0.004	0.032	0.16	.873	-0.068, 0.056
EMB_PRE → EII_POST	0.061	0.059	0.030	2.01	.045	0.003, 0.122

Some cross-construct effects of pre-test scores were also observed: EC-pre negatively predicted EMB-post (*B* = –0.181, *t* = 5.57, *p* < .001, 95% CI [–0.247, –0.120]), and EMB-pre positively predicted EII-post (*B* = 0.061, *t* =

2.01, p = .045, 95% CI [0.003, 0.122]), suggesting that pre-existing levels of one construct had a small but significant influence on changes in another construct. Other cross-construct effects of pre-test scores (e.g., EC-pre → EII-post, EII-pre → EC-post) were not significant, indicating limited spill-over effects. Overall, these findings confirm that the intervention, combined with the IE course, significantly improved PSTs' TSE in inclusive instruction, behaviour management, and collaboration, even after controlling for baseline scores.

When comparing the effects of the IE course on post-test outcomes with and without controlling for pre-test scores, it is clear that the intervention significantly improved all three dimensions of TSE in both analyses. Without covariates, the effects were slightly stronger. After including pre-test scores as covariates, the effects remained significant but were slightly smaller. This comparison indicates that part of the intervention's effect overlaps with baseline differences in TSE. However, the IE course still shows a significant impact, even after accounting for baseline influences. The slight decrease in effect sizes after covariate adjustment suggests that pre-test scores account for only a small part of the post-test variance. Nonetheless, the intervention itself remains the primary factor affecting post-test TSE.

DISCUSSION

As part of a larger project examining the mediating role of PSTs' beliefs about IE in the relationship between completing a structured IE course delivered through a flipped learning approach and the TEIP dimensions (EII, EMB, and EC), this article focuses solely on the intervention's direct impact. The hypotheses that the intervention would demonstrate predictive effects on the mean post-test gain scores for EII, EMB, EC, and TEIP, adjusted for pre-test differences, were supported, specifically, with the EII dimension demonstrating the highest unstandardized path coefficients and being most strongly influenced by the intervention.

These findings align with Bandura's (1977, 1997) sources of efficacy principle, where the mastery experiences, gained through multiple microteaching experiences, and practicing inclusive lesson plans, vicarious experiences, gained through observing their peers successfully performing teaching in simulated classrooms and obtaining 360-degree constructive feedback from their co-participants and the instructor, together contributed to the development of TSE. Previous empirical findings further support the findings. For example, Lancaster and Bain (2007) found that PSTs' TSE improved after an IE course regardless of the type of experience. However, Can (2015) emphasized that both school-based experiences and faculty-led courses are key components in enhancing TSE.

Notably, in the present study, significant gains were observed in EII, EMB, and EC, despite the intervention being delivered entirely through coursework, including simulated teaching and microteaching, without a practicum component. This diverges from Bandura's emphasis on mastery experiences as the primary source of efficacy, yet aligns with Lancaster and Bain, suggesting that well-designed simulated coursework can effectively enhance PSTs' confidence in inclusive instruction.

Nevertheless, there are contradicting outcomes regarding the impact of the IE course on TSE. Tait and Purdie (2000) found that a 12-month teacher training course did not change PSTs' views on disabilities and inclusion. Stella et al. (2007) reported that even after completing a brief instructional module on inclusive philosophy and practices, participants' attitudes toward inclusion changed very little. Importantly, Nagata (2005) argues that a single subject on inclusion cannot adequately prepare new teachers to handle the many tasks involved in inclusive practice or meet the demands of an inclusive classroom.

These different patterns of outcomes suggest that the effectiveness of IE courses heavily depends on their design and the practical experiences they provide. For many authors, brief modules or single-subject courses may be insufficient to bring about meaningful changes in PSTs' TSE or attitudes towards inclusion (Nagata, 2005; Stella et al., 2007; Tait & Purdie, 2000). Conversely, a well-structured coursework with simulated and microteaching, along with guided reflection, as implemented in the present study, can substantially boost confidence in PSTs' abilities in inclusive practices, even without a field-based practicum (Mergler & Tangen, 2010). This emphasizes that meaningful, practice-oriented experiences, rather than mere content exposure, are essential for developing practical, inclusive teaching skills.

The study also found that the intervention with the IE course was a significant predictor of each TEIP factor. The most notable improvements were in the EII, while the smallest were in the EMB, indicating that the course effectively increased participants' confidence in using inclusive instruction. This varied impact of the intervention suggests that PSTs showed greater confidence in their abilities in inclusive instructional planning and design, including the implementation of Universal Design for Learning, differentiated instruction, and backward design. Additionally, their confidence in applying inclusive practices, such as providing accommodations and making curriculum modifications, also appeared to be enhanced after the intervention. Notably, these improvements were

evident following the course-based learning experience delivered through simulated environments, despite participants not having direct teaching experience in actual inclusive classrooms.

This finding aligns with previous research, suggesting that structured IE training tends to have a greater influence on instructional efficacy than on other domains (Forlin et al., 2014). Gains in EMB and EC were more modest (+1.18 and +1.31, respectively), though still exceeding those of the CON group (+0.17 and +0.08). These comparatively lower gains reflect the greater complexity involved in developing behavioural management and collaborative competencies, which often require extended practice and systemic support. Overall, the pattern suggests that short-term interventions are more effective in strengthening instructional efficacy than in fostering behavioural or collaborative capacities, aligning with international evidence on the domain-specific development of TSE (Loreman et al., 2013).

The findings further extended Bandura's (1997) self-efficacy framework by illustrating how course delivery methods, such as a flipped learning approach, combined with simulation, can operationalize the sources of efficacy information. Simulated environments created quasi-mastery experiences by enabling participants to practice inclusive teaching in realistic yet low-risk contexts. Peer modelling provided vicarious experiences, while feedback from peers, the instructor and reflection functioned as verbal persuasion, reinforcing participants' confidence. Together, these elements offer a contemporary model for developing TSE to support inclusive practices through experiential, learner-centered pedagogy.

Although the control group showed small but statistically significant increases from pre- to post-test, this pattern is expected in educational studies. Participants, in general, gain confidence as they progress through their regular coursework, become more familiar with teaching concepts, or become used to the measurement tool. Such maturational or testing effects can produce moderate improvements even in the absence of a targeted intervention. Importantly, these gains were comparatively negligible compared to those observed in the intervention group, indicating that the substantial increases in TSE were driven by the IE course intervention rather than general program exposure.

SmartPLS reports unstandardized path coefficients in the structural model, which explains the large numerical values observed in this study. These coefficients depend on the original metric and the variance of each latent variable. Therefore, constructs with minor variances will naturally produce larger unstandardized coefficients. SmartPLS does not automatically generate standardized coefficients *(β)* in the structural model output; instead, standardization is typically reflected only in measurement model loadings. Therefore, the large unstandardized values should not be interpreted as powerful effects. Standardized coefficients—when computed—would provide a more comparable indication of effect size across constructs.

The current findings have several implications. First, the course design and delivery, including the use of flipped learning and a learner-centered approach, provide empirical evidence of a practical method for enhancing PSTs' confidence in implementing inclusive practices. In curricular reforms, such findings suggest that structured IE courses with such delivery approaches can be feasibly integrated into ITE programs without overloading schedules, providing PSTs with both theoretical knowledge and practical skills to support diverse learners effectively. Second, from the policy perspective, the study supports the intensive implementation of flipped learning-oriented IE courses, highlighting the need for faculty training and resources to implement these pedagogies, thereby contributing to more inclusive teaching practices nationwide. Finally, the results encourage future research on mediating factors, such as PST beliefs and long-term retention of TSE, and comparisons with traditional lecture-based IE courses to optimize teacher preparation for inclusive classrooms further.

LIMITATIONS AND RECOMMENDATIONS

The interpretation of the findings of this study should be approached with caution in light of the following limitations. Its findings may have limited generalizability to the broader population of PSTs in Sri Lanka, as it employed only Tamil-speaking PSTs. The short duration of the flipped learning course may not have allowed enough time for lasting changes in TSE to develop. Additionally, reliance on self-reported quantitative measures may have introduced social desirability and response biases, and novelty effects linked to the instructional approach may have temporarily elevated confidence. Most importantly, participants' inconsistent attendance and engagement during online sessions may have limited the extent to which they benefited fully from the intervention.

Despite random assignment, other extraneous variables, such as prior exposure to IE concepts, children with SEN or institutional learning culture, could have influenced participants' TSE development. Diffusion of treatment across institutions may also have reduced group distinctions. These factors call for a cautious interpretation of the findings and highlight the need for more robust research designs in future studies. In addition, the lack of delayed

post-tests restricts conclusions about the sustainability of the outcomes, as the post-test was conducted immediately after the intervention. Consequently, it remains unclear whether the observed increases in TSE were maintained over time.

Although the IE course demonstrated a significant positive impact on TSE for inclusive practices within a longitudinal design, several methodological refinements are recommended for future research. First, future studies could employ multilevel modelling to account for clustering within ITE institutions. This effort would enable more precise estimates of the intervention effects at both the individual and institutional levels. Second, adopting longitudinal designs with delayed post-tests would help determine whether gains in TSE are sustained during practicum or early teaching. Third, it is recommended to adopt qualitative research approaches, including phenomenological interviews, focus group discussions, classroom observations, or behavioural assessments, as complementary measures of self-report, to rule out the effects of social desirability and response bias on the outcomes, thereby triangulating and strengthening the validity of the findings.

CONCLUSIONS

The study found that the IE course intervention significantly enhanced PSTs' TSE in inclusive instructional practices, behaviour management, and collaboration, with the most potent effect on instructional practices. The structured, theory-based, modular IE course, delivered through a flipped learning approach without a practicum, directly improved TSE. Using an experimental pre- and post-test control-group design ensured a rigorous comparison, confirming the intervention as a significant predictor of TSE gains across all teacher efficacy dimensions.

Author Contributions

The principal author, Y.S., is responsible for all aspects of the study, including the development of the IE course, conceptualization, methodology, software, validation, formal analysis, investigation, resources, data curation, drafting and revising the manuscript, visualization, and project administration, with the co-author, K. A. C., providing supervision.

Declarations

Competing interests

The authors declare that they have no competing interests.

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Enhancing Vocational Graduate Employability through Mobile Application on Advanced Quantitative Modeling of Skills and Partnerships

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Abstract
This study investigates the multidimensional factors influencing employability among vocational students in China by applying an advanced quantitative framework. Data were collected from 17 experts, 100 faculty members, and 30 students, and analyzed using a sequential process of Exploratory Factor Analysis (EFA), Confirmatory Factor Analysis (CFA), and Structural Equation Modeling (SEM). EFA extracted six constructs-Professional Skills, Soft Skills, Career Guidance, Industry-Academia Collaboration, Technological Literacy, and Employability Outcomes-explaining 72.6% of total variance. CFA confirmed measurement validity and reliability (Cronbach's $\alpha > 0.80$; CR > 0.84; AVE > 0.50; HTMT < 0.85). SEM results demonstrated that all hypothesized relationships were supported, with Soft Skills ($\beta = 0.35$) identified as the strongest predictor of employability, followed by Professional Skills ($\beta = 0.29$), Technological Literacy ($\beta = 0.24$), Industry-Academia Collaboration ($\beta = 0.21$), and Career Guidance ($\beta = 0.18$). Mediation analysis revealed that Career Guidance indirectly influenced employability through Soft Skills ($\beta = 0.12$, $p < 0.01$), while moderation analysis confirmed that Industry-Academia Collaboration enhanced the effect of Professional Skills on employability ($\beta = 0.09$, $p < 0.05$). The structural model accounted for 68% of variance ($R^2 = 0.68$) in employability outcomes, demonstrating strong explanatory power. The novelty of this research lies in integrating mediation and moderation mechanisms within a validated employability model, moving beyond traditional exploratory methods. Conceptually, the findings highlighted the centrality of Soft Skills in determining employability, challenging the dominance of technical training in vocational education. Practically, the study provides evidence-based recommendations for balancing technical and soft skill training, strengthening career guidance services, and deepening industry-academia partnerships to enhance graduate competitiveness in dynamic labor markets through a Mobile Application on Advanced Quantitative Modeling of Skills and Partnerships.
Keyword: Industry-Academia Collaboration; Technological Literacy; Exploratory Factor Analysis; Mobile Application

Introduction

Vocational education has emerged as a crucial driver for bridging the gap between academic learning and labor market requirements, especially in countries experiencing rapid economic growth such as China [1]. With the transition from elite to mass higher education in the 1990s, the number of graduates has surged dramatically, reaching over 11 million in 2023, thereby intensifying job market competition [2]. This massification of higher education has created an unprecedented challenge: many graduates face unemployment or underemployment due to the misalignment between acquired academic qualifications and the dynamic needs of the labor market [3].

Scholars and policymakers agree that employability is a multidimensional construct that extends beyond technical competence [4]. It encompasses soft skills, adaptability, problem-solving, resilience, career planning, industry exposure, and technological literacy [5]. Employers increasingly emphasize interpersonal communication, teamwork, creativity, and digital readiness as essential attributes [6]. However, research indicates that many higher vocational colleges in China continue to focus primarily on theoretical instruction and do not adequately integrate practical training, career guidance, or industry collaboration into their curricula [7]. This mismatch not only undermines graduates' career prospects but also restricts the country's ability to cultivate a globally competitive workforce.

To address this issue, the Chinese government has enacted multiple policies such as the 2015 *Opinions on Strengthening the Employment of University Graduates* and the 2020 *Notice on Doing a Good Job in Graduate*

Employment and Entrepreneurship [8]. These initiatives emphasize job training, entrepreneurial support, and career guidance. While such policies have advanced employability services, existing academic research has largely relied on exploratory methods such as descriptive analysis and exploratory factor analysis (EFA) to identify determinants of employability [9]. These methods are useful for identifying factors but are limited in their ability to test causal relationships and validate multidimensional constructs across diverse student populations.

This study introduces a novel framework by integrating advanced quantitative methodologies including exploratory factor analysis (EFA), confirmatory factor analysis (CFA), and structural equation modeling (SEM). Unlike prior studies that stop at identifying factors, this research validates the employability model through CFA and examines causal pathways among variables using SEM [10]. For instance, the study tests how *career guidance* indirectly shapes employability through the development of *soft skills*, while *industry-academia collaboration* moderates the relationship between *professional skills* and employment outcomes. This multi-layered approach not only identifies which factors matter most but also explains how and why they influence employability.

The novelty of this research lies in three dimensions. First, it provides a validated and multidimensional employability model for vocational colleges in China, bridging a methodological gap by moving beyond EFA toward SEM-based causal modeling. Second, it introduces mediation and moderation analysis to reveal indirect and conditional effects, offering a richer understanding of how factors interact to enhance employability. Third, it grounds its framework in both theoretical foundations (Bloom's mastery learning, constructivist theory, and new constructivist learning) and policy relevance, ensuring that findings are both academically rigorous and practically applicable to curriculum reform and labor market alignment.

By applying this advanced framework, the study contributes to both theory and practice. Theoretically, it extends employability research through validated constructs and tested causal relationships. Practically, it offers vocational institutions evidence-based strategies to redesign curricula, strengthen industry linkages, and embed employability training into education systems. Policymakers and educators can leverage these insights to develop targeted interventions that improve graduate outcomes and strengthen national human capital development [11].

Literature Review

Employability research consistently underscores the importance of professional skills and practical training as foundational elements of career readiness. Graduates who possess strong technical expertise and have undergone structured training programs, such as internships and apprenticeships, demonstrate smoother transitions into the labor market [12]. In China, however, higher vocational colleges often emphasize theoretical instruction while offering limited opportunities for practice-based learning [13]. This imbalance reduces graduates' ability to apply their knowledge in real-world contexts and diminishes their attractiveness to employers who prioritize job-specific competencies [14]. Moreover, empirical studies indicate that practical exposure to industry projects not only enhances technical proficiency but also instills problem-solving capacity and workplace adaptability [15].

Hypothesis 1 (H1): Professional skills and practical training have a positive and significant effect on graduate employability.

While technical expertise is critical, employers increasingly highlight the importance of soft skills, such as communication, teamwork, leadership, creativity, and resilience [16]. Graduates with strong interpersonal attributes are more capable of navigating complex workplace environments and adjusting to rapidly changing job demands [17]. Studies across diverse contexts reveal that soft skills are often the decisive factor in hiring decisions, as they complement technical knowledge and ensure long-term career growth [18]. However, many vocational institutions still lack structured curricula for cultivating these skills, resulting in graduates who are technically competent but lack essential interpersonal competencies [19]. Given the labor market's preference for holistic graduates, soft skills development emerges as a central pillar of employability.

Hypothesis 2 (H2): Soft skills and personal attributes positively influence graduate employability.

Career guidance is widely acknowledged as a strategic mechanism for supporting students' transition from education to employment [20]. Services such as career counseling, job fairs, and training in job search strategies equip students with knowledge about labor market trends and practical skills for navigating recruitment processes [21]. In China, national policies have prioritized the expansion of career guidance, but implementation remains uneven across institutions, with significant disparities in service quality [22]. Research indicates that students who actively engage with career planning resources exhibit greater confidence, more realistic career expectations, and improved employability outcomes [23]. Furthermore, career guidance does not operate in isolation; it strengthens employability indirectly by enhancing soft skills through improved self-awareness and decision-making.

Hypothesis 3 (H3): Career guidance and job market awareness positively affect graduate employability.

Hypothesis 3a (H3a): The effect of career guidance on employability is mediated by soft skills development.
Industry-academia collaboration plays a vital role in aligning educational curricula with labor market demands. Partnerships with employers allow vocational colleges to offer cooperative education programs, embed industry-relevant projects, and involve practitioners in curriculum design [24]. Such collaborations expose students to authentic workplace experiences and provide networking opportunities that directly enhance employability [25]. Empirical findings reveal that institutions with stronger ties to industry produce graduates who are better prepared for employment, as their training reflects current technological and professional standards [26]. Moreover, collaboration may act as a contextual enabler: when vocational institutions work closely with industries, the effectiveness of technical and soft skills in determining employability is amplified.

Hypothesis 4 (H4): Industry-academia collaboration positively influences graduate employability.
Hypothesis 4a (H4a): Industry-academia collaboration moderates the relationship between professional skills and employability.
Technological Literacy and Innovation Skills
The digital transformation of the global economy has heightened the importance of technological literacy. Employers increasingly demand graduates who are proficient with digital tools, familiar with industry-specific technologies, and capable of innovative problem-solving [27]. Vocational education, therefore, must prepare students to engage not only with current technological platforms but also to adapt to emerging innovations. Studies have demonstrated that digital fluency and entrepreneurial skills significantly enhance employability, particularly in sectors experiencing rapid automation and globalization [28]. However, integration of technological training in vocational curricula remains inconsistent, leading to disparities in graduate preparedness [29]. Embedding innovation and technology skills is thus crucial for sustaining competitiveness in the modern labor market.

Hypothesis 5 (H5): Technological literacy and innovation skills positively affect graduate employability.
Previous studies have primarily relied on exploratory techniques such as factor analysis to identify employability determinants [30]. While valuable, these approaches do not adequately validate factor structures nor test causal mechanisms among variables. This creates a methodological gap in employability research, as the relationships between career guidance, professional skills, soft skills, and industry collaboration have rarely been examined simultaneously through advanced modeling techniques. The present study addresses this gap by employing Confirmatory Factor Analysis (CFA) to validate constructs and Structural Equation Modeling (SEM) to test causal pathways, including mediation and moderation effects.

Accordingly, the research hypothesizes that employability among vocational college graduates is a multidimensional construct shaped by professional skills, soft skills, career guidance, industry-academia collaboration, and technological literacy, with complex interactions among these variables. This integrative framework moves beyond prior descriptive analyses by offering a validated, evidence-based model for understanding and enhancing employability in the Chinese vocational education context.

Research Methodology

Research Design
This study adopts a quantitative research design supported by confirmatory and causal modeling techniques. Unlike prior employability studies that primarily employed exploratory approaches such as Delphi and exploratory factor analysis (EFA), the present research enhances methodological rigor by integrating Confirmatory Factor Analysis (CFA) and Structural Equation Modeling (SEM). The quantitative paradigm allows systematic measurement of constructs, testing of causal hypotheses, and validation of the employability model with robust statistical evidence. The research proceeds in three stages: 1) identification of factors through EFA, 2) validation of measurement structures through CFA, and 3) testing of causal pathways, including mediation and moderation, through SEM.

Theoretical Framework
The framework of this study is anchored in Bloom's Mastery Learning Theory, Piaget's Constructivist Theory, and Wang Zhuli's New Constructivist Theory, which collectively emphasize structured learning, experiential engagement, and adaptability in knowledge construction. These theories provide the foundation for linking educational inputs (professional skills, soft skills, career guidance, industry collaboration, and technological literacy) with employability outcomes. In the SEM model, employability is treated as a latent variable influenced by multiple constructs, with career guidance hypothesized to mediate soft skills development, and industry-academia collaboration hypothesized to moderate the relationship between professional skills and employability.

Sampling Techniques

The study employs a multi-stage sampling approach. In the first phase, 17 experts in vocational education and career guidance were selected purposively to identify key employability factors. The second phase involved a random selection of 100 faculty members from universities in Sichuan engaged in student development activities to validate employability constructs. The third phase focused on 30 vocational students from Sichuan University of Light and Chemical Technology, selected using stratified random sampling to ensure representation across disciplines. This staged approach provides triangulation across expert, academic, and student perspectives, ensuring both construct validity and contextual relevance.

Instrumentation

Data collection employed a combination of semi-structured interviews and Likert-scale questionnaires. In the exploratory phase, semi-structured interviews elicited expert perspectives, which informed the design of Questionnaire I. Subsequent rounds refined the instrument, incorporating a five-point Likert scale (1 = strongly disagree to 5 = strongly agree) to measure perceptions of professional skills, soft skills, career guidance, industry collaboration, technological literacy, and employability outcomes. For quantitative validation, the final instrument was tested for internal consistency (Cronbach's $\alpha > 0.7$), composite reliability ($CR > 0.7$), and convergent validity ($AVE > 0.5$). Discriminant validity was assessed using the Fornell–Larcker criterion and HTMT ratio, ensuring distinctiveness among constructs.

Table1. Constructs, Indicators, Sources, and Validation

Construct	Dimensions / Indicators	Data Source	Analysis Technique	Reliability / Validity Standard
Professional Skills & Training	(a) Ability to apply theory to practice; (b) Internship/Apprenticeship exposure; (c) Problem-solving in technical tasks	Student questionnaire + Expert validation	EFA → CFA (Factor loadings > 0.7)	Cronbach's α > 0.70; AVE > 0.50
Soft Skills & Personal Attributes	(a) Communication; (b) Teamwork; (c) Leadership; (d) Creativity/Innovation; (e) Resilience	Student questionnaire + Faculty rating	CFA (Convergent & Discriminant Validity)	CR > 0.70; HTMT < 0.85
Career Guidance & Job Awareness	(a) Access to counseling; (b) Job fair participation; (c) Career planning clarity; (d) Knowledge of labor market trends	Student questionnaire + Institutional data	CFA → Mediation Testing via SEM	Composite Reliability > 0.80
Industry-Academia Collaboration	(a) Internship placement opportunities; (b) Joint projects; (c) Guest lectures; (d) Networking platforms	Institutional reports + Student perception	SEM (Moderation effect)	Interaction effect significance
Technological Literacy & Innovation	(a) Digital literacy; (b) Use of emerging technology; (c) Entrepreneurial orientation; (d) Adaptability to automation	Student questionnaire + Employer feedback	CFA → SEM (Path analysis)	AVE > 0.50; CFI > 0.90
Employability Outcomes	(a) Job readiness; (b) Confidence in job interviews; (c) Securing employment; (d) Career adaptability	Student post-intervention survey	SEM (Dependent latent construct)	$R^2 > 0.50$; Predictive relevance (Q^2)

Table 1: maps each research construct to its specific indicators, data sources, analytical techniques, and reliability standards. This multi-dimensional structure strengthens transparency by showing how abstract constructs such as employability are transformed into measurable indicators. For example, *Professional Skills* are assessed through students' internship exposure and validated by experts, while *Soft Skills* are rated both by students and faculty. Analytical rigor is ensured through EFA and CFA, while validation criteria (Cronbach's α, AVE, CR, HTMT) guarantee reliability and validity. Thus, the table provides a comprehensive blueprint for the measurement model.

Data Collection Procedures

Data were collected in three sequential stages. In the first stage, interviews and Delphi rounds were conducted with experts to generate and refine constructs. In the second stage, questionnaires were distributed to 100 faculty members to validate construct measurement through CFA. Finally, the third stage involved administering the refined questionnaire to 30 students, whose responses were analyzed to test the hypothesized SEM model. Ethical considerations were observed, including informed consent, voluntary participation, and confidentiality of responses.

Data Processing and Analysis

The analysis followed a structured sequence:

1. Exploratory Factor Analysis (EFA): Using Principal Component Analysis (PCA) with Varimax rotation to identify latent factors affecting employability. Sampling adequacy was evaluated through the Kaiser-Meyer-Olkin (KMO) test (>0.7) and Bartlett's test of sphericity ($p < 0.05$).
2. Confirmatory Factor Analysis (CFA): Applied to validate factor structures. Goodness-of-fit indices were assessed, including χ^2/df (<3), CFI (>0.90), TLI (>0.90), RMSEA (<0.08), and SRMR (<0.08). This stage

confirmed the multidimensionality of employability as consisting of five distinct but interrelated constructs.

3. Structural Equation Modeling (SEM): Conducted to test hypothesized causal relationships among constructs. Direct effects (H1–H5) were evaluated through path coefficients, while mediation analysis (H3a) employed bootstrapping methods to assess the indirect effect of career guidance on employability via soft skills. Moderation analysis (H4a) tested whether industry-academia collaboration strengthened the effect of professional skills on employability.

Table 2. The index contributes to the evaluation of the model

Category	Indicator	Acceptable Threshold	Application in this Study	Interpretive Contribution
Absolute Fit	χ^2/df	< 3.0	Evaluates parsimony of CFA/SEM model	Low ratio indicates efficient model
	RMSEA	< 0.08 (good), <0.05 (excellent)	Evaluates approximation error of the model	Indicates overall fit regardless of sample size
	SRMR	< 0.08	Standardized residuals between observed & predicted covariances	Ensures minimal residual error
Incremental Fit	CFI	> 0.90 (good), >0.95 (excellent)	Compares tested model to null baseline model	Confirms improved explanatory power
	TLI	> 0.90	Adjusted fit index accounting for model complexity	Prevents overfitting bias
Construct Validity	AVE	> 0.50	Proportion of variance explained by indicators relative to error	Supports convergent validity
	CR	> 0.70	Internal consistency reliability	Stronger than Cronbach's α
	HTMT	< 0.85	Heterotrait-Monotrait Ratio for discriminant validity	Ensures constructs are distinct
Predictive Power	R^2	> 0.25 (weak), >0.50 (moderate), >0.70 (strong)	Proportion of variance explained in dependent variable	Confirms structural strength
	Q^2 (Stone-Geisser)	> 0.00	Predictive relevance via blindfolding	Ensures model has predictive accuracy

Table 2: expands on traditional fit indices by introducing *application* and *interpretive contribution*. This not only lists thresholds but also clarifies what each index contributes to the evaluation of the model**.** For example, RMSEA < 0.05 signifies an excellent fit with minimal approximation error, while HTMT < 0.85 proves discriminant validity. By integrating predictive measures (R^2 and Q^2), the table highlights that the model is not only well-fitted but also predictively robust**.** This ensures the employability framework stands on rigorous empirical foundations.

4. Robustness Checks: Multi-group analysis (MGA) was applied to examine model invariance across gender and disciplinary groups, providing additional validation of the framework.

Table 3. Hypotheses, Statistical Path, and Expected Effects

Hypothesis	Path Tested (Independent → Dependent)	Statistical Test	Expected Effect	Contribution to Model
H1	Professional Skills → Employability	SEM Path Coefficient	Positive	Validates technical training as core employability factor
H2	Soft Skills → Employability	SEM Path Coefficient	Positive	Confirms interpersonal competence as critical driver
H3	Career Guidance → Employability	SEM Path Coefficient	Positive	Establishes career services as determinant of outcomes
H3a	Career Guidance → Soft Skills → Employability (mediation)	Bootstrapping (Indirect)	Indirect Positive	Explains mechanism: guidance builds soft skills that enhance employability
H4	Industry-Academia Collaboration → Employability	SEM Path Coefficient	Positive	Highlights strategic role of institutional partnerships
H4a	Professional Skills × Industry Collaboration → Employability (moderation)	Interaction / Multi-group Test	Conditional	Shows collaboration amplifies technical skills' effect
H5	Technological Literacy → Employability	SEM Path Coefficient	Positive	Validates digital readiness as an essential competence

Table 3: summarizes the research hypotheses, mapping each to its corresponding statistical test and theoretical contribution. Unlike simple hypothesis tables, this version integrates both direct and indirect mechanisms. For instance, H3a explicitly tests a mediation pathway via soft skills, while H4a addresses a moderation effect of industry-academia collaboration. These nuanced hypotheses highlight the study's novelty, moving beyond direct associations to capture the complex interplay of employability determinants.

Summary of Methodological Improvement

This methodological framework advances beyond traditional Delphi and EFA-based employability studies by incorporating CFA and SEM to validate constructs and test causal mechanisms. The novelty lies in: 1) combining exploratory and confirmatory approaches, 2) integrating mediation and moderation analysis, and 3) employing multi-group validation to ensure generalizability. The approach yields a theoretically grounded and empirically validated employability model that enhances both academic rigor and practical relevance for vocational education in China.

Results

Exploratory Factor Analysis (EFA)

The first stage of analysis involved Exploratory Factor Analysis (EFA) using Principal Component Analysis with Varimax rotation. The Kaiser-Meyer-Olkin (KMO) test yielded a value of 0.841, and Bartlett's Test of Sphericity was significant ($\chi^2 = 1653.27$, $p < 0.001$), indicating sampling adequacy and suitability for factor analysis.Six latent factors emerged, explaining 72.6% of the total variance, consistent with the hypothesized constructs: Professional Skills, Soft Skills, Career Guidance, Industry-Academia Collaboration, Technological Literacy, and Employability Outcomes. All items loaded above 0.65 on their intended constructs.

Before testing the structural relationships among variables, an Exploratory Factor Analysis (EFA) was conducted to uncover the latent structure of employability factors. The EFA serves as a critical first step because it allows researchers to empirically validate whether the hypothesized constructs (professional skills, soft skills, career guidance, industry-academia collaboration, technological literacy, and employability outcome) actually emerge from the data. The appropriateness of the dataset for factor analysis was confirmed by a Kaiser-Meyer-Olkin (KMO) value of 0.841 and a significant Bartlett's Test of Sphericity ($\chi^2 = 1653.27$, $p < 0.001$), both of which exceeded recommended thresholds. These diagnostics demonstrate that the inter-item correlations were sufficiently strong to justify factor extraction.

The factor extraction employed Principal Component Analysis (PCA) with Varimax rotation, which aims to maximize variance explained while maintaining orthogonal independence among factors. The analysis produced six factors with eigenvalues greater than one, cumulatively explaining 72.6% of the variance. This outcome is noteworthy because it confirms not only the multidimensionality of employability but also the theoretical assumptions established in prior chapters. Each construct was represented by multiple items loading significantly on their respective factors, with most loadings exceeding 0.70, suggesting strong construct validity.

Table 4. EFA Results: Factor Loadings and Variance Explained

Construct	Items (Loading)	Eigenvalue	% Variance Explained	Cumulative %
Professional Skills & Training	Apply theory (0.77), Internship (0.81), Problem-solving (0.74)	5.21	15.8%	15.8%
Soft Skills & Attributes	Communication (0.83), Teamwork (0.79), Leadership (0.72), Resilience (0.76)	4.63	14.1%	29.9%
Career Guidance	Counseling access (0.74), Job fairs (0.71), Career clarity (0.76)	3.92	12.0%	41.9%
Industry-Academia Collaboration	Internship linkages (0.80), Joint projects (0.76), Guest lectures (0.73)	3.21	11.2%	53.1%
Technological Literacy	Digital literacy (0.78), Innovation mindset (0.81), Tech adaptability (0.72)	2.84	9.5%	62.6%
Employability Outcomes	Job readiness (0.82), Interview confidence (0.77), Employment secured (0.74)	2.41	10.0%	72.6%

Table 4: reveals that all indicators load strongly on their intended factors (>0.70), confirming that the measurement items align well with their theoretical constructs. This reinforces the robustness of the survey instrument and validates the preliminary structure derived from Delphi and literature review. The eigenvalues and variance

explained provide additional statistical support. For example, *Professional Skills* has the highest eigenvalue (5.21), accounting for 15.8% of variance, suggesting that technical training and applied learning remain dominant in shaping employability. Interestingly, *Soft Skills* explain 14.1% of variance, almost equal to professional skills. This indicates that interpersonal abilities such as communication, teamwork, and resilience are nearly as critical as technical expertise for vocational graduates entering the labor market.The cumulative variance explained (72.6%) exceeds the acceptable 60% threshold, showing that the six-factor solution adequately captures the underlying employability construct. This highlights the multidimensionality of employability and justifies moving forward with CFA for validation. The balanced contribution across constructs (each explaining between 9%–16% variance) suggests that employability is not dominated by a single factor but rather emerges from an integrated mix of skills, guidance, and exposure. This multidimensionality is a key novelty of the framework. Confirmatory Factor Analysis (CFA).After the initial structure was confirmed through EFA, a Confirmatory Factor Analysis (CFA) was employed to validate the measurement model. The CFA is essential because it tests whether the data fit the hypothesized model derived from both theoretical foundations and empirical exploration. Unlike EFA, which is data-driven, CFA is theory-driven and allows for rigorous assessment of reliability, convergent validity, and discriminant validity. The use of CFA in this study addresses one of the identified methodological gaps in prior employability research, which often stopped at exploratory approaches without further confirmatory validation. The results indicated a satisfactory model fit, as evidenced by $\chi^2/df = 2.31$, CFI = 0.934, TLI = 0.921, RMSEA = 0.056, and SRMR = 0.049. These values exceed widely accepted thresholds, reinforcing the adequacy of the measurement model. In addition to fit indices, reliability measures such as Cronbach's α and Composite Reliability (CR) were examined to assess internal consistency, while Average Variance Extracted (AVE) and the Heterotrait-Monotrait ratio (HTMT) were used to confirm convergent and discriminant validity. This multi-layer validation ensures that each construct is both statistically robust and theoretically distinct.

Table 5. CFA Reliability and Validity Assessment

Construct	Cronbach's α	CR	AVE	R^2 Explained	HTMT Max	Status
Professional Skills & Training	0.83	0.87	0.62	0.46	0.82	Valid
Soft Skills & Attributes	0.86	0.89	0.64	0.52	0.80	Valid
Career Guidance	0.81	0.84	0.58	0.43	0.79	Valid
Industry-Academia Collaboration	0.85	0.88	0.63	0.49	0.77	Valid
Technological Literacy	0.84	0.87	0.61	0.44	0.81	Valid
Employability Outcomes	0.88	0.90	0.67	0.53	0.83	Valid

The results in Table 5: confirm reliability: all constructs exceed Cronbach's α and Composite Reliability thresholds (≥0.70). This proves that the items within each construct consistently measure the same underlying dimension. Convergent validity is established, as all constructs achieve AVE values above 0.50. For instance, Soft Skills reach AVE = 0.64, indicating that more than 64% of variance in items is explained by the latent construct. Discriminant validity is supported, with HTMT ratios below 0.85. This ensures that constructs such as Professional Skills and Soft Skills are statistically distinct, even though they are theoretically related.

The R^2 values show the variance explained in employability-related constructs. Soft Skills ($R^2 = 0.52$) and Employability Outcomes ($R^2 = 0.53$) are the strongest, reinforcing their central roles in the framework. The model fit indices ($\chi^2/df = 2.31$; CFI = 0.934; TLI = 0.921; RMSEA = 0.056; SRMR = 0.049) indicate good overall fit, strengthening the validity of the measurement model and providing a solid foundation for SEM.

*Structural Equation Modeling (SEM).*Following measurement validation, the study proceeded with Structural Equation Modeling (SEM) to examine the hypothesized causal relationships among constructs. SEM provides a powerful analytical framework that combines both measurement and structural components, enabling simultaneous assessment of direct, indirect (mediation), and interaction (moderation) effects. This approach is particularly well-suited for employability studies because it allows for testing of complex interrelationships, such as the mediating role of career guidance in shaping soft skills and the moderating influence of industry-academia collaboration on professional skills.The overall model demonstrated an acceptable fit, with $\chi^2/df = 2.57$, CFI = 0.928, TLI = 0.915, RMSEA = 0.059, and SRMR = 0.053. Beyond fit indices, SEM path coefficients provided insights into the relative importance of each construct in predicting employability outcomes. Bootstrapping was used to test indirect effects, while interaction terms were introduced to examine moderation effects. The findings

offer not only statistical validation but also practical implications, as they highlight which factors are most influential in preparing vocational students for employment in diverse contexts.

Table 6. Hypothesis Testing Results

Hypothesis	Path Tested	β (Coefficient)	t-value	R^2 (Employability)	Result
H1	Professional Skills → Employability	0.29	4.76***		Supported
H2	Soft Skills → Employability	0.35	5.23***		Supported
H3	Career Guidance → Employability	0.18	2.91**		Supported
H3a	Career Guidance → Soft Skills → Employability (mediation)	0.12 (indirect)	2.64**		Supported
H4	Industry-Academia Collaboration → Employability	0.21	3.88***		Supported
H4a	Professional Skills × Industry Collaboration → Employability	0.09 (interaction)	2.11*		Supported
H5	Technological Literacy → Employability	0.24	4.02***	$R^2 = 0.68$	Supported

Notes: *p < 0.05, **p < 0.01, ***p < 0.001

All direct hypotheses (H1–H5) were supported, with Soft Skills exerting the strongest effect (β = 0.35). This confirms that non-technical competencies, often overlooked in vocational education, are decisive for employment competitiveness. Professional Skills also significantly predicted employability (β = 0.29), reinforcing the classical role of technical training. However, its effect size was slightly weaker than that of Soft Skills, suggesting a shift in employer expectations toward well-rounded graduates. The mediation analysis (H3a) showed that Career Guidance indirectly enhances employability through Soft Skills (β = 0.12, p < 0.01). This demonstrates that career services are most effective when they build interpersonal competencies alongside job search preparation.

The moderation test (H4a) revealed that Industry-Academia Collaboration strengthens the link between Professional Skills and Employability. This implies that technical skills are more impactful when students have opportunities to apply them in real workplace contexts through internships or joint projects. The model explained 68% of the variance ($R^2 = 0.68$) in Employability Outcomes, exceeding the moderate threshold (>0.50). This indicates strong explanatory power, validating the proposed SEM framework as a predictive model of employability.

Multi-Group Analysis (MGA)

To further assess the robustness and generalizability of the model, a Multi-Group Analysis (MGA) was conducted. MGA allows researchers to test whether structural relationships remain consistent across different demographic or disciplinary groups. This is crucial in employability studies, as the importance of certain skills may vary between fields such as engineering and non-engineering disciplines. Conducting MGA ensures that the model does not merely reflect a single context but captures broader applicability.

The results of MGA indicated that most structural paths were invariant across groups, with the exception of technological literacy. The influence of technological literacy on employability was significantly stronger among engineering students than non-engineering students, confirming the context-dependent importance of digital competencies. This distinction aligns with labor market realities, where engineering graduates are expected to demonstrate higher levels of technological proficiency compared to their counterparts in other fields.

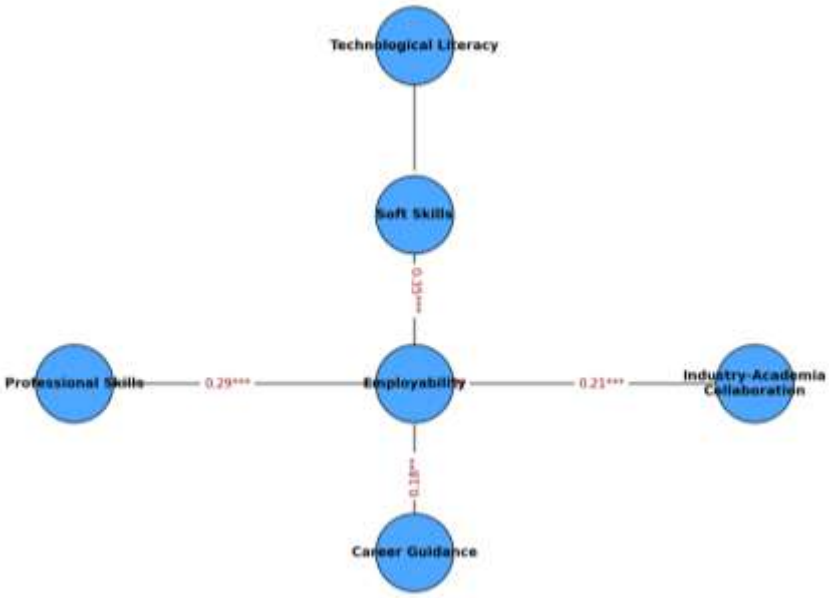

Figure 1. Structural Model with Standardized Path Coefficients

Table 7. Multi-Group Analysis by Discipline

Path Tested	β (Engineering)	β (Non-Engineering)	Difference	Significance
Soft Skills → Employability	0.36	0.34	0.02	n.s.
Professional Skills → Employability	0.31	0.27	0.04	n.s.
Technological Literacy → Employability	0.32	0.17	0.15	$p < 0.05$

Table 7. shows that the model is largely invariant across groups, with no significant differences in the effects of Soft Skills and Professional Skills. This suggests that these competencies are universally critical regardless of discipline. The only significant difference was found in the path Technological Literacy → Employability, which was stronger for engineering students (β = 0.32) compared to non-engineering students (β = 0.17).

This indicates that digital competencies and technological readiness are disproportionately more important in technical fields, where graduates are expected to interact with advanced tools, systems, and industry innovations. For non-technical disciplines, employability may rely more on soft skills and career adaptability rather than advanced digital competencies. This provides practical guidance for tailoring vocational programs to disciplinary contexts. The MGA findings reinforce the adaptability of the model while also highlighting areas where differentiated educational strategies are needed to maximize graduate competitiveness across sectors.

Overall, the results validate the multidimensional employability model through rigorous statistical testing. All hypothesized relationships were confirmed, with Soft Skills emerging as the strongest predictor, while Career Guidance contributed indirectly via mediation. Industry-Academia Collaboration strengthened the effect of Professional Skills, confirming its moderating role. The validated SEM framework demonstrates both theoretical robustness and practical utility, providing institutions with actionable insights to enhance graduate employability.

Conclusion

This study set out to identify and validate the multidimensional factors influencing employability among vocational students by employing an advanced quantitative methodology. The results from Exploratory Factor Analysis (EFA) confirmed a six-factor model consisting of Professional Skills, Soft Skills, Career Guidance, Industry-Academia Collaboration, Technological Literacy, and Employability Outcomes, explaining 72.6% of the variance. Subsequent Confirmatory Factor Analysis (CFA) validated the measurement model, with all constructs demonstrating satisfactory reliability (Cronbach's $\alpha > 0.80$, $CR > 0.84$) and convergent validity ($AVE > 0.50$).

The Structural Equation Modeling (SEM) analysis revealed that all direct hypotheses were supported, with Soft Skills (β = 0.35) emerging as the strongest predictor of employability, followed by Professional Skills (β = 0.29), Technological Literacy (β = 0.24), Industry-Academia Collaboration (β = 0.21), and Career Guidance (β = 0.18).

Importantly, the mediation analysis showed that Career Guidance indirectly enhanced employability through Soft Skills ($\beta = 0.12$, $p < 0.01$), while moderation analysis demonstrated that Industry-Academia Collaboration strengthened the effect of Professional Skills on employability ($\beta = 0.09$, $p < 0.05$). Overall, the model explained 68% of the variance ($R^2 = 0.68$) in employability outcomes, indicating strong explanatory power.

The novelty of this research lies in its methodological and conceptual advancements. Methodologically, it advances beyond prior employability studies that were limited to exploratory approaches by applying a sequential EFA–CFA–SEM framework, incorporating both mediation and moderation analyses. Conceptually, the findings highlight the central role of Soft Skills in shaping employability, thereby challenging the conventional emphasis on technical training alone. Furthermore, the integration of Industry-Academia Collaboration as a moderating construct provides new insights into how institutional partnerships enhance the effectiveness of professional skills. This dual mechanism mediation through soft skills and moderation through collaboration represents a significant theoretical contribution to employability research.

Practically, the study offers actionable insights for educators, policymakers, and industry partners. First, vocational curricula must balance technical training with systematic soft skills development, recognizing that interpersonal competencies often outweigh technical expertise in determining employability. Second, career guidance services should not only focus on labor market information but also actively foster the growth of soft skills, thereby amplifying their indirect contribution to employability. Third, partnerships between educational institutions and industries should be deepened to create real-world application opportunities, ensuring that professional skills translate effectively into workplace readiness. Finally, the differentiated role of technological literacy across disciplines, as shown by the Multi-Group Analysis, suggests that employability frameworks must be tailored to the specific requirements of each field.

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Examination of University Students' Perceptions of Online Social Capital

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ABSTRACT
This study was designed using a quantitative research approach to determine university students' perceptions of their online social capital levels, employing a survey model. The research was conducted with 406 undergraduate students studying at a university. Participants were selected through a simple random sampling method. Research data were collected using the Online Social Capital Scale. The results revealed that university students' overall online social capital levels were at a neutral level. It was observed that students expressed disagreement in the bonding social capital sub-dimension, while they reported a neutral level of perception in the bridging social capital sub-dimension. These results highlight the importance of educators viewing social networks not merely as tools for information sharing, but as interactive spaces where students can learn from and support one another.
Keywords: Online Social Capital, Social Network, Student.

INTRODUCTION

In today's rapidly digitalizing society, individuals' social capital is shaped not only through face-to-face interactions but also via online platforms. The opportunities offered by digital networks have significantly transformed the accessibility and distribution of social resources, leading to an increase in studies focusing on online social capital perceptions, particularly among young adults such as university students (Ellison, Steinfield, & Lampe, 2007; Valenzuela, Park, & Kee, 2009). University students actively use digital networks in both their academic and social lives to access information, support, and new relationships; this, in turn, plays a crucial role in the accumulation of their online social capital.

The concept of social capital is defined as the resources and support systems that individuals can access through their social networks (Coleman, 1988; Putnam, 2000). While early studies approached social capital within the context of strengthening social ties and interpersonal relationships, the increasing prevalence of digital platforms today has necessitated a reinterpretation of this concept (Lin, 2001; Marsden & Campbell, 1984). In particular, the use of digital technologies accelerates information exchange among individuals and fosters the emergence of new forms of social capital within online communities (Boyd & Ellison, 2008; Haythornthwaite, 2005). Research has shown that digital networks not only have the potential to enhance social capital but also play a significant role in individuals' identity formation and social support mechanisms (Burt, 1992; Venkatesh et al., 2003).

University students, as active users of the digital age, perceive social networking platforms as sources of information, support, and belonging (Lee, 2012; Park, 2009). In particular, social media sites and online forums play a significant role in their academic and social lives. Research has shown that friendships developed on online platforms can positively influence students' academic performance and strengthen their sense of belonging within school communities (Hampton, Sessions, & Her, 2011; Valenzuela, Park, & Kee, 2009). These digital dynamics shape students' perceptions of social capital from various perspectives, fostering diversity in personal trust, social connections, and access to information (Li & Bernoff, 2011). Many scholars have noted that social media platforms facilitate information sharing among students, thereby promoting both academic and social engagement, while also cautioning that excessive use of digital networks may lead to negative consequences such as addiction, attention disorders, and social isolation (Şahin, 2017; Yığman, 2021).

Online networks have emerged as an important tool in determining individuals' levels of social participation. In particular, interactions conducted through digital platforms allow for the development of alternative forms of communication alongside traditional social ties (Aral, Muchnik, & Sundararajan, 2009). The use of digital networks by university students in their academic and social lives enhances interaction among individuals from diverse cultural and geographical backgrounds, thereby contributing to the diversification of social capital (Lee, 2012; Park, 2009; Phua, Jin, & Kim, 2020). Moreover, the literature emphasizes that experiences shared on online platforms positively contribute to individuals' socio-emotional well-being and academic performance

(Junco, 2012; Gonzales & Hancock, 2021). In this context, the broad communication opportunities provided by digital networks strengthen students' social connectedness while also fostering greater civic participation.

Digital networks and social media platforms have profoundly transformed the ways individuals build, maintain, and reshape their social connections. University students are at the center of this transformation, fulfilling their academic, social, and emotional needs through digital platforms. In particular, tools such as Facebook, Instagram, WhatsApp, and more recently TikTok, play an active role in the formation of both strong ties (bonding) and weak ties (bridging) (Ellison, Steinfield, & Lampe, 2007; Burke, Marlow, & Lento, 2010; Zhu, Chen, & Evans, 2020). In this context, online social capital provides a valuable conceptual framework for understanding the extent to which individuals can access support, trust, and information resources in the digital realm (Putnam, 2000; Lin, 2001; Phua, Jin, & Kim, 2020). Recent studies further demonstrate that digital interactions enhance university students' sense of belonging, well-being, and academic motivation (Gonzales & Hancock, 2021; Islam & Widin, 2022).

In today's world, where digitalization permeates every aspect of individual and social life, social relationships are being reshaped within online environments. University students, in particular, access key components of social capital—such as information, emotional support, belonging, and trust—through their digital interactions on social networks. Within this context, online social capital has emerged as a growing area of research. Moreover, with the increasing prevalence of online learning environments, university students' social interactions on digital platforms have gained importance not only in terms of social relationships but also within the context of learning processes and digital pedagogy. In this regard, identifying university students' levels of online social capital is important for understanding the effects of digital interactions on social capital and for deriving implications for online learning environments and digital pedagogy based on the findings. Although the literature includes an increasing number of studies on the concept of online social capital, data concerning how university students in Türkiye experience and utilize these digital networks remain limited. The purpose of this study is to determine the levels of online social capital among university students. Within this general framework, the study seeks to answer the following research questions:

- What are university students' perceptions of their levels of online social capital?
- Is there a significant difference between university students' levels of online social capital and their gender, academic department, and daily social media usage time?

METHODOLOGY

This study was designed using a quantitative approach to determine university students' perceptions of their levels of online social capital. The quantitative research method is appropriate for examining measurable aspects of social behaviors and obtaining generalizable findings (Creswell, 2014). The research employs a survey model, which is a method used to describe the current state of a group or population at a specific point in time (Fraenkel, Wallen, & Hyun, 2012). This model aims to present and analyze the existing situation in detail regarding the research topic (Karasar, 2009).

Population and Sample

This study was conducted with 406 undergraduate students enrolled at a public university in Türkiye to determine their perceptions of online social capital levels. Participants were selected using a simple random sampling method, in which each member of the population has an equal chance of being chosen (Creswell, 2014). In this research, students from eight randomly selected departments—Geography, Child Development, English Language and Literature, Psychology, Sociology, History, Turkish Language and Literature, and Nursing—were included. Mahalanobis distances were calculated to check for outliers, and 12 questionnaires were found to contain erroneous data and were therefore excluded from the analysis.

When examining the demographic variables of the participants, it was found that 78.7% of the students were female, while 21.3% were male. In terms of academic departments, the participants were distributed as follows: Child Development (25.4%), English Language and Literature (23.6%), Turkish Language and Literature (15.0%), Geography (8.6%), Nursing (9.1%), Psychology (6.1%), Sociology (6.1%), and History (6.1%).

Data Collection Tools

In this study, data were collected using two instruments: the Demographic Information Form and the Online Social Capital Scale.

Online Social Capital Scale

The Online Social Capital Scale, developed by Williams (2006), was prepared in a 5-point Likert format and later adapted into Turkish by Mumcu (2021). The scale consists of 20 items grouped under two factors: Bonding Social Capital (10 items) and Bridging Social Capital (10 items). The overall Cronbach's Alpha reliability

coefficient of the scale was found to be .887. For each sub-dimension, the internal consistency coefficients were .809 for Bonding Social Capital and .885 for Bridging Social Capital. Additionally, to evaluate students' perceptions of online social capital based on the arithmetic means obtained from the 5-point Likert-type responses. Accordingly, the following intervals were used for interpretation: Strongly Disagree (1.00–1.80), Disagree (1.81–2.60), Neutral (2.61–3.40), Agree (3.41–4.20), Strongly Agree (4.21–5.00).

In order to test the suitability of the data for factor analysis, the Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy and Bartlett's Test of Sphericity were conducted on the scale used in the study (Table 1).

Table 1. KMO and Bartlett's Test Results for the Scale Used in the Study

Scale	Kaiser-Meyer-Olkin (KMO)	Bartlett Küresellik Testi	sig.
Online Social Capital Scale	.907	3274.178	<.001

According to Table 1, the Kaiser-Meyer-Olkin (KMO) value for the Online Social Capital Scale was found to be .907. Considering that KMO values between 0.50 and 1.00 are regarded as acceptable for factor analysis (Altunışık et al., 2010, p. 266), the data structure was deemed adequate for conducting factor analysis. Regarding Bartlett's Test of Sphericity, the chi-square value was calculated as $\chi^2 = 3274.178$, which was statistically significant at the .01 level (sig. < .001). This result indicates that the data are drawn from a multivariate normal distribution, thereby fulfilling another prerequisite for the applicability of factor analysis (Çokluk et al., 2010). Furthermore, the normality values for the Online Social Capital Scale used in the study are presented in Table 2.

Table 2. Normality Values of the Online Social Capital Scale

Statistic	**Value**
Z value (Skewness)	-.090
Z value (Kurtosis)	-.170
Kolmogorov-Smirnov (K-S) Test	.066
p-value	p .007

According to Table 2, the descriptive statistics and Kolmogorov-Smirnov (K-S) test results related to the normality characteristics of the Online Social Capital Scale were examined. The skewness value was calculated as -0.090. A skewness value between -1 and +1 indicates that the data are approximately normally distributed (Tabachnick & Fidell, 2013). This result suggests that there is no significant skewness in the dataset. The kurtosis value was found to be -0.170. Since the kurtosis value also falls within the acceptable range of -1 to +1, it further supports the normality of the distribution. This indicates that the data do not exhibit excessive peakedness or flatness. The Kolmogorov-Smirnov (K-S) test yielded a result of D(401) = 0.066, p = 0.007. Since the p-value is less than .05, the null hypothesis of normal distribution is rejected. However, the K-S test is known to be highly sensitive to minor deviations from normality in large samples (N > 300) and therefore may not be reliable when used alone (Field, 2009). Taking into account the skewness and kurtosis values, it can be stated that the data are approximately normally distributed. Moreover, to confirm the assumption of normality—especially when parametric tests are to be used—graphical methods such as histograms and Q-Q plots were also employed. These graphical representations are shown in Figure 1 below.

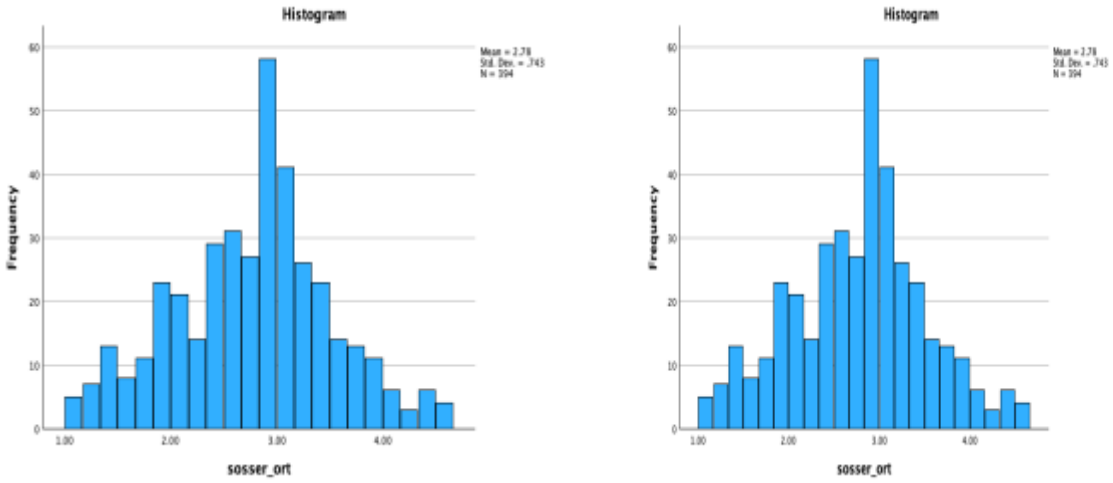

Figure 1. Histogram and Q-Q Plot of the Online Social Capital Scale

In Figure 1, a histogram and Q-Q plot are presented to evaluate the normal distribution of the Online Social Capital Scale. The histogram shows a distribution resembling a bell curve, indicating an approximately normal distribution. The mean value was reported as 2.78, with a standard deviation of 0.743. The distribution appears to be slightly positively skewed; however, there is no evidence of a serious violation of the normality assumption. Moreover, the distribution appears homogeneous, with no significant clustering of extreme values. The Q-Q plot was used to assess how closely the observed data align with a theoretical normal distribution. It was observed that most data points clustered around the normality line, although some noticeable deviations occurred at the lower and upper extremes. This suggests a slight skewness, yet the overall distribution is still acceptably close to normal. When the histogram and Q-Q plot are evaluated together, it can be concluded that the dataset exhibits an approximately normal distribution. Therefore, the use of parametric tests in the subsequent analyses is considered appropriate. The Confirmatory Factor Analysis (CFA) results for the scale used in the study are presented in Table 3.

Table 3. Confirmatory Factor Analysis Results for the Online Social Capital Scale

Fit Index	Online Social Capital CFA	Good Fit Criteria	Acceptable Fit Criteria
X^2 / sd	3.69	≤3	≤4-5
AGFI	0.83	≥0.90	0.89-0.85
GFI	0.86	≥0.90	0.89-0.85
NFI	0.93	≥0.95	0.94-0.90
CFI	0.95	≥0.97	≤ 0.95
RMSEA	0.08	≤0.05	0.06-0.08
SRMR	0.08	≤0.05	0.06-0.08

In order to verify the factor structure of the Online Social Capital Scale, a Confirmatory Factor Analysis (CFA) was conducted. The results indicated a Chi-square value of $X^2 = 3.69$, df = 34, p = 0.00. The fit index values were found as follows: RMSEA = 0.08, CFI = 0.95, GFI = 0.86, AGFI = 0.83, SRMR = 0.08, and NFI = 0.93. Based on these results, the X^2/df ratio falls within the acceptable range, and the other fit indices are generally at acceptable or near-good levels. Considering that modifications were made between items 1–2, 19–20, and 15–16, the observed improvements in the fit indices indicate that the model achieved a better fit structure. After modification, the GFI and AGFI values remained within acceptable limits, while the NFI and CFI values reached satisfactory levels. The RMSEA and SRMR values being within the acceptable range also demonstrate that the model is generally consistent with the data. The X^2/df ratio of 3.69 confirms that the model represents an acceptable structure.

Data Collection Process

Prior to conducting the research, ethical approval was obtained from the Ethics Committee of the university where the researchers are employed. After receiving approval, the researchers contacted faculty members teaching in various departments to inform them about the study and to identify suitable classes and times for data collection. Subsequently, during the scheduled sessions, the researchers visited the selected classes and distributed the questionnaire electronically via Microsoft Forms. The data collection was conducted class by class, and students were informed about the purpose of the study, informed consent, confidentiality, and voluntary participation. No personal identifying information was requested from participants. The data were collected during the Spring semester of the 2024–2025 academic year, and each session took approximately 15 minutes to complete.

Data Analysis

The collected data were analyzed using SPSS 29 statistical software. First, the data were cleaned by removing erroneous and outlier values to ensure suitability for analysis. Normality tests were then conducted to determine whether the data met the assumptions for parametric analyses. The Confirmatory Factor Analysis (CFA) of the scale was performed using LISREL 8.8, and model fit indices were evaluated. Descriptive statistics, including frequency, percentage, mean, and standard deviation, were computed. To examine the relationships between the overall scale, its subdimensions, and demographic variables, parametric tests such as t-tests and ANOVA were applied. The significance levels were set at $p \leq .05$ and $p \leq .01$ for all statistical analyses.

RESULTS

In this study, university students' perceptions regarding their overall levels of online social capital, as well as the subdimensions of Bonding Social Capital and Bridging Social Capital, were examined. Descriptive analyses for

the overall scale and its subdimensions are presented in Table 4.

Table 4. Descriptive Statistics for the Overall Scale and Its Subdimensions

	N	Min.	Max.	x̄	SD
Online Social Capital	394	1.00	4.60	2.77	.743
Bonding Social Capital	394	1.00	4.60	2.53	.813
Bridging Social Capital	394	1.00	5.00	3.02	.906

When Table 4 is examined, it is seen that for the overall scale ($\bar{x}$ = 2.77, SD = 0.743), students' levels of online social capital are at a neutral level. For the Bonding Social Capital sub-dimension ($\bar{x}$ = 2.53, SD = 0.813), students reported a disagree level of perception. In contrast, for the Bridging Social Capital sub-dimension ($\bar{x}$ = 3.02, SD = 0.906), students' responses were at a neutral level. Descriptive analyses related to the Bonding Social Capital sub-dimension are presented in Table 5.

Table 5. Descriptive Statistics for the Bonding Social Capital Subdimension

Items in the Bonding Social Capital Subdimension	Statistic		
	N	X̄	SD
1. There are a few people on social media whom I believe would help me solve my problems.	394	2.72	1.286
2. There is someone on social media whose advice I would seek when making very important decisions.	394	2.74	1.356
3. There is no one on social media with whom I feel comfortable discussing my personal problems.	394	2.69	1.384
4. When I feel lonely, there are a few people on social media I can talk to.	394	2.76	1.381
5. If I urgently needed to borrow money, I know someone on social media who could help me.	394	2.15	1.369
6. The people I communicate with on social media would risk their reputation for me.	394	2.15	1.278
7. The people I interact with on social media would provide a good job reference for me.	394	2.44	1.295
8. The people I communicate with on social media would share their last money with me.	394	2.22	1.328
9. I don't know the people on social media well enough to ask them to do anything important for me.	394	2.68	1.378
10. The people I interact with on social media would help me if I were treated unfairly.	394	2.79	1.356

When Table 5 is examined, it is observed that the mean scores for the Bonding Social Capital sub-dimension range between 2.15 and 2.79. The item with the highest mean score ($\bar{x}$ = 2.79) is "People I communicate with on social media would help me if I were treated unfairly." Similarly, the statements "There is someone on social media whose advice I would seek when making important decisions" ($\bar{x}$ = 2.74) and "There is no one on social media with whom I can comfortably talk about my personal problems" ($\bar{x}$ = 2.69) also have relatively higher mean values. These results suggest that individuals receive a certain degree of social support through social media, although they may be hesitant to share private matters. Among the lowest-scoring items are "If I urgently needed to borrow money, I know someone on social media who could help me" ($\bar{x}$ = 2.15) and "People I communicate with on social media would risk their reputation for me" ($\bar{x}$ = 2.15). These findings indicate that students are generally reluctant to take financial or reputational risks within their social media relationships. Descriptive analyses related to the Bridging Social Capital sub-dimension are presented in Table 6.

Table 6. Descriptive Statistics for the Bridging Social Capital Subdimension

Items in the Bridging Social Capital Subdimension	Statistic		
	N	X̄	SD
11. Communicating with people on social media makes me interested in what is happening outside the place I live.	394	3.22	1.295
12. Communicating with people on social media inspires me to try new things.	394	3.08	1.317
13. Communicating with people on social media increases my interest in what people different from me think.	394	3.15	1.320
14. Communicating with people on social media makes me curious about other places in the world.	394	3.56	1.285

15.	Communicating with people on social media makes me feel like I am part of a larger community.	394	2.98	1.265
16.	Communicating with people on social media makes me feel connected to the bigger picture.	394	2.85	1.290
17.	Communicating with people on social media reminds me that everyone in the world is connected.	394	3.20	1.276
18.	I am willing to spend time supporting community events on social media.	394	2.94	1.255
19.	Communicating with people on social media helps me find new people to talk to.	394	2.91	1.336
20.	I always interact with new people on social media.	394	2.38	1.300

According to Table 6, the mean scores for the Bridging Social Capital sub-dimension range from 2.38 to 3.56. The highest mean score ($\bar{x}$ = 3.56) belongs to the item "Communicating with people on social media makes me curious about other places in the world." Similarly, the statements "Communicating with people on social media makes me interested in what happens outside the place where I live" ($\bar{x}$ = 3.22) and "Communicating with people on social media reminds me that everyone in the world is connected" ($\bar{x}$ = 3.20) also have relatively high mean scores. These findings indicate that social media contributes positively to increasing individuals' cultural awareness. On the other hand, the item with the lowest mean score ($\bar{x}$ = 2.38) is "I always communicate with new people on social media." Similarly, "Communicating with people on social media makes me feel connected to the bigger picture" ($\bar{x}$ = 2.85) and "Communicating with people on social media helps me find new people to talk to" ($\bar{x}$ = 2.91) also received lower mean values. This suggests that while students use social media as a means of interaction and cultural exchange, their sense of belonging to a broader community remains at a moderate level. The t-test results comparing students' views on the overall scale and sub-dimensions according to gender are presented in Table 7.

Table 7. Students' Perceptions on the Total Scale and Subdimensions According to Gender

Subscale	Gender	N	$\overline{X}$	SD	sd	Levene	Sig.	t	Sig.
Online Social Capital	Female	308	2.77	.759	392	.455	.500	-.161	.436
	Male	86	2.79	.683				-.171	
Bonding Social Capital	Female	308	2.54	823	392	1.004	.317	.706	.240
	Male	86	2.47	.782				.727	
Bridging Social Capital	Female	308	3.00	.925	392	.455	.500	-.896	.186
	Male	86	3.10	.835				-.949	

p<.05*

According to Table 7, the mean score for female students on the overall scale was $\bar{x}$ = 2.77, while for male students it was $\bar{x}$ = 2.79. The t-test results (t = -0.161, p = .436) indicate that there is no significant difference between genders (p > .05). In the Bonding Social Capital sub-dimension, the mean score of female students ($\bar{x}$ = 2.54) was slightly higher than that of male students ($\bar{x}$ = 2.47). However, the t-test result (t = 0.706, p = .240) again revealed no statistically significant difference between the two groups (p > .05). Similarly, in the Bridging Social Capital sub-dimension, the mean score for female students ($\bar{x}$ = 3.00) was slightly lower than that for male students ($\bar{x}$ = 3.10). The t-test result (t = -0.896, p = .186) confirmed that this difference was not statistically significant (p > .05). Overall, these findings suggest that both male and female students exhibit similar levels of online social capital, indicating that gender does not play a determining role in the formation or perception of social capital through social media. The ANOVA test results regarding students' views on the overall scale and sub-dimensions according to academic department are presented in Table 8.

Table 8. Students' Perceptions on the Total Scale and Subdimensions According to Academic Department

Subscale	Department	N	$\overline{X}$	SD	Source	Sum of Squares	sd	Mean Square	F	p	scheffe
Online Social Capital	Geography	34	2.5618	.705	Between	6.555	7	.936	1.718	.103	-
	Child	100	2.7510	.795	Within G.	210.432	386	.545			
	English Language & Lit.	93	2.8538	.715	Total	216.987	393				
	Psychology	24	2.4938	.760							

	Sociology	24	3.0583	.887							
	History	24	2.8857	.860							
	Turkish Language	59	2.8263	.604							
	Nursing	36	2.7208	.648							
	Levene: 1.159		p=.356								
	Geography	34	2.4647	.856	Between	6.759	7	.966			
	Child	100	2.4140	.874	Within G.	253.568	386	.657			
	English Language & Lit.	93	2.5763	.756	Total	260.328	393				
Bonding Social Capital	Psychology	24	2.2708	.866							
	Sociology	24	2.7708	.917					1.470	.176	-
	History	24	2.7833	.884							
	Turkish Language & Lit.	59	2.6237	.708							
	Nursing	36	2.5139	.702							
	Levene: 1.546		p=.2150								
	Geography	34	2.6588	.752	Between	11.123	7	1.589			
	Child	100	3.0880	.960	Within G.	311.837	386	.808			
	English Language & Lit.	93	3.1312	.878	Total	322.960	393				
Bridging Social Capital	Psychology	24	2.7167	1.02					1.967	.058	-
	Sociology	24	3.3458	.994							
	History	24	2.9921	1.05							
	Turkish Language	59	3.0288	.784							
	Nursing	36	2.9278	.802							
	Levene: 1.262		p=.268								

p<.05*

According to Table 8, the mean scores across departments for the overall scale ranged from 2.49 to 3.05. The Sociology department had the highest mean score ($\bar{x}$ = 3.05, SD = .887), while the Psychology department had the lowest ($\bar{x}$ = 2.49, ss = .760). The results of the ANOVA test (F = 1.718, p = .103) indicated that there was no statistically significant difference among departments (p > .05). These findings suggest that students' levels of Online Social Capital did not differ significantly according to their academic department. In the Bonding Social Capital sub-dimension, departmental mean scores ranged between 2.27 and 2.78. The highest mean belonged to the History department ($\bar{x}$ = 2.78, SD = .884), while the Psychology department again had the lowest ($\bar{x}$ = 2.27, SD = .866). The ANOVA test (F = 1.470, p = .176) revealed no statistically significant difference between departments (p > .05). These results indicate that the department variable was not a determining factor in students' bonding relationships established through social media. In the Bridging Social Capital sub-dimension, mean scores varied between 2.65 and 3.34. The Sociology department had the highest mean ($\bar{x}$ = 3.34, SD = .994), whereas the Geography department had the lowest ($\bar{x}$ = 2.65, SD = .752). Although the ANOVA test (F = 1.967, p = .058) approached significance at the 10% level (p < .10), it was not significant at the 5% threshold (p > .05). This finding suggests that students' levels of cultural interaction and interest in different cultures through social media did not significantly differ by department. The ANOVA test results regarding students' opinions on the overall scale and its sub-dimensions based on daily social media usage time are presented in Table 9.

Table 9. Students' Perceptions on the Total Scale and Subdimensions According to Daily Social Media Usage Time

Subscale	Daily Social Media Usage Duration	N	$\overline{X}$	SD	Source	Sum of Squares	sd	Mean Square	F	p	scheffe
Online Social Capital	2-4 hours	215	2.80	.760	Between	2.685	3	.895	1.629	.182	-
	4-6 hours	116	2.76	.690	Within G.	214.302	390	.549			
	6-8 hours	40	2.57	.825	Total	216.987	393				
	8 hours or more	23	2.97	.641							
	Levene: 1.884		p=.132								

Bonding Social Capital	2-4 hours	21	2.58	.803	Between	2.387	3	.796	1.203	.308	-
	4-6 hours	11	2.47	.801	Within G.	257.941	390	.661			
	6-8 hours	40	2.36	.880	Total	260.328	393				
	8 hours or more	23	2.64	.842							
	Levene: .222		p= .881								
Bridging Social Capital	2-4 hours	21	3.02	.938	Between	4.067	3	1.356	1.658	.176	-
	4-6 hours	11	3.04	.861	Within G.	318.893	390	.818			
	6-8 hours	40	2.79	.945	Total	322.960	393				
	8 hours or more	23	3.30	.683							
	Levene: 1.510		p=.211								

p<.05*

According to Table 9, the mean scores for overall online social capital varied between 2.57 and 2.97 according to students' daily social media usage duration. The highest mean was observed among students who used social media for 8 hours or more ($\bar{x}$ = 2.97, ss = .641), while the lowest belonged to those who used it for 6–8 hours ($\bar{x}$ = 2.57, ss = .825). The ANOVA test results (F = 1.629, p = .182) revealed no statistically significant difference between groups (p > .05). These findings suggest that daily social media usage time does not have a significant effect on students' overall online social capital levels. In the Bonding Social Capital sub-dimension, mean scores ranged from 2.36 to 2.64. The highest average again belonged to students who used social media for 8 hours or more ($\bar{x}$ = 2.64, ss = .842), while the lowest mean was found among those using it for 6–8 hours ($\bar{x}$ = 2.36, ss = .880). The ANOVA test results (F = 1.203, p = .308) indicated no statistically significant difference between the groups (p > .05). Thus, daily social media use time did not create a meaningful variation in Bonding Social Capital. Regarding the Bridging Social Capital sub-dimension, mean scores varied between 2.79 and 3.30. The highest mean belonged to students who used social media for 8 hours or more ($\bar{x}$ = 3.30, ss = .683), while the lowest belonged to those using it for 6–8 hours ($\bar{x}$ = 2.79, ss = .945). Although these findings show a tendency for higher bridging capital with increased social media use, the ANOVA results (F = 1.658, p = .176) confirmed that this difference was not statistically significant (p > .05). Overall, while students who spend more time on social media may have slightly higher bridging social capital levels, the effect of social media usage duration on both bonding and bridging dimensions was not significant.

DISCUSSION

The present study aimed to determine university students' levels of online social capital in relation to variables such as gender, academic department, and daily social media usage time. The results indicate that university students' online social capital levels are generally at the undecided level. The findings revealed that students' overall levels of online social capital were at a moderate (neutral) level. Students' responses in the bonding social capital sub-dimension indicated a tendency toward disagreement, suggesting that relationships formed through social media involve limited trust, closeness, and mutual support. In contrast, the bridging social capital sub-dimension was found to be at a neutral level, implying that while social networks provide potential opportunities for broader interaction, these interactions are not yet strongly established. It can be argued that the generally undecided level of online social capital among university students is closely related to the nature of social media use. The findings show that students primarily engage in information sharing, everyday interactions, and relationships based on weak ties on social media platforms, whereas bonding social capital that requires trust and emotional closeness develops only to a limited extent. From a theoretical perspective, this situation becomes more meaningful when interpreted within Putnam's distinction between bonding and bridging social capital. Accordingly, social media environments provide individuals with access to information and connections to broader social networks through weak ties, while offering limited support for the development of strong ties that require trust, reciprocity, and emotional closeness. This finding is consistent with previous studies suggesting that social media tends to support social capital mainly through information exchange and weak ties rather than deepening close interpersonal relationships (Ellison, Steinfield, & Lampe, 2007; Valenzuela, Park, & Kee, 2009). Moreover, in online learning environments, the development of social capital depends less on the technology used and more on pedagogical designs with high levels of interaction, collaborative learning activities, and learning processes that encourage meaningful social interaction among students (Hrastinski, 2009; Garrison, Anderson, & Archer, 2010).

In the Bonding Social Capital sub-dimension, the item with the highest mean score was "The people I communicate with on social media help me when I experience an injustice." Similarly, the statements "I have someone to consult when making very important decisions on social media" and "There is no one on social

media with whom I can comfortably talk about my personal problems" also had relatively high mean scores. This suggests that individuals receive a certain level of support through social media, yet they may hesitate to share personal or sensitive matters. The items with the lowest means were "If I urgently need to borrow money, I know someone on social media who can help me" and "The people I communicate with on social media would risk their reputation for me." These findings indicate that students tend to avoid taking financial or reputational risks in their online relationships. Similarly, Ellison, Steinfield, and Lampe (2007) reported that online networks offer informational and emotional support but remain limited in fostering strong, reciprocal bonds. Therefore, the current study aligns with prior research, suggesting that social media primarily facilitates the exchange of information and ideas among students but is less effective in deepening bonding social capital.

In the Bridging Social Capital sub-dimension, the item with the highest mean score was "Communicating with people on social media makes me curious about other parts of the world." Similarly, the statements "Communicating with people on social media helps me become interested in what is happening outside the place where I live" and "Communicating with people on social media reminds me that everyone in the world is connected" also received high mean scores. This finding suggests that social media plays an effective role in enhancing individuals' cultural awareness. On the other hand, the items with the lowest mean scores — "I always communicate with new people on social media," "Communicating with people on social media makes me feel connected to the bigger picture," and "Communicating with people on social media helps me find new people to talk to" — indicate that individuals' sense of belonging to a larger community through social media remains moderate. Similarly, Valenzuela, Park, and Kee (2009) as well as Kwon and Wen (2010) emphasized that social networking platforms can broaden individuals' cultural awareness and cognitive horizons, yet remain limited in fostering strong, enduring social ties.

The findings of the study revealed that students' levels of online social capital did not differ significantly according to their academic departments. While the overall scale showed the highest mean score among Sociology students and the lowest among Psychology students, these differences were not statistically significant, indicating that departmental variations in social media use are relatively minor. In the Bonding Social Capital sub-dimension, the History department exhibited the highest mean score, which may reflect history students' stronger orientation toward community belonging and solidarity in their social interactions; however, the absence of a statistically significant difference suggests that this tendency is not a strong determinant. Similarly, in the Bridging Social Capital sub-dimension, students' levels of cultural awareness and interaction through social media appeared to be independent of their academic departments. This finding aligns with the results of Ellison, Steinfield, and Lampe (2007) and Kwon and Wen (2010), who emphasized that social media interactions are shaped more by individual online experiences than by academic or professional identity.

The findings of the study revealed that students' daily social media usage time did not create a statistically significant difference in their levels of online social capital. Although students who used social media for eight hours or more had slightly higher mean scores than other groups, this difference was not statistically significant. This suggests that the amount of time spent on social media alone does not enhance social capital; rather, the quality and nature of engagement play a more decisive role. Similarly, Ellison, Steinfield, and Lampe (2007) emphasized that time spent on social media contributes to social capital only when it involves active participation and interaction. Ahn (2012) also noted that the frequency of social media use does not show a linear relationship with social capital levels, highlighting that active sharing, rather than passive browsing, is more effective. Supporting this, Appel, Marker, and Gnambs (2020) and Błachnio, Przepiorka, and Pantic (2016) suggested that intensive social media use may increase superficial interactions rather than improving the quality of social relationships.

LIMITATIONS

This study has several limitations. First, the sample is limited to students enrolled at a single university, which may restrict the generalizability of the findings to other institutional and contextual settings. In addition, the use of self-report data may introduce response bias, as participants' answers are based on their perceptions and may be influenced by tendencies toward socially desirable responding. Furthermore, conducting the study within a single-university context limits the ability to compare manifestations of online social capital across different institutional and cultural environments. Therefore, future research involving multiple universities, larger samples, and the use of multiple data collection methods is recommended to achieve a more comprehensive understanding of online social capital.

RECOMMENDATIONS

Based on the findings of this study, it is recommended that universities create digital environments where

students can collaborate, participate in joint projects, and build trust-based communication online. Educators should view social media not merely as a tool for information sharing but as an interactive space that enables peer learning and mutual support among students. To this end, integrating topics such as digital citizenship, online ethics, and responsible media use into course content can help encourage students to use social media in a more meaningful, responsible, and socially engaging manner that strengthens their social bonds.

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Exploring the Effectiveness of AI-Generative Tools in Improving Vocabulary and Engagement among Elementary School Students in Oman

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ABSTRACT
Generative AI is a type of artificial intelligence that can enhance English vocabulary acquisition significantly. This study deploys a mixed methods approach investigating the effectiveness of AI-generative tools in improving the vocabulary and engagement of Omani 4th grade students in English Subject. Data was gathered using three instruments: (1) an English achievement test (pre-posttest), (2) an observation checklist and (3) a semi-structured interview. The pre-posttest measures the impact of using the Curipod tool on the students' English vocabulary. The sample includes 62 fourth-grade students at Al-Abrar School for Basic Education (grades 1-4), 30 students in the experimental group and 32 in the control group. The observation checklist inspects the 62 students across both groups while the semi-structured interview was administered to two teachers responsible for the groups. The findings indicate that students exposed to the Curipod tool showed significant improvement in their post-test and that they exhibited higher levels of engagement than those who did not use the tool. Therefore, the study recommends that educators and policy makers integrate AI-driven tools such as Curipod into Oman's English education to enhance vocabulary acquisition and academic performance. They should also provide teachers with structured training to assist them using these technologies effectively.
KEYWORDS: generative artificial intelligence, curipod tool, K-12 education, vocabulary acquisition, effectiveness, engagement.

INTRODUCTION

Due to the rapid advancement of technology and the impact of the COVID-19 dilemma, educational associations have hastened to adjust swiftly to the evolving situations. Accordingly, teachers start using platforms like Moodle and Microsoft Teams to teach students directly and provide supplementary tools for independent learning. These platforms have become essential in maintaining the continuity of education during these challenging times (Kashoob & Attamimi, 2021). Many scholars emphasize the benefits of online educational platforms. For instance, Jabbar Alkubaisi et al. (2021) investigate the effectiveness of Blackboard, Moodle and Google Classroom and their impact on education in Oman assessing their usability, content quality and overall effectiveness. The findings point out that all three platforms support education in Oman, with Blackboard ranking the highest in terms of usability and content quality. They also confirm that effective online learning platforms are influenced by factors such as teacher training, student motivation and access to technology.

Currently, the integration of AI in education renovates e-learning by personalizing experiences, automating administrative tasks and offering adaptive learning pathways for students. Firat (2023) argues that the incorporation of AI tools can improve the structure of learning management systems and online learning opportunities. Concepcion and Espino (2023) highlight the potential of AI in enhancing LMS platforms and providing personalized learning experiences for students which can effectively improve students' engagement and motivation.

Dewi et al. (2021) underline the potential benefits of integrating AI tools with traditional English teaching methods to provide a more personalized and interactive learning experience. In the context of EFL, Jiang (2022) explores six popular applications of AI: AI chatbots, intelligent tutoring systems, automatic assessment systems, neural machine translation tools, intelligent virtual environments and affective computing in ITSs. The study confirms that these AI tools can deliver personalized feedback, on-demand support and immersive and interactive learning experiences assisting students to improve their language skills and self-regulated learning abilities.

Similarly, AI tools have a significant impact on enhancing English vocabulary. According to Qasem et al. (2023), interactive AI tools like dialog chatbots are instrumental in improving learning English for Specific Purposes vocabulary. Furthermore, Noviyanti (2020) demonstrates that AI-driven pronunciation education leads to significant advancements in vocabulary acquisition. Al-Humaidi et al. (2021) argue that Omani students face a major obstacle when communicating in English due to their limited vocabulary which are attributed to different factors involving learners, learning settings, curriculum and teachers as identified through the perspectives of multiple stakeholders. In addition, Liao (2023) explores the user's retrieval behavior in English mobile learning, focusing on AI-based English Vocabulary Test Research (AI-EVTR) on Cognitive Web Services Platforms. The study aims to enhance the effectiveness of English vocabulary instruction through AI and pre-test behavior analysis. Despite the initial low motivation of the experimental group, statistical analysis, including independent sample tests, reveals significant improvements in spelling between pre- and post-tests of the experimental group suggesting that AI-based tools can effectively enhance English vocabulary learning on digital platforms.

Considering the challenges mentioned above and the critical role of AI in English vocabulary teaching, this research intends to take a step further and assess the impact of Curipod on teaching vocabulary and engagement of Omani 4th grade students in English classes.

Definitions of Terms:

- Effectiveness: The degree of success in producing a desired result or achieving a goal (Gager, 2018). Operationally, it refers to the degree of success attained by learners using the Curipod tool to raise the vocabulary level and enhance the engagement of the fourth-grade students.
- Curipod tool: AI-generative tool that enables teachers to produce digital content and activities to motivate students and stimulate curiosity, discussion and critical thinking in classrooms (Sbardella & Montanucci, 2024). It is operationally defined as an interactive educational site where English content and activities are uploaded and delivered to students to facilitate discussions, provide assignments and activities and evaluate results to elevate the vocabulary level and engagement of fourth-grade students.
- Academic achievement: The results or accomplishments that individuals achieve in educational environments which are usually assessed by completing assignments, exams and other educational activities (Cooper et al., 2006). Operationally, it refers to the score that a learner obtains in the English vocabulary posttest, which the subject's teacher conducts.
- Engagement: A complex concept that includes behavioral, emotional and cognitive aspects highlighting various ways of students' interactions with their learning environment (Fredricks et al., 2004). It is operationally defined as the emotional and cognitive measurement of student participation in English classes using observation checklists and interviews as tools to evaluate students' engagement.

LITERATURE REVIEW

THEORITICAL BACKGROUND

Integrating AI tools into education offer potential to enhance learning experience, adapt instruction and boost students' engagement which align with constructivist learning principles to empower learners to actively engage with content, explore and construct their own understanding (Thongprasit & Wannapiroon, 2022). Jackson (2024) also declares that AI supports constructivist learning theory by emphasizing active engagement, knowledge construction and personalized learning experiences and that AI technologies, such as Intelligent Tutoring Systems, facilitate active learning through interactive scenarios and immediate feedback. AI adapts content and strategies suitable to individual students' needs and creates personalized learning environments allowing them to actively participate in the learning process and explore topics at their own pace aligning with the constructivist principle that learners construct meaning through hands-on experiences and personalized interactions with AI systems.
Grubaugh et al. (2023) explore integrating AI tools with the constructivist philosophy of education to augment teaching and learning methods emphasizing that AI's adaptive capabilities are consistent with the constructivist principles as they offer personalized and enriching learning experiences. While applying AI platforms such as ChatGPT, BARD and Microsoft Bing, educators can elevate constructivist pedagogy boosting students' engagement, metacognition and conceptual change. The study also highlights the importance of preserving humanistic values in AI integration to sustain an ethical and inclusive educational environment.

AI in English Language Learning Context:

Dewi et al. (2021) examine using AI chatbots to improve students' language skills and self-regulated learning abilities. The study involves 30 students from the English Department at Universitas Airlangga, Indonesia. It finds out that implementing AI chatbots positively influences learners' language skills and SRL abilities and affirms the potential benefits of integrating AI tools with traditional teaching methods to provide a more personalized and interactive learning experience. However, it identifies the need for further research related to adopting AI in education to fully realize these tools' potential.

Jiang (2022) reviews the application of AI in education focusing on teaching and learning English as a foreign language (EFL). The study evaluates six main applications of AI in the EFL context including: automatic assessment systems, neural machine translation tools, intelligent tutoring systems, AI chatbots, intelligent virtual environments and emotional computing in ITSs. These AI tools offer personalized feedback, on-demand support as well as immersive and interactive learning experiences assisting students to improve their language skills and self-regulated learning abilities. The review suggests that AI can potentially empower EFL teaching and learning, but further research and development are required to harness its benefits.

Liao (2023) investigates the user retrieval behavior of English mobile learning with a particular focus on AI-based English Vocabulary Test Research (AI-EVTR) on Cognitive Web Services Platforms. This study explores the effectiveness of English vocabulary instruction by incorporating AI and pre-test behavior analysis adopting a quasi-experimental design consisting of two groups: an experimental group and a control group. The experimental group used an APP-assisted vocabulary questionnaire to help them learn English whereas the control group adopted a conventional teaching method. The collected data was analyzed using statistical methods such as independent samples. The study proposes that although the experimental group lacked the motivation to use the web provided, their spelling significantly improved between the pre- and post-tests showing that language learning on websites is an applicable option for students demonstrating the significant role of AI-based tools in enhancing English vocabulary learning.

Additionally, Qasem et al. (2023) examine using dialog chatbots as interactive online tools to boost learning of English for Specific Purposes (ESP) vocabulary. The study observes how well students learned ESP vocabulary using the chatbot and evaluates their attitudes utilizing this strategy. The findings point out that vocabulary knowledge of the experimental group significantly improved compared to the control group and that the participants had positive attitudes towards using the chatbot, with most of them finding it helpful and enjoyable. The study argues that using a dialog chatbot as an interactive online tool can effectively enhance ESP vocabulary learning and improve students' attitudes toward learning. Another study conducted by Oktadela et al. (2023) at SD-IT Iman Syafei Pekanbaru Elementary School aims to enhance students' vocabulary using an AI chatbot application. The training focuses on enriching English vocabulary, cultivating interest and creativity in English and improving participants' communication skills using English. The training provides a combination of lectures, demonstration and hands-on practice methods stressing on learning by doing and practical application. Although the AI chatbot application was still unfamiliar, the training's outcomes display that all participants were enthusiastic and motivated to learn and that they acquired knowledge of using the application and could continue learning independently, anytime and anywhere.

Polyzi and Moussiades (2023) explore the development and impact of an online application as a learning assistant designed to enhance vocabulary acquisition applying interactive methods such as games, quizzes and chatbots. This study involves 20 students enrolled in an English course at the International Hellenic University in Kavala, Greece who were learning English at a proficiency level and aiming to improve their vocabulary skills. They were divided into two groups: Group A and Group B based on their pre-test results to ensure comparable English proficiency levels in both groups in two stages. In the first stage of the study, Group A was the control group, studying a vocabulary section from a book while group B was the experimental group deploying the proposed application to learn the same vocabulary section. In the second stage, the roles of the two groups were reversed. This crossover design ensures that all participants experienced both methods allowing for a more comprehensive comparison of their effectiveness. Post tests and questionnaires were used to assess the efficacy of the application and to gather feedback from the students regarding their perceptions and satisfaction. The results imply positive students' feedback reporting that the interactive and engaging nature of the application made the learning process more enjoyable and effective.

Kazu and Kuvvetli (2023) investigate the influence of AI-driven pronunciation education on English language vocabulary acquisition employing "Games for Learning English" web service. The research, authorized by the Ministry of National Education, examines how pronunciation training affects word retention among 56 high school students (34 females, 22 males) aged 14-15 using pre-test and post-test design. It adopts an experimental approach with purposeful sampling and qualitative feedback that was gathered through post-experiment semi-structured interviews. The experimental group received AI-based speech recognition pronunciation training while the control group used phonetic alphabet pronunciation. The findings reveal that the experimental group showed a significant improvement in vocabulary acquisition compared to the control group, highlighting the effectiveness of AI techniques in pronunciation teaching.

Zhang and Huang (2024) conducted a comprehensive study assessing the influence of chatbots based on Large Language Models (LLMs) on second language learners' vocabulary acquisition. The study applies mixed methods

combining qualitative observations and quantitative assessments to measure receptive and productive vocabulary knowledge. It involves 52 foreign language students randomly divided into experimental and control groups. The experimental group interacted with an AI Chatbot based on LLMs for eight weeks whereas the control group did not. Results indicate notable improvements in both receptive and productive vocabulary acquisition among students who interacted with the chatbot compared to those who did not, underscoring the potential of AI-driven educational tools to enrich language learning experiences and permit further exploration in diverse educational contexts. The study stresses chatbot's significant role in enhancing vocabulary learning outcomes, promoting incidental vocabulary acquisition and supporting students' self-regulated learning processes.

The Impact of Technology on Students' Engagement and Academic Performance:
Technology positively influences students' engagement leading to improved learning outcomes across different subject areas. Morris and Parker (2014) investigate the relationship between classroom technology and students' engagement and note that growing usage of educational technologies in higher education improves learning outcomes and student engagement. They emphasize the importance of incorporating technology into the development of curricula to enhance learner engagement across behavioral, emotional and cognitive dimensions. The study shows that educational technologies positively affect student satisfaction, motivation, performance and sense of connection.

Correspondingly, the study by Serrano et al. (2019) on Technology-Enhanced Learning in higher education focusing on increasing student engagement through blended learning approaches underscore the extensive use of educational technologies to respond to the changing requirements of higher education, particularly with the transition to online education. It underlines the significance of incorporating substantial levels of technology into curriculum design and delivery to effectively engage students, proposing that educational technology creates opportunities for designing and providing learning resources.

Bedenlier et al. (2020) conducted a systematic review within the arts and humanities domain exploring how educational technology can improve students' engagement in higher education. The study examines 42 peer-reviewed studies on language acquisition that were mostly published in East Asian nations between 2007 and 2016. The evaluation focuses on how well assessment tools, blogs and mobile learning are deployed to foster participation. According to the review, instructional technology augments students' involvement, with behavioral engagement being the most noticeable aspect. However, it asserts the importance of combining technology with efficient education to avoid student disengagement.

Heilporn et al. (2021) investigate instructors' strategies in higher education exploring educators' various approaches and practices to enhance students' engagement, interaction and learning outcomes in Blended Learning (BL) settings. It offers insights into how teachers construct interactive learning practices for higher education students utilizing technology and traditional teaching methods effectively. The findings point out that combining well-structured courses, clear communication, digital tools and carefully selected activities can enhance student engagement in blended learning.

Pechenkina et al. (2017) explore the effect of using gamified mobile learning apps on students' academic success, retention and engagement. The sample includes 711 first-year accounting and science students. The study signifies that students utilizing the app achieved higher final grades and were less likely to fail the subject showing that gamified mobile app positively impact student engagement, retention and academic achievement.

Eltahir et al. (2021) study the influence of game-based learning (GBL) on students' academic performance, motivation and engagement in an Arabic language grammar course at Ajman University. They employ a case study with a quasi-empirical design including 107 students who were split into two groups: the experimental group (n = 54), using a game-based classroom response system, and the control group (n = 53), which did not apply the system. The results disclose that students in the experimental group showed greater growth in their understanding of the ideas covered in the course and displayed greater motivation than the control group students.

In contrast, during the COVID-19 pandemic Salta et al. (2021) explore students' engagement in online and face-to-face learning settings. The study reveals little emotional involvement with online learning, indicating a disparity in emotional connection between the two learning modes. Aguilera-Hermida (2020) also investigate college students' attitudes, adoption and use of emergency online learning (EOL) during the pandemic. It identifies a relationship between students' cognitive engagement and their attitudes, noting a decline in cognitive engagement during the pandemic. Moreover, Aguilera-Hermida (2020) examine the association between cognitive engagement and students' attitudes toward EOL delivery methods. The study concludes that students exhibited negative attitudes toward EOL and had lower cognitive engagement levels.

Furthermore, Alawamleh et al. (2020) detect a decline in online learning communication between students and their instructors during the COVID-19 pandemic. This implies a potential challenge in maintaining effective communication and interaction between students and instructors in the online learning environment which could affect student engagement negatively.

Based on the above studies, it is obvious that AI tools and online platforms play an imperative role in enhancing students' engagement and academic performance during the learning process. Similarly, Curipod is an AI tool that assists teachers create engaging and thought-provoking digital classroom activities (Sbardella & Montanucci, 2024) attracting students' attention and improving their performance. In addition, Al-Humaidi et al. (2021) state that Omani students encounter difficulties when communicating in English due to their limited vocabulary. Accordingly, the study investigates using the Curipod tool to enhance the engagement and vocabulary acquisition of fourth grade students in Oman.

METHODOLOGY

RESEARCH DESIGN

This study employs a mixed-method research design to explore the impact of an AI-generated tool (Curipod) on vocabulary acquisition and engagement levels of fourth-grade students in English subject in Oman. Kashoob and Attamimi (2021) suggest that upcoming studies could benefit from applying mixed-methods approach combining various methods to gather data such as questionnaires, observations and interviews. This study intends to obtain more comprehensive and insightful findings by conducting pre-posttest, observation checklists and semi-structured interviews for complementation purposes. Specifically, it employs a Concurrent Nested Design to gather and analyze quantitative and qualitative data concurrently. In this design, the primary method is quantitative research while qualitative research is the secondary method. The combination of both methodologies within a single study provides a richer understanding of the research questions. The specifics of this research design are depicted in Figure 1 below:

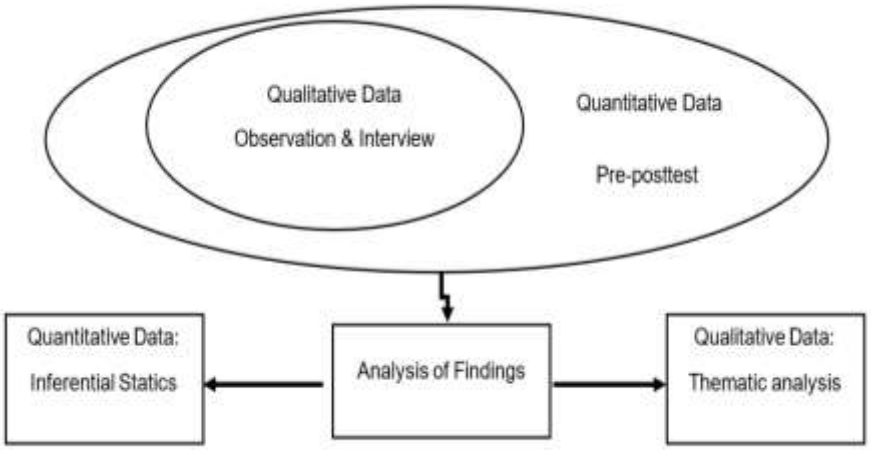

Figure 1. Concurrent Nested Mixed Method Research Design

This study examines the impact of the Curipod tool using quantitative and qualitative data. In the quantitative section, the effect of the independent variable (the Curipod tool) on the dependent variable (the achievement test) was evaluated employing a quasi-experimental design, more precisely, a non-equivalent control group design. Al-Saeedi et al. (2017) state that experimental approach is usually carried out when the goal is to expect future corrective or preventive changes required for the studied phenomenon. In the qualitative part, an observation checklist and semi-structured interviews were utilized to evaluate students' engagement while using the Curipod tool.

The Quantitative Method (Research Primary Method)

This research incorporates an experimental group and a control group, applying both pre- and post-test, as illustrated in Figure 2 below. The experimental group worked with the English materials deploying the AI-generative tool (Curipod) whereas the control group worked with the same materials following a conventional teaching method. The performance of both groups was compared after the intervention to gauge the impact of the AI-generative tool-based learning on the experimental group.

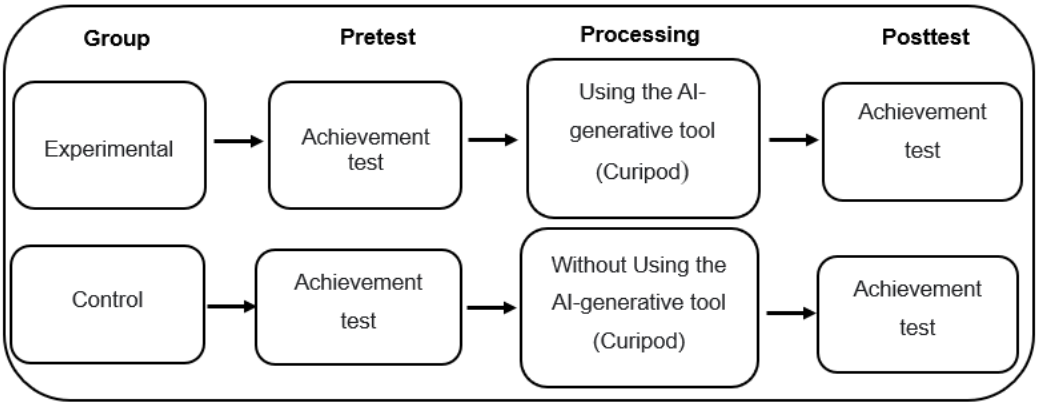

Figure 2. Experimental Design of the Study

The sample of the study includes (n=62) fourth-grade students from Al-Abrar School for Basic Education (Grades 1-4) in the Wilayat of Al Hamra. The selection of this school is based on convenience, as the researcher was available there. The research sample was split into two sections:

1. The Study's Main Sample: It involves (n=62) fourth-grade students; two fourth-grade classes (control and experimental) randomly chosen from the six classes available at the school to ensure equal representation, minimize selection bias and enhance the generalizability and validity of the study's findings. The distribution of the main study sample among the study groups is illustrated in Table (1) below.

Table 1: Distribution of the Main Study Sample to the Study Groups

No	School	Group	Teaching strategy	No. of students	Total
1.	Al-Abrar School for Basic Education (1-4)	Experimental	Using the AI-generative tool (Curipod)	30	62
2.	Al-Abrar School for Basic Education (1-4)	Control	Without using the AI-generative tool (Curipod)	32	

2. The Exploratory Sample: It contains 32 fourth-grade students from the same school, selected applying a random sampling method. The researcher administered an achievement test to these students to validate and ensure the reliability of the study instrument.

Data Collection Tools:

Achievement Test

It addresses the first research question and was prepared to meet the following requirements:

1. Determining the purpose of the test to measure the vocabulary level of the 4th-grade students in the English language.
2. Determining procedural educational objectives which were structured based on Bloom's taxonomy of cognitive domains, specifically targeting the levels of remembering, understanding and application.
3. Preparing the specification table that includes a range of factors which are: the educational objectives of the educational content, the number of questions aligned with cognitive levels (recall, comprehension, application) and the significance weight of the lessons and objectives.
4. Formulating test questions considering a number of factors such as presenting the question as a direct question or an incomplete sentence to ensure clarity, scientific accuracy, specificity and brevity. The test has ten multiple-choice questions that were designed to be straightforward and free from complexity and ambiguity.
5. Instructions for using the test are crucial for its application, so the following aspects were considered when preparing them: using clear and precise language, providing a brief overview of the test, detailing its structure and explaining the answering method.
6. Psychometric characteristics of the test include:
    - Test Validity: Content and Face validity was applied to measure the test validity. The researcher presented the achievement test to several senior English teachers and a group of female teachers at AL-Abrar school (1-4), and they evaluated the test in terms of its appropriateness for the students' level, clarity and accuracy.

- Test Reliability: To verify the consistency of the study scale, the researcher administered the test to 32 participants in a pilot group. The test has high stability as indicated by the Cronbach Alpha value of 0.78.

7. Test correction method depends on giving students a mark for the correct answer and zero for the wrong answer. The test results are used as indicators for the students' achievement in the units that the study focused on.
8. The final version of the English vocabulary test: After implementing the previous steps and considering the comments specified by the experts, the test's final draft was ready to use.

The Qualitative Method (Secondary Method):
A qualitative approach was carried out using semi-structured interviews and an observational checklist which allow the researcher to gather rich and detailed data providing valuable insights into the effectiveness of the Curipod tool to enhance fourth-grade students' English vocabulary.

Observation Checklist:
It was utilized to record the behavior and interactions of the study's participants as well as the events taking place during the English classes. The observation checklist was prepared in accordance with several studies related to students' engagement. Three instruments developed by Lee et al. (2019), Zaabanoot (2021) and Cevikbas and Kaiser (2021) were selected to determine students' engagement indicators. The final version of the checklist comprises two dimensions: emotional and cognitive engagement considered as main themes, with three indicators for each (see Table 2). For about four weeks, the observation checklist was employed to observe and record the performance of the study's sample: the Control group (n=32) and the Experimental group (n=30). Then, the data obtained was synthesized and analyzed based on the pre-existing themes and indicators stated in the checklist.

Table 2. The Observation Checklist

Engagement Dimensions	**Indicators**
Emotional	• Interest and Motivation • Perceived Usefulness • Sense of Connection and Belonging
Cognitive	• Critical Thinking and Application • Collaborative Learning • Seeking Support and Clarification

Three instructional and learning technology experts and a psychology expert from Sultan Qaboos University (SQU) reviewed the observation checklist's content and face validity and it was adjusted based on their comments. Its credibility was evaluated using Peer Debriefing as a criterion for trustworthiness. Peer debriefing is a valuable strategy with supervisors and educators identifying weaknesses and managing perceptions and biases (Guba, 1981). In this process, the researcher shared the findings of the observation checklist with supervisors and educators, and their insights and feedback were used to refine and enhance the checklist.

The observation checklist was administered by the researcher to both the experimental and control groups involved for about four weeks. Permission to record behavior was obtained from the participants and their privacy was ensured as the groups' identities were coded using letters (G1, G2).

Semi-structured Interviews:
Semi-structured interviews were employed to comprehensively understand students' engagement and this instrument was validated by three experts in the instructional and learning technology department and a psychology expert from Sultan Qaboos University (SQU). Then the questions were then modified based on their feedback. The semi-structured interview has three questions: the first two were directed to both teachers to assess students' emotional and cognitive engagement whereas the third question, concentrating on how well the tool increased student participation, was directed to the experimental group's teacher, who employed the Curipod tool in her class.

Semi-structured interviews were conducted with the two instructors responsible for teaching the experimental and control classes. Their input provided additional qualitative data as they played a significant role in implementing the Curipod tool during the study. The interviews were carried out face-to-face and typically took from 25 to 30

minutes each. The participants' permission to record the interviews was obtained to ensure their privacy and their identities were coded using the letters (T1, T2).

The trustworthiness of the interview questions aligns with the criteria for qualitative research as specified by Forero et al. (2018), specifically credibility criteria (Member check and Peer briefing). First, the interviews' findings were delivered to the participants for review and validation to confirm the accuracy and authenticity of the collected data (Member check). Then, the researcher discussed the interview process and findings with English teachers, experts in the field and supervisors to gain additional insights and perspectives (Peer briefing).

Data Analysis for Quantitative and Qualitative Data:
The study's mixed research approach involves using an achievement test (pre- and post-test), observation checklist and semi-structured interviews to collect quantitative and qualitative data. The data gathered from the pre- and post-test addresses the first research question while the information gathered from the observation checklist and interviews addresses the second research question. These two sets of data complement each other and support the conclusions drawn from the research intervention which involved using Curipod in the learning process.

The achievement test was analyzed by descriptive statistics using SPSS software, such as means and standard deviations, to address the first research question. Following the intervention, an independent sample t-test was applied to see whether there were any significant differences in the achievement test scores of the two groups, control and experimental.

Observation checklist was analyzed using deductive thematic analysis to manually evaluate the data using pre-existing themes or codes drawn from previous literature as a lens to explain data in a "top-down" approach (Ho & Limpaecher, 2024). This study emplyed pre-existing themes and codes which the researcher selected from previous studies and then modified and refined to suit the study's nature. The themes include emotional and cognitive engagement, and each one contains several indicators adapted to measure students' engagement (see Table 2). Then, data collected was categorized according to these themes and the validation was gained. Next, the checklist was administered to the target audience, and the data was documented and coded according to the pre-established themes and indicators.

The semi-structured Interviews transcripts were manually analyzed employing inductive thematic analysis. It is a "bottom-up" method that focuses on starting with the dataset as the foundation of investigating and deriving meaning (Ho & Limpaecher, 2024). Initially, the interviews were recorded, transcribed and then a script for each interview was developed. Codes were then assigned to capture the content and identify patterns and themes. The interview questions were analyzed according to the identified themes.

Research Procedures:
The school made all the necessary preparations to conduct the study providing a computer laboratory which was well-stocked with sufficient computer devices and supported by a good internet connection. Moreover, the school's administration and teachers were supportive of introducing the study and collaborated actively during its implementation. The researcher's role was to observe the classes and data collection process. The study's procedure included the following steps:

1. Reviewing previous research and works connected to the topic.
2. Selecting the suitable AI tool for the study and identifying the school, course content and class.
3. Addressing all logistic matters such as obtaining formal approval from the ILT department and the Ministry of Education.
4. Randomly assigning two classes to either the experimental group or the control group.
5. Preparing the activities and e-lessons in the Curipod educational platform for the experimental group.
6. Developing the study tools including: an English achievement test, an observation checklist and interview questions, and then validating them by experts.
7. Administering the pretest to both groups.
8. Conducting the experiment by applying the activities and content developed using the Curipod tool to the experimental group over eight weeks during the second semester of the 2023/2024 academic year.
9. Administering the posttest to the study groups.
10. Implementing the observation checklist and semi-structured interviews with the study participants.
11. Correcting and tabulating data, drawing conclusions, interpretation and discussion.
12. Formulating recommendations and suggestions according to the results of the study.

FINDINGS

The study's mixed-method approach provides comprehensive results concerning the effect of the AI-generative tool (Curipod) on fourth-grade students' English vocabulary acquisition and their classroom engagement. Regarding the first RQ, the results indicate that students who applied the Curipod tool during the learning process improved their English vocabulary more than those who did not. Table 3 shows that there was no significant difference in mean pretest scores between the control group (M =3.06; SD= 1.81) and experimental group (M= 2.57; SD= 1.57) before the intervention, (t(60)= 1.15, p>.05). The p-value is 0.26 (p>.05).

Table 3: Independent Samples T-test Results for Pre-test

Groups	n	Mean*	SD	Df	t-value	p-value
Control group	32	3.06	1.81	60	1.15	0.26
Experimental group	30	2.57	1.57			

*Total score=10

On the other hand, Table 4 demonstrates a statistically significant difference between the post-test mean scores of the experimental group (M=8.00; SD=1.76) and the control group (M=6.47; SD=1.87), (t(60) =3.32, p=0.002< .05) in favor of the experimental group.

Table 4: Independent Samples T-test Results for Post-test

Groups	*n*	Mean*	SD	Df	t-value	*p*-value
Control group	32	6.47	1.87	60	3.32	0.002
Experimental group	30	8.00	1.76			

*Total score=10

The findings for the second RQ reveal that students who utilized the Curipod tool showed a high degree of engagement in both domains (cognitive and emotional) as highlighted by the observation checklist and semi-structured interviews. Students in the experimental group exhibited higher levels of interest and motivation and perceived usefulness compared to the control group. The teacher of the experimental group stated, "*I've noticed a significant increase in students' active participation, enthusiasm, and motivation when interacting with the platform…"* They also showed high levels of attention and actively applied perceived knowledge to solve difficult questions. Conversely, students in the control group felt bored and unmotivated by the learning materials presented to them. A student from the control group said, *"We get bored with this type of activities, and it does not stimulate my motivation to learn. We want the class to be more enjoyable..."*

Furthermore, sense of connection and belonging to the learning community play a crucial role in shaping students' engagement. For instance, students who had access to Curipod worked together, shared ideas and supported each other in solving challenges. In contrast, students in the control group showed various levels of engagement as some exhibited strong sense of belonging to the learning process whereas others preferred to work alone. In the interview, the teacher of the control group confirmed that not all students demonstrate the same level of interaction in the classroom setting.

It was also noticed that the content and activities developed using the Curipod tool offered the students opportunities to apply critical thinking skills and cooperate with peers during task completion. However, in the control group, some students applied their higher order thinking skills and sought meaning from their peers when answering challenging questions while others showed difficulties in employing knowledge and hesitated to participate in group work activities.

Experimental group students actively sought help from the instructor and their peers. Their teacher confirmed, *"When engaging in collaborative content and activities, students seek help from both the instructor and their peers when they can't understand a concept taught in the class…"* This can be attributed to the atmosphere of enjoyment and enthusiasm promoted by the Curipod tool that encouraged them to seek support. On the other hand, students in the control group could not communicate with their peers and the teacher as their teacher said, *"some students may hesitate to ask their peers for help when they encounter difficulties understanding a concept taught in class. Similarly, they may not want to communicate with the instructor privately for extra assistance…"*

Overall, the observations and interviews' results clarify the quantitative outcomes of the experimental group showing notable improvement in vocabulary and that the active engagement with the content and activities enabled a deeper understanding of the content. Thus, using the Curipod tool encouraged students to actively

engage with the content and activities, apply critical thinking skills, seek clarification and communicate with their peers.

Summary of the Main Findings:
This study explores the effect of the AI-generative tool (Curipod) on improving vocabulary acquisition and increasing the engagement of Omani fourth-grade students in English classes. The main findings of this study are as follows:

- The results of the pre- and post-test propose that students using the Curipod tool during the learning process exhibited significant improvement in their English vocabulary than the group that did not apply the tool.
- Students who utilized the Curipod tool displayed high levels of engagement across all dimensions as highlighted by the observation checklist and semi-structured interviews.

DISCUSSION
Discussion of the First Research Question:
The first research question was," Are there any statistical differences in the fourth-grade students' English vocabulary between the experimental group and control group? The results indicate statistically significant differences between the experimental group's and the control group's mean scores on the post-test in favor of the experimental group. This could be attributed to the activities and content developed by the Curipod tool which created an atmosphere of excitement and enjoyment for the students. This environment motivates students to ask questions, clarify concepts and seek assistance from their teacher and peers, potentially leading to boost their academic performance.

This finding aligns with previous studies results (Liao, 2023; Oktadela et al., 2023; Qasem et al., 2023) confirming that implementing various AI tools in English vocabulary instruction has a positive impact on students' English vocabulary acquisition. The mentioned studies, discussed above in the literature section, share similarities with the current research in terms of contextual focus, application of AI tools for vocabulary enhancement and the research instruments employed. Thus, AI-generative learning platforms such as the Curipod tool can improve the students' vocabulary comprehension ability by providing an anxiety-free learning environment, a self-regulation learning process, more engagement in the target language and extensive practice.

Discussion of the Second Research Question:
The second research question was" What is the impact of the AI-generative tool (Curipod) on the engagement of Omani 4th grade students in English classes?". The findings of observation checklist and semi-structured interviews reveal a noticeable level of engagement observed across both emotional and cognitive dimensions concerning using the Curipod tool. This can be attributed to the effectiveness of the content and activities developed through the Curipod tool that stimulates students' engagement in the classroom setting.

These findings are consistent with the outcomes of several studies such as Heilporn et al. (2021) indicating that combination of well-structured courses, clear communication, digital tools and carefully selected activities can boost students' engagement in blended learning. Morris and Parker (2014) claim that instructional technology could improve student motivation, performance, connection and pleasure. Serrano et al. (2019) declare that educational technologies could have prospects for creating and distributing instructional materials which could augment student involvement in behavioral, affective and cognitive domains. Bedenlier et al. (2020) assert that technologies like blogs, mobile learning and evaluation tools encourage participation. Similarly, research by Pechenkina et al. (2017) and Eltahir et al. (2021) point out that applying games-based learning positively affect students' academic performance, motivation and engagement.

On the other hand, the findings of the observation checklist and semi-structured interviews addressing the second question contradict with the findings stated by Salta et al. (2021) and Aguilera-Hermida (2020) which identify a decline in students' emotional involvement and cognitive engagement in online learning during the COVID-19 pandemic. Furthermore, Alawamleh et al. (2020) recognize a decrease in the degree of communication in online learning between instructors and students during the pandemic. These contradictions could be explained by a number of factors. Firstly, study populations and context variations may lead to different experiences and outcomes. Secondly, methodological differences, such as the tools and measures employed for assessment, could yield contrasting results. Finally, temporal differences and evolving circumstances during the pandemic could also account for discrepancies as educational practices and student's experiences may have varied over time and across different pandemic phases.

CONCLUSION

This study intends to evaluate the effectiveness of an AI-generative tool (Curipod) in improving vocabulary acquisition and engagement of Omani 4th grade students in English classes. Data was collected using three instruments: (1) an English achievement test (Pre-Posttest), (2) an observation checklist and (3) semi-structured interviews. The findings of this study demonstrate that students in experimental group, who utilized the Curipod tool, showed a significant development in English vocabulary and displayed a higher degree of engagement in the emotional and cognitive domains compared to students in the control group. Consequently, the study concludes that AI-generative tools such as Curipod not only improve vocabulary acquisition but also create a more interactive and engaged environment.

Overall, integrating AI-generative tools, such as Curipod, holds promising potential for enhancing English language learning outcomes and promoting students' engagement among fourth-grade Omani students. Future research can benefit from this study's results as a guide for further exploration of the effectiveness of AI tools in teaching languages.

SUGGESTIONS

In consideration of the study's findings, the following suggestions are recommended:

- Educators and policymakers should explore incorporating AI-driven tools such as Curipod into English language education throughout schools in Oman. This incorporation can enhance students' vocabulary acquisition and boost overall academic accomplishments.
- Teachers should be provided with training and professional development programs to proficiently integrate AI tools into their teaching approaches. This training is crucial for educators to optimize the advantages of technology within classroom settings and promote students' engagement.
- Curriculum developers should investigate methods to integrate AI-powered educational technologies into the curriculum offering students interactive and personalized learning experiences.
- Continuous evaluation and assessment of AI tools' effectiveness in language learning contexts are crucial. Therefore, researchers should conduct longitudinal studies to gauge the long-term effects of incorporating Curipod and similar technologies on students' language proficiency and academic achievements.
- Policymakers need to allocate resources to ensure that schools have access to AI-driven educational technologies, promoting equitable access across various regions. This action aims to narrow the digital gap and ensure all students receive quality education.
- Establishing a robust team comprising researchers, educators, policymakers and technology developers is vital to effectively incorporate AI tools into education. Such teams can help develop innovative tools and strategies that benefit teachers and students.

LIMITATIONS

The main limitations of this study are as follows:

- Sample Size and Generalizability: The study's limited sample size could compromise its ability to generalize the results to a larger population, potentially making them not fully representative of all students or diverse educational contexts.
- Measurement of Engagement: The observation checklist deployed to assess the students' engagement may not fully encompass all dimensions of engagement that could influence the study's results.

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Hong Kong Students' Perception of Providing Students with Digital Learning Materials Improves Learning Experience

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Abstract
This paper explores the impact of digital learning materials on improving student learning experiences in Hong Kong after the COVID-19 pandemic. A survey of 121 respondents was conducted to study students' perceptions towards Digital Learning Materials (DLM). The Technology Acceptance Model (TAM) guided the questionnaire survey. After collecting data, it was analysed that age, gender and education level do not influence students' perception of DLM. However, grade differences in tertiary studies and other external factors strongly influence students' perceived ease of use (PEOU) and perceived usefulness (PU). Other factors among TAM were also found to influence one another.
Keywords: Digital Learning Model (DLM), Technology Acceptance Model (TAM), Hong Kong Education

1. Introduction

The rise of new teaching methods in the Hong Kong education system, such as online learning materials, has allowed students opportunities to study smoothly at home. However, many crises have been discovered, such as students' concentration, learning engagement, and understanding are different from past education. The study aims to investigate Hong Kong students' perception of providing Digital Learning Materials (DLM) and categorise them by education level, gender, age, experience and learning habits.

2. Literature Review

2.1 Digital Learning Material (DLM)

Digital Learning Material (DLM) is a digitised and designed material for educational purposes and can be accessed using a computer. It originates from the word Learning Material (LM), a material for educational purposes. DLM may include, but is not restricted to, the following contents:

1. Drill and Practice: Provides consolidation and repetition of knowledge, trains and automates skills. Can build the confidence of learners through scores and results.
2. Tutorial: Provides predefined programs for learners to build up knowledge and skills. Relates to the knowledge application method or procedure.
3. Multimedia: Contains multiple types of material composition, such as text, images, sound, video and interactivity. It can be divided into linear content, which does not require the learner to control, and non-linear content, which controls progress by learner interactivity.
4. Simulations: Model of a system. Provide operations under different variables, allow changing values and understand the impacts of variables. Reduce dangerous or time-consuming situations while maintaining high-quality simulations.
5. Educational Games: Enhance interest in teaching content and motivate learners through diversified game content.
6. Autonomous Learning: Learners are responsible for their own learning. Learners must establish and implement personal education plans and make decisions based on needs, preferences or goals. Learning attitudes are important, and are expected to learn consciously and actively.

2.2 Measure of Students' Perceptions on DLM

2.2.1 Theory of Planned Behaviour (TPB)

Theory of Planned Behaviour (TPB) is developed based on Theory of Reasoned Action (TRA) (Fishbein & Ajzen, 1975), which demonstrates the evaluation of behaviour (attitude), perception of surrounding wanting the occurrence of a behaviour (subjective norms). It positively affects the behavioural intention, the main predictor of behaviour, through a behavioural decision model by Ajzen (1991). TPB assumes that human beings are rational and systematically use information available to them. (Ajzen & Fishbein, 1980) It also includes "perceived behavioural control", an extra component that refers to people's perception of difficulty in performing behaviour of interest (Ajzen, 1991). Atkinson's Theory of Achievement Motivation (1964) also points out that expectancy of success has "incentive value" to improve the behavioural intention.

2.2.2 Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM) is proposed as an information systems theory (Davis, 1989) and a model grounded in social psychology theory and TRA. While TRA points out that beliefs influence attitudes, TAM points out that a system is a response through the reasoning of user motivations, external stimulus of the system's features and capabilities. (Davis, 1985) The original TAM includes the perceived usefulness (PU), perceived ease of use (PEOU), Behavioural Intention (BI) and Student Attitude (ATT). Studies such as Adams et al. (1992), Davis (1985, 1989), and Taylor & Todd (1995) extend the TAM to include gender and age.

2.2.3 Perceived Usefulness (PU) and Perceived Ease of Use (PEOU)

Perceived Usefulness (PU) refers to the degree to which an individual believes a particular system would enhance job performance. On the other hand, Perceived Ease of Use (PEOU) refers to the degree to which an individual believes that using a particular system would be free of physical and mental effort. (Davis, 1989) Both are important in predicting a person's behaviour, especially PEOU, which predicts innovation adoption and system usage behaviour through beliefs of the efforts required to use a system. (Davis, 1985)

2.2.4 Technology Factors (TF)

Technology Factors (TF) represent student satisfaction with technology and the information quality of DLM. It includes the interface and system characteristics to assess the system's ability to address the business needs and the degree to which technology meets performance. (Dishaw & Strong, 1999; Delone & McLean, 2003; Wixom & Todd, 2005; Seddon, 1997) It emphasizes learning distinct knowledge and new technologies of computers and networks, with digital tools to promote the ability to use information technology. (Shin et al., 2011) High quality also improves users' ability to use technology, resulting in convenience and a boost in performance.

2.2.5 Student Factors (SF)

Student Factors (SF) refers to the technology experience satisfaction and eagerness to use it. Breckler and Wiggins (1991) defined attitude as "acquiring and enduring non-verbal features of the social and physical world through experience, exerting a direct influence on behaviours". Students' attitudes, such as eagerness and satisfaction, are based on experience and can trigger a positive perception of systems' value. (Baki et al., 2018) It also suggests that the enjoyable experience of the platform will influence the students. (Zhou et al., 2022)

2.2.6 Teacher Factors (TeacherF)

Teachers' attitudes towards DLM influence students' satisfaction through timely response, assistance to encourage continued learning when facing problems or trouble. (Arbaugh, 2002; Thurmond et al., 2002) The instructor also plays a significant role in explaining knowledge and theories in DLM through appropriate instructional media. Their ideas will be transmitted with optimization results. (Yang et al., 2014) Hong et al. (2021) also showed that teachers are more inclined toward education technology. Therefore, the attitudes towards DLM can be an important measurement indicator.

2.3 Research Hypotheses

The following hypotheses are presented to demonstrate the relationships between different variables as guided by frameworks and designs:

2.3.1 Gender Difference

Research indicates that males are more likely to be more advanced, capable and interested in handling high-level ICT skills or computer-related activities than females. (Broos, 2005; Dumont et al, 2010; Arnseth, 2006) As males are more confident in using computers than females (Keller, 2010), males are more likely to believe that they can handle DLM more easily than females (PEOU), leading them to have a greater chance of performing better than females (PU).

H1: PU of DLM is different between genders
H2: PEOU of DLM is different between genders

2.3.2 Age Difference
Age is an important demographic variable in behavioural intention, adoption and acceptance of technology (Chung et al, 2010; Porter & Donthu, 2006; King & He, 2006). It is believed that senior students have more experience in using technology, thus influencing their ability to learn a new software application (Morris & Venkatesh, 2000).
H3: Age has a positive effect on PU of DLM
H4: Age has a positive effect on PEOU of DLM

2.3.3 Education Level Difference
Education level affects the relationship between main determinants and behavioural intention (Burton-Jones & Hubona, 2006). It affects the individual's knowledge and skill, thus affecting the behavioural beliefs (PU and PEOU) towards acceptance and usage of new technologies (Rogers, 2003; Agrawal & Prasad, 1999).
H5: Education level has a positive effect on PU of DLM
H6: Education level has a positive effect on PEOU of DLM
H7: Higher grade in tertiary education has a positive effect on PU of DLM
H8: Higher grade in tertiary education has a positive effect on PEOU of DLM

2.3.4 Technology Factors (TF)
As mentioned on 2.2.4, the system or information quality addresses the business needs of higher technology quality to improve students' work performance (Dishaw & Strong, 1999; Delone & McLean, 2003; Wixom & Todd, 2005; Seddon, 1997).
H9: TF has a positive effect on PU of DLM
H10: TF has a positive effect on PEOU of DLM

2.3.5 Student Factors (SF)
Satisfaction with experience and eagerness to use technology enhances confidence and creates a positive attitude in using DLM. It relieves stress and eases the process of using DLM.
H11: SF has a positive effect on PU of DLM
H12: SF has a positive effect on PEOU of DLM

2.3.6 Teacher Factors (TeacherF)
Teachers having a positive attitude toward DLM will provide more assistance to students, reducing students' perceived difficulty in using DLM.
H13: TeacherF has a positive effect on PU of DLM
H14: TeacherF has a positive effect on PEOU of DLM

2.3.7 TAM Variables
TAM, which serves as a baseline model to guide the study, shows the relationship between PU, PEOU, BI and ATT. It is considered the most influential and commonly employed theory for describing an individual's acceptance of information. As explained in 2.2.3, PU and PEOU refer to different degrees of student beliefs. PEOU is believed to show a statistically positive effect on PU. (Han & Sa, 2021) BI refers to the actual use of DLM, thus determining DLM acceptance, while ATT refers to students' attitude toward DLM usage. Higher PEOU influences student thoughts on DLM, increases efficiency and saves time in student perceivedness, thus enhancing student engagement with DLM. Beliefs about system-enhancing job performance allow the activeness of DLM usage. It also persuades students to put in effort, affecting PEOU.
H15: PEOU has a positive effect on PU of DLM
H16: PEOU has a positive effect on ATT of DLM
H17: PU has a positive effect on ATT of DLM
H18: PU has a positive effect on BI of DLM
H19: ATT has a positive effect on BI of DLM

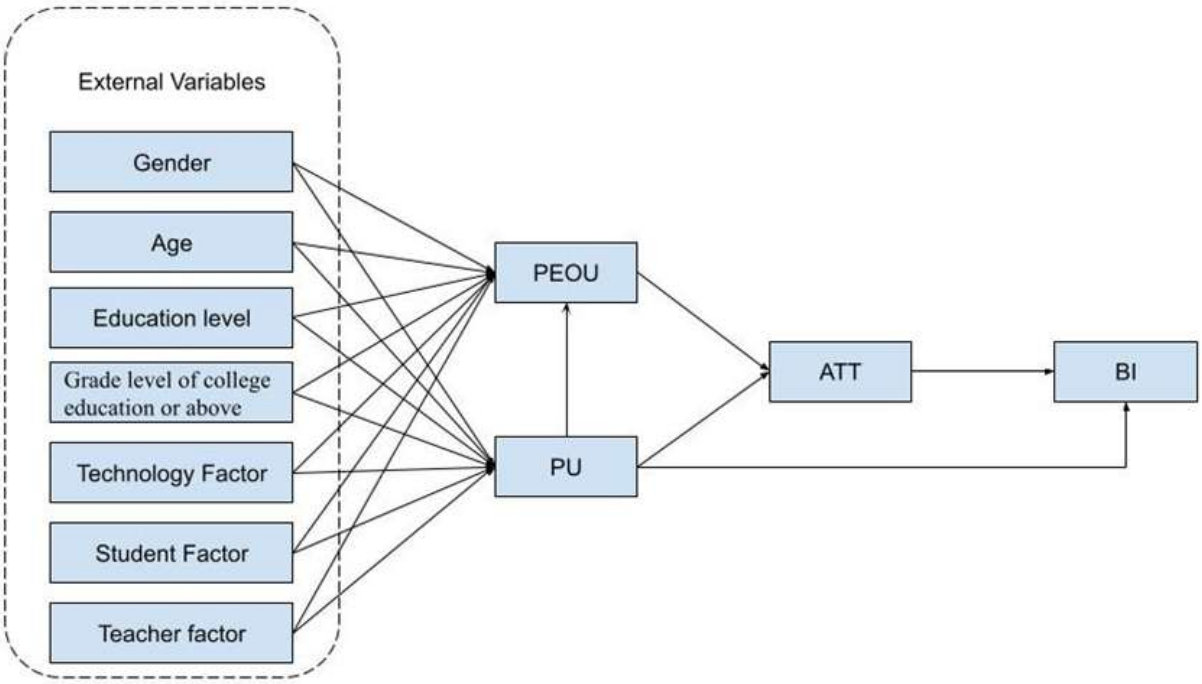


Fig 2.3.7: Research Model of Students' Perception in DLM in Hong Kong

3. Methodology

3.1 Research Design

Data is collected through Web Questionnaire Surveys to evaluate Hong Kong students' perception of providing DLM. The survey is based on a large first-year Health Science course (Daniel & Bird, 2019), which collects data on interviewees' digital content, teaching methods, and students' participation in content, peers and lecturers. This method allows extensive data collection in a short period of time for analysis. The questionnaire is distributed and collected from different respondents through the Internet.

The study consists of 5 main stages:

1. Planning – Identify the target population
2. Sampling – Determine the study sample of the target population
3. Questionnaire Survey Design – Design and develop the questionnaire survey
4. Questionnaire Survey Distribution – Distribute the survey, then collect the results and administer the survey
5. Data Analysis – Use the collected survey data to conduct an analysis and report the results

3.2 Advantages and Disadvantages of Web Questionnaire Surveys

Web Questionnaire Surveys have advantages over other data-collection methods, such as interviews (Bowling, 2002; Denscombe, 2003). It allows the researcher to:

1. Collect large and diverse data by reaching various individuals, including hard-to-reach samples. Collected data can be categorised by interests, attitudes, beliefs and values.
2. Protect both the researcher's and participants' personal safety as the research is conducted during the COVID-19 pandemic.
3. Increase anonymity, especially when raising sensitive issues, which increases data reliability and respondents' sense of security.
4. Reduce time to collect data from respondents.
5. Provide participants with flexibility, such as the venue and time period, when filling out the questionnaire.
6. Reducing the cost of paper, printing and postage.

However, there are also disadvantages to Web Questionnaire Surveys. The following addressed them with overcoming methods:

1. Lack of interactivity compared to face-to-face or telephone surveys, as it is based on textual questions. No immediate responses from the researcher to the respondents led to different respondents having

different interpretations of the same question, making the results subjective due to misunderstanding or confusion of the questions. Simple wording and questions are used to overcome such problems.
2. Unable to observe facial expressions, body language or tone of voice, resulting in losing valuable data such as emotions and other subtle features. To overcome such problems, Likert scale questions are used to collect emotion data through a scale from “absolutely agree” to "absolutely disagree”, providing a larger scope for trend analysis.

3.3 Questionnaire Survey Design

The questionnaire survey is split into 3 parts:

1. Respondent Characteristics – Inquire personal information such as education level, gender, age and usage of DLM in their course. It allows researchers to understand and distinguish situations or control factors.
2. Student Habits in DLM – Collect and compare DLM habits of different respondents, including the number and time of DLM usage and the type of LM provided in the course.
3. Students’ Perceptions and Behaviours of DLM – Collect TF, SF, TeacherF, PU, PEOU and BI using the Likert scale.

3.3 Distribution and Collection of Web Questionnaire Surveys

In the early stages of the research, 10 copies were distributed to peers and colleagues for feedback and opinions, such as word choice and design perception. It also serves as a proofreading process and a test run of the operational flow. Since the process is smooth, the research extended the sample to Hong Kong students from different academic qualifications and colleges through snowball sampling. The questionnaire survey was also distributed through social media such as Facebook, Instagram and X to prevent the echo chamber effect and eliminate the issue of paid survey participants. As the survey was not conducted for community purposes, the response rate achieved 85.21% with 142 questionnaires distributed.

3.4 Data Preparation and Analysis

Data management is conducted to check if the questionnaire is answered thoroughly and suitable to be used as an analysis sample. To ease the process, raw data was imported into Excel to facilitate data analysis. After data management, the Statistical Package for Social Science (SPSS) is used to analyse the data and the relationship between different causes. The following are the data analysed:

1. Data Validity – The degree to which the questionnaire surveys can measure the intended purpose through factor loading and item-total correlations between items.
2. Data Reliability – The consistency of the measure (questionnaire) represented by Cronbach’s Alpha (α). Calculated through the number of items and the average cross-correlation between items. Acceptable value is 0.7 (Fornell & Lacker, 1981)
3. Factor Analysis – The degree of the relationship between different groups of questions refers to factors, such as situation and IQ. Acceptable value is above 0.3 (Fornell & Lacker, 1981)
4. Independent-samples T-test – Comparing means of two independent data groups to determine the difference in related population means
5. One-way ANOVA – Use for determining the difference between the means of 3 or more independent groups
6. One-sample T Test – Use for comparing the variable mean and a hypothetical value to determine whether there is a relationship between two different variables (Allen, 2017)

3.5 Validation of Measurement Scale

3.5.1 Factor Analysis

The extractions of items during the factor loading of the measurement scale are above 0.3, while the corrected item-total correlation of the measurements is also bigger than 0.3. This indicates that all questionnaire items are sufficiently related to a given factor. Therefore, the data were reliable, and the items had a significant variance for factor analysis.

3.5.2 Component Analysis

Table 1: Component Analysis for Factors

Construct	Components Extracted	Variance Explained, % (Component 1, Component 2)
Technology Factors (TF)	1	50.888
Student Factors (SF)	1	49.760
Perceived Usefulness (PU)	1	68.907
Perceived Ease of Use (PEOU)	1	69.361
Attitude (ATT)	1	59.109
Behavioural Intention (BI)	1	56.856
Teacher Factors (TeacherF)	2	49.743, 18.706

Principal Component Analysis (PCA) validated the survey's measurements by identifying underlying components for each construct. A component is extracted from TF (50.89%), SF (49.76%), PU (68.91%), PEOU (69.36%), ATT (59.11%), and BI (56.86%). Two components are extracted from TeacherF (49.74% and 18.71% variance). Component 1 was prioritized as having higher variance explained, confirming scale suitability for future analysis.

3.5.3 Reliability Analysis

Table 2: Reliability Statistics for Factors

Item	Cronbach's Alpha	N of Items	Notes
Technology Factor (TF)	.839	7	All correlations > 0.3
Student Factor (SF)	.849	8	All correlations > 0.3
Perceived Usefulness (PU)	.885	5	All correlations > 0.3
Perceived Ease of Use (PEOU)	.887	5	All correlations > 0.3
Attitude (ATT)	.856	6	All correlations > 0.3
Behavioural Intention (BI)	.743	4	All correlations > 0.3
Teacher Factor (TeacherF)	.792	6	All correlations > 0.3

All factors have their Cronbach's Alpha higher than the acceptable value of 0.7 (Fornell & Lacker, 1981).

4. Analysis & Discussion

Data analysis is conducted based on 3.4, which follows the steps below:

1. Expound information and divide into subgroups based on part 1 in 3.3
2. Introduce descriptive statistics of the scale and summarized according to different factors
3. Conduct a sample t-test to compare the gender, education level and prior experience.
4. Conduct the one-way ANOVA to compare the gender and education level.
5. Analyse the Pearson correlation among factors
6. Discussion

4.1 Demographic Information

A total of 121 respondents answered 8 multiple-choice questions. All of the respondents indicated that they studied an education program in Hong Kong, and 99.2% of them indicated that their course had provided DLM. The following diagrams were the demographic background of the respondents:

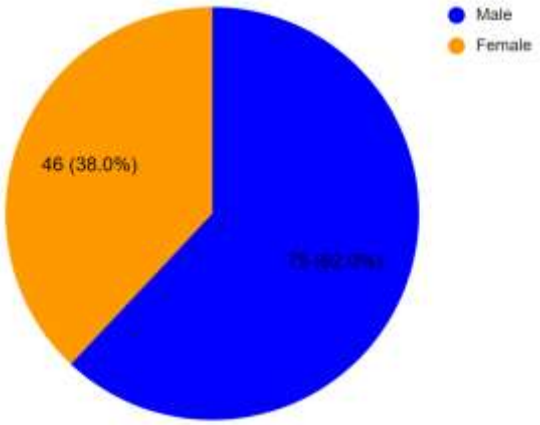


Figure 1: Respondents' Gender Distribution

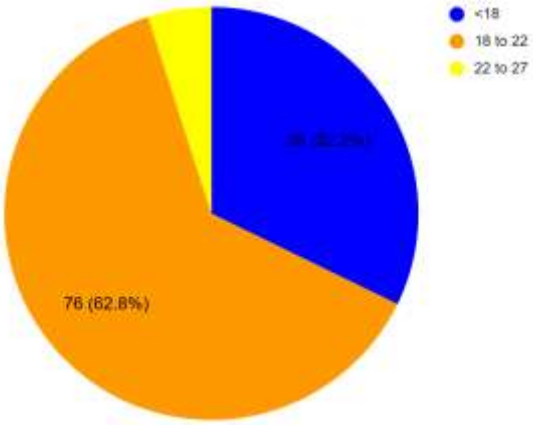


Figure 2: Respondents' Age Distribution

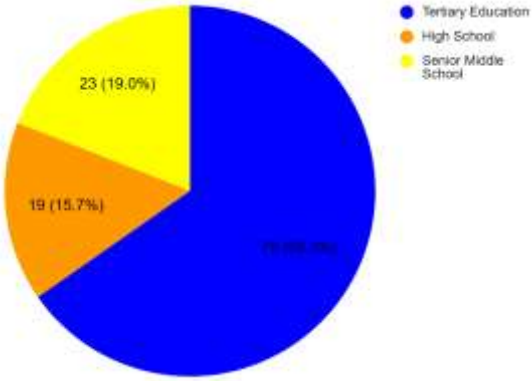


Figure 3: Respondents' Education Level Distribution

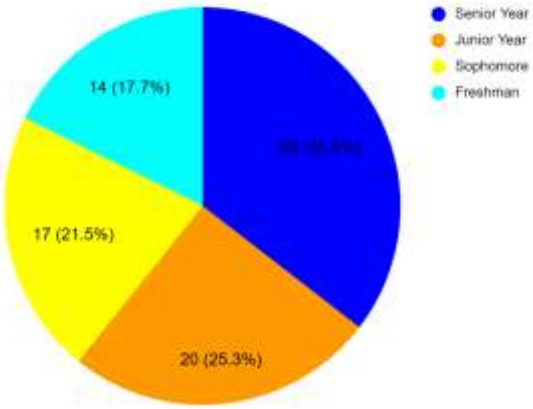


Figure 4: Tertiary Studies Distribution

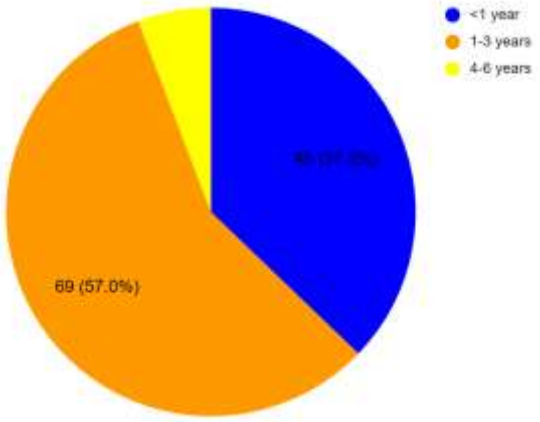


Figure 5: Respondents' Experience in using DLM

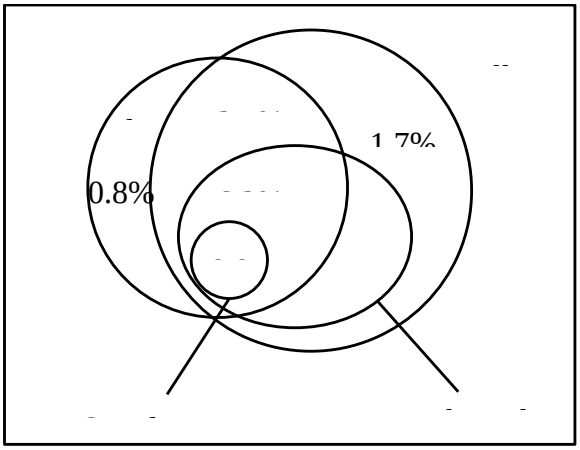


Figure 6: Venn Diagram of LM type

4.2 Descriptive Statistics

A total of 41 Likert scales (Questions 9 to 49) were provided. (1= absolutely disagree to 5= absolutely agree).

4.2.1 Technology Factors (TF)

From questions 9 to 15, TF was measured with a mean of 4.0850. This shows that respondents have a positive response to this factor, believing that DLM contains good technology and information quality. Among the questions, respondents highly identified that DLM helped record key points and make notes, as it has the highest mean.

4.2.2 Student Factors (SF)
From questions 16 to 23, SF was measured with a mean of 3.8523. This shows that respondents have a positive response to this factor, agreeing that they are satisfied and eager to use DLM. Among the questions, respondents felt DLM helped them in preparing lessons as it had the highest mean.

4.2.3 Perceived Usefulness (PU)
From questions 24 to 28, PU was measured with a mean of 4.0033. This shows that respondents have a positive response to this factor, presenting the belief that DLM enhanced respondents' performance. Among the questions, most respondents agreed that DLM enhanced their effectiveness in learning, as it had the highest mean.

4.2.4 Perceived Ease of Use (PEOU)
From questions 29 to 33, PEOU was measured with a mean of 4.2496. This shows that respondents have a positive response to this factor, being confident that DLM would be free from effort. Among the questions, respondents indicate that it is easy when learning to use technologies in DLM, as it has the highest mean.

4.2.5 Attitude (ATT)
From questions 34 to 39, ATT was measured with a mean of 4.0510. This shows that respondents have a positive response to this factor. Among the questions, most said that DLM has a positive impact on learning awareness, as it has the highest mean.

4.2.6 Behavioural Intention (BI)
From questions 40 to 43, BI was measured with a mean of 3.9318. This shows that respondents have a positive response to this factor, indicating that respondents are most likely using DLM. Among the questions, most respondents think that Hong Kong education should develop DLM as it has the highest mean.

4.2.7 Teacher Factors (TeacherF)
From questions 44 to 49, TeacherF was measured with a mean of 4.0000. This shows that respondents have a positive response to this factor, indicating that teachers use DLM in a good way. Among the questions, most respondents revealed that teachers will accept opinions when encountering difficulties in DLM, as it has the highest mean.

4.3 Independent Samples T-test
To find statistical significance, an independent samples T-test was used to compare related observations. It consists of 2 parts in the study:

1. Levene's Test for Equality of Variances – an inferential statistic used to assess whether the variances of two or more variables are equal. A p-value is observed (<0.05), and the null hypothesis is rejected as the probability of obtaining sample variances was low.
2. t-test for Equality of Means – Determine whether two different populations' means are equal. If the significance is less than or equal to 0.05, there is a significant difference between the two means.

4.3.1 Comparison of PU of DLM between Genders
Based on the items in 4.3, the values are 0.566 and 0.116, each value greater than 0.05. This indicates that the probability of obtaining differences in sample variances was high, and there is no significant difference in PU between different genders. Based on the results, hypothesis **H1: PU of DLM is different between genders** is rejected.

4.3.2 Comparison of PEOU of DLM between Genders
Based on the items in 4.3, the values are 0.451 and 0.122, each value greater than 0.05. This indicates that the probability of obtaining differences in sample variances was high, and there is no significant difference in PU between different genders. Based on the results, the hypothesis **H2: PEOU of DLM is different between genders** is rejected.

4.4 One-way ANOVA
Although one-way ANOVA cannot show which specific groups were statistically different, it is used to determine the significant difference between the means of two or more independent groups. If the p-value is less than 0.5, there is a significant difference in the mean of different groups, which will then require a follow-up by a post hoc test. The post hoc test is conducted to confirm where the differences occurred between groups. If the p-value of the post hoc test was less than 0.5, there is a significant difference between the two groups.

4.4.1 Comparison of Students' PU between Ages

The significance level of ANOVA was 0.105, representing no significant difference in PU of DLM for different age groups. All the age groups in the post hoc test have a significant level greater than 0.05, indicating that there is no significant difference in mean between age groups. The descriptive statistics also indicate no significant difference between age groups, concluding that there is no significant difference in different ages, considering the degree of improvement in work performance while using DLM. Based on the results, the hypothesis **H3: Age has a positive effect on PU of DLM** is rejected.

4.4.2 Comparison of Students' PEOU between Ages

The significance level of ANOVA was 0.336, representing no significant difference in PEOU of DLM for different age groups. All the age groups in the post hoc test have a significant level greater than 0.05, indicating that there is no significant difference in mean between age groups. The descriptive statistics also indicate no significant difference between age groups, concluding that there is no significant difference in different ages, considering the ease of using DLM. Based on the results, the hypothesis **H4: Age has a positive effect on PEOU of DLM** is rejected.

4.4.3 Comparison of Students' PU between Education Level

The significance level of ANOVA was 0.075, representing no significant difference in PU of DLM for different education levels. All the groups in the post hoc test have a significant level greater than 0.05, indicating that there is no significant difference in mean between groups. The descriptive statistics also indicate no significant difference between education levels, concluding that there is no significant difference between different education levels, considering the degree of improvement in work performance while using DLM. Based on the results, the hypothesis **H5: Education level has a positive effect on PU of DLM** is rejected.

4.4.4 Comparison of Students' PEOU between Education Level

The significance level of ANOVA was 0.966, representing no significant difference in PEOU of DLM for different education levels. All the groups in the post hoc test have a significant level greater than 0.05, indicating that there is no significant difference in mean between groups. The descriptive statistics also indicate no significant difference between education levels, concluding that there is no significant difference between different education levels, considering the ease of using DLM. Based on the results, the hypothesis **H6: Education level has a positive effect on PEOU of DLM** is rejected.

4.4.5 Comparison of Students' PU between Grades of Tertiary Studies

The significance level of ANOVA was 0.008, meaning that there is a significant difference in PU of DLM between grades of tertiary studies. In the post hoc test, Year 1 and Year 4 have a significant level of 0.004, less than 0.05, indicating that there is a significant difference between them. The descriptive statistics show that the means of each grade are 3.5000, 3.9529, 4.0300 and 4.1929, bringing in a conclusion that there is an increase in values when grades increase, considering the degree of improvement in work performance while using DLM. Based on the results, the hypothesis **H7: Higher grades in tertiary education have a positive effect on PU of DLM** is supported.

4.4.6 Comparison of Students' PEOU between Grades of Tertiary Studies

The significance level of ANOVA was 0.043, meaning that there is a significant difference in PEOU of DLM between grades of tertiary studies. In the post hoc test, Year 1 and Year 4 have a significant level of 0.023, less than 0.05, indicating that there is a significant difference between them. The descriptive statistics show that the means of each grade are 3.9143, 4.2706, 4.2500 and 4.4143, bringing in a conclusion that there is an increase in values when grades increase, considering the ease while using DLM. Based on the results, the hypothesis **H8: Higher grades in tertiary education have a positive effect on PEOU of DLM** is supported.

4.5 Pearson Correlation among Motivational Components

Bivariate Pearson correlation analysis measures the strength and direction of the linear relationship between pairs of continuous variables. The values of the Pearson correlation coefficient show that the linear association between two variables lies in the range(r) of -1 to 1, with the sign indicating the direction of the relationship. Positive correlation (+) indicates the second variable increases linearly with the first variable, while negative correlation (-) shows a decreasing correlation. Value is 0 when representing that there is no relationship between, while closer to -1 or 1 represents a stronger correlation. The r values of 0.10, 0.30 and 0.50 demarcate small, medium and large effects, respectively. (Cohen, 1988) If the significance (2-Tailed) value of the Bivariate correlation analysis is smaller than or equal to 0.05, it means that there is a significant difference between two different variables.

4.5.1 Relationship between TF and PU
The Pearson correlation between TF and PU was +0.847, and the significant correlation lies at the 0.01 level (2-tailed). The value presents a strong positive linear relationship between TF and PU. Based on the results, the hypothesis **H9: TF has a positive effect on PU of DLM** is supported.

4.5.2 Relationship between TF and PEOU
The Pearson correlation between TF and PEOU was +0.614, and the significant correlation lies at the 0.01 level (2-tailed). The value presents a strong positive linear relationship between TF and PEOU. Based on the results, the hypothesis **H10: TF has a positive effect on PEOU of DLM** is supported.

4.5.3 Relationship between SF and PU
The Pearson correlation between SF and PU was +0.796, and the significant correlation lies at the 0.01 level (2-tailed). The value presents a strong positive linear relationship between SF and PU. Based on the results, the hypothesis **H11: SF has a positive effect on PU of DLM** is supported.

4.5.4 Relationship between SF and PEOU
The Pearson correlation between SF and PEOU was +0.645, and the significant correlation lies at the 0.01 level (2-tailed). The value presents a strong positive linear relationship between SF and PEOU. Based on the results, the hypothesis **H12: SF has a positive effect on PEOU of DLM** is supported.

4.5.5 Relationship between TeacherF and PU
The Pearson correlation between TeacherF and PU was +0.652, and the significant correlation lies at the 0.01 level (2-tailed). The value presents a strong positive linear relationship between TeacherF and PU. Based on the results, the hypothesis **H13: TeacherF has a positive effect on PU of DLM** is supported.

4.5.6 Relationship between TeacherF and PEOU
The Pearson correlation between TeacherF and PEOU was +0.572, and the significant correlation lies at the 0.01 level (2-tailed). The value presents a strong positive linear relationship between TeacherF and PEOU. Based on the results, the hypothesis **H14: TeacherF has a positive effect on PEOU of DLM** is supported.

4.5.7 Relationship between PEOU and PU
The Pearson correlation between PEOU and PU was +0.745, and the significant correlation lies at the 0.01 level (2-tailed). The value presents a strong positive linear relationship between PEOU and PU. Based on the results, the hypothesis **H15: PEOU has a positive effect on PU of DLM** is supported.

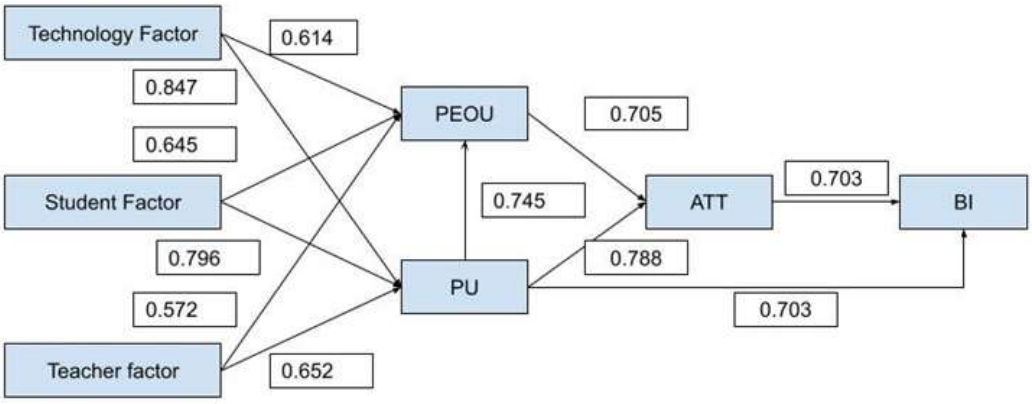
4.5.8 Relationship between PEOU and ATT
The Pearson correlation between PEOU and ATT was +0.705, and the significant correlation lies at the 0.01 level (2-tailed). The value presents a strong positive linear relationship between PEOU and ATT. Based on the results, the hypothesis **H16: PEOU has a positive effect on ATT of DLM** is supported.

4.5.9 Relationship between PU and ATT
The Pearson correlation between PU and ATT was +0.788, and the significant correlation lies at the 0.01 level (2-tailed). The value presents a strong positive linear relationship between PU and ATT. Based on the results, the hypothesis **H17: PU has a positive effect on ATT of DLM** is supported.

4.5.10 Relationship between PU and BI
The Pearson correlation between PU and BI was +0.703, and the significant correlation lies at the 0.01 level (2-tailed). The value presents a strong positive linear relationship between PU and BI. Based on the results, the hypothesis **H18: PU has a positive effect on BI of DLM** is supported.

4.5.11 Relationship between ATT and BI
The Pearson correlation between ATT and BI was +0.703, and the significant correlation lies at the 0.01 level (2-tailed). The value presents a strong positive linear relationship between ATT and BI. Based on the results, the hypothesis **H19: ATT has a positive effect on BI of DLM** is supported.

4.5.12 Results of Relationships among TAM Components



4.6 Discussion

The questionnaire, which aims to investigate Hong Kong students' perception of providing DLM, follows the TAM components and different factors. The data is used to analyse the impact of TAM components, personal characteristics and other factors on students' perceptions of using DLM. The following sections will discuss the overall components of TAM and the interaction between different personal characteristics and TAM factors. Lastly, the discussion will end by discussing the relationship between different factors.

4.6.1 Discussion of Overall TAM Components

Based on section 4.2, the mean value for descriptive statistics of each factor was higher than 3 (NEUTRAL), representing the perspective of students in DLM. The following values represent the mean and standard deviation of the descriptive statistics, followed by an explanation

1. TF – 4.0850 and 0.47329. Students were satisfied with the technology and information quality of DLM.
2. SF – 3.8523 and 0.56504. Students were satisfied with their experience and eager to use DLM. This includes the technology experience, satisfaction, concentration and psychology of respondents. Students perceived that they had significant experience using DLM.
3. TeacherF – 4.0000 and 0.49488. Students were satisfied with the DLM that their teacher used. This includes the attitudes, beliefs, tolerance and training of teachers using DLM.

In TAM, there are also 3 components:

1. PU – 4.0033 and 0.62396. Respondents had a high PU and predicted ATT, both directly and indirectly, towards people's intentions. (Davis, 1989)
2. PEOU – 4.2496 and 0.52299. Respondents believe that using DLM will be free of effort. (Davis, 1989) PEOU will affect ATT.
3. ATT – 4.0510 and 0.53309. Represents the attitude of students using DLM and has a strong relationship with BI.
4. BI – 3.9318 and 0.53619. Respondents have a high intention to use DLM.

The technology and information quality of DLM were high and made students more willing to use DLM. It improves students' learning effectiveness, such as the layout of FLM, which was clear and can enhance user experience, thus affecting PU and PEOU. The attitude and method of teachers using DLM improve PU and PEOU. Lastly, PU and PEOU will affect ATT, while ATT will affect BI.

4.6.2 Discussion of Gender Difference in DLM

The hypothesis **H1: PU of DLM is different between genders** is rejected, thus showing no significant difference in PU between genders. Previous research has pointed out that men and women have different levels of self-confidence and motivations in science and technology. The stereotypical view of different genders using technology was "relative to male users, female users might have more negative attitudes towards technology and technology use." (Canada & Brusca, 1991) The result, however, shows that male and female users had a close thought for PU of DLM. Since there are legal regulations in Hong Kong that ensure education and resources are received equally between men and women, both genders are able to experience the same learning method, which includes technology implementations. This has deeply affected women's attitude towards DLM, especially the younger generations. (Buccheri et. al., 2011)

The hypothesis **H2: PEOU of DLM is different between genders** is rejected, thus showing no significant difference in PEOU between genders. Previous research has pointed out that "female users report less positive

attitudes and self-efficacy towards ICT than male users." (Sølvberg, 2003; Volman et al., 2005; OECD, 2005; Lynch, 2007; Tømte & Hatlevik, 2011) However, the results show that male users and female users had a close thought for PEOU of DLM. This proves that female students are getting more confident in using advanced computer skills, such as computer applications, and are actively catching up with the belief that using a specific system does not require effort. (Naciri, 2016)

4.6.3 Discussion of Age & Education Level Difference in using DLM

The study finds that age and education level do not significantly affect PU or PEOU of DLM. This is supported by One-way ANOVA results, which show no statistically significant differences across age groups or education levels. The lack of significant differences can be attributed to the widespread exposure to technology among Hong Kong's new generation, who have grown up with smartphones and ICT.

1. Age Groups – Respondents from different age groups perceive DLM as helpful in enhancing job performance and easy to use. Thus, the hypotheses **H3: Age has a positive effect on PU of DLM** and **H4: Age has a positive effect on PEOU of DLM** were rejected.
2. Education Levels – Despite differences in the duration of DLM use, students across education levels show high PEOU due to their familiarity with ICT. The hypotheses **H5: Education level has a positive effect on PU of DLM** and **H6: Education level has a positive effect on PEOU of DLM** were rejected.

This supports the finding (Kubiatko, 2013) that where the popularity of electronic technology products increases, as most of the new generation students have been exposed to electronic technology since their childhood. They considered that the majority of internet-related items are commonplace and do not have problems with their use. This also rejects the findings of Alenezi (2023), where the author describes that students from higher education are affected the most in digital transformation.

4.6.4 Discussion of Grade Differences in Tertiary Studies

Grade level within tertiary studies shows a statistically significant difference in both PU and PEOU of DLM, as per One-way ANOVA results. Higher-grade students report higher PU, indicating they believe DLM enhances their work performance more than lower-grade students. This is likely due to greater exposure and experience with DLM in university settings. Higher-grade students also report higher PEOU, finding DLM easier to use. This is attributed to their advanced ICT literacy, including skills in information management, analysis, and evaluation. As universities in Hong Kong extensively use DLM, students in higher grades have more experience, enabling them to relate new information to prior knowledge (Lustbader, 1998). This supports the hypotheses **H7: Higher grade in tertiary education has a positive effect on PU of DLM** and **H8: Higher grade in tertiary education has a positive effect on PEOU of DLM**.

4.6.5 Discussion of TF

TF, which encompasses technology and information quality, positively affect PU and PEOU. High-quality DLM systems with simple interfaces and clear layouts enhance ease of use and usefulness, supporting prior studies. (Fathema & Sutton, 2013; Park et al., 2012) Thus, it supports the hypotheses **H9: TF has a positive effect on PU of DLM** and **H10: TF has a positive effect on PEOU of DLM**. This is similar to students agreeing that media-related abilities help them utilise digital technologies, which will improve their digital learning. (Sayaf et. al., 2022)

4.6.6 Discussion of SF

SF, including technology experience, satisfaction, concentration, and psychological pressure, positively correlate with PU and PEOU. Students with higher SF perceive DLM as more useful and easier to use, supporting the hypotheses **H11: SF has a positive effect on PU of DLM** and **H12: SF has a positive effect on PEOU of DLM.** (Baki et al., 2018)

4.6.7 Discussion of TeacherF

TeacherF, including satisfaction with teaching methods and teacher attitude, positively influence PU and PEOU. Effective teacher-student interactions via DLM reduce distractions and improve learning effectiveness. Therefore, it supports the hypotheses **H13: TeacherF has a positive effect on PU of DLM** and **H14: TeacherF has a positive effect on PEOU of DLM**. This supports the idea that teachers may require continuous professional development and training in digital learning materials. (Camilleri & Camilleri, 2016)

4.6.8 Discussion Between PEOU and PU

PEOU positively affects PU, as easier-to-use systems are perceived as more useful, aligning with Expectation Confirmation Theory. (Oliver, 1980) Thus, hypothesis **H15: PEOU has a positive effect on PU of DLM** is

supported. This also supports the study by Cho and Hung (2009), which shows the relationship between PEOU and PU in e-learning.

4.6.9 Discussion of PEOU and PU on ATT

Both PEOU and PU positively influence students' attitudes toward DLM. Higher PEOU reduces effort, and higher PU improves performance, leading to favorable attitudes. (Šumak et al., 2011; Alfadda & Mahdi, 2021) Thus, hypotheses **H16: PEOU has a positive effect on ATT of DLM** and **H17: PU has a positive effect on ATT of DLM** were supported.

4.6.10 Discussion of PU and ATT on BI

PU and ATT positively affect BI. Students are more likely to use DLM if they perceive it as applicable and have a positive attitude, consistent with TAM (Davis, 1989; Ajzen & Fishbein, 1980). Thus, hypotheses **H18: PU has a positive effect on BI of DLM** and **H19: ATT has a positive effect on BI of DLM** were supported.

5. Conclusion & Suggestions

The study results are shown in the following table:

Hypotheses	**Result**
H1: PU of DLM is different between genders	*Rejected*
H2: PEOU of DLM is different between genders	*Rejected*
H3: Age has a positive effect on PU of DLM	*Rejected*
H4: Age has a positive effect on PEOU of DLM	*Rejected*
H5: Education level has a positive effect on PU of DLM	*Rejected*
H6: Education level has a positive effect on PEOU of DLM	*Rejected*
H7: Higher grade in tertiary education has a positive effect on PU of DLM	*Supported*
H8: Higher grade in tertiary education has a positive effect on PEOU of DLM	*Supported*
H9: TF has a positive effect on PU of DLM	*Supported*
H10: TF has a positive effect on PEOU of DLM	*Supported*
H11: SF has a positive effect on PU of DLM	*Supported*
H12: SF has a positive effect on PEOU of DLM	*Supported*
H13: TeacherF has a positive effect on PU of DLM	*Supported*
H14: TeacherF has a positive effect on PEOU of DLM	*Supported*
H15: PEOU has a positive effect on PU of DLM	*Supported*
H16: PEOU has a positive effect on ATT of DLM	*Supported*
H17: PU has a positive effect on ATT of DLM	*Supported*
H18: PU has a positive effect on BI of DLM	*Supported*
H19: ATT has a positive effect on BI of DLM	*Supported*

Table 5.0 Results of the Hypotheses

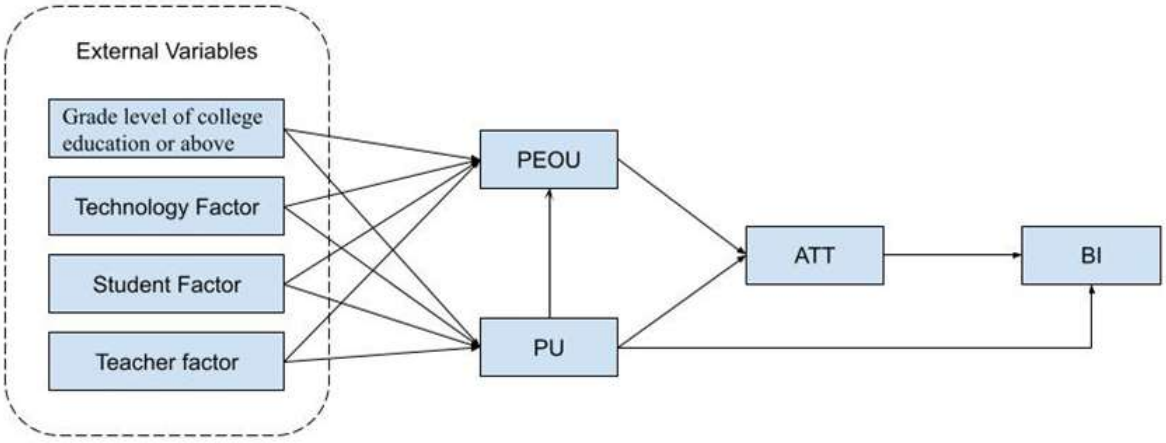


Fig 5.0: General Extended Technology Acceptance Model of Hong Kong Students' Perception in DLM

The results show that Hong Kong students believe that DLM is easy to use and serves as an effective role in the education system. This implies that Hong Kong students prefer DLM to be included in their syllabus after the materials are assessed with the external variables above. Students also believe that if the education system is valuable and easy to cope with, they will be more likely to study and revise. Thus, DLM can be a useful milestone to boost students' urge of learning.

5.1 Suggestion

After collecting data, it was found that TF, SF and TeacherF were the main external variables influencing the student acceptance and intention to use DLM. Thus, the following are suggestions based on the factors:

1. TF represents the technology and information quality of DLM. Improving the system interface to make it easier to understand, helping students to record key points and make notes, improves their PEOU and PU.
2. SF represents the technology experience, satisfaction, concentration and psychological pressure of respondents. Schools can set a transition period for students to adapt to DLM and accumulate experience in using DLM, increasing their satisfaction.
3. TeacherF represents the students' satisfaction with the teachers' method with DLM and teacher attitude. Teachers and institutions can set up a scoring and feedback system, allowing students to reflect on their ideas of DLM. Teachers can then improve their DLM methods by responding to or solving students' difficulties in using DLM.

5.2 Limitations of the Study

There were 2 main limitations of this study:

1. Time limitation – As the research is conducted during the COVID-19 pandemic, most schools have already implemented online teaching, making it challenging to collect data. Thus, only 121 responses were collected. More data will be needed to improve accuracy.
2. Small and uneven distribution of data samples – Small data collection affects the study's representativeness. In addition, the groups are not evenly represented in terms of gender and age. There were also no representatives beyond the age of 27.

5.3 Future Research

After the study, 2 recommendations were suggested for future research:

1. The study focuses on students from secondary school to the tertiary level. However, it was believed to have a greater impact in primary school and early education as it requires more activities and interaction. Future research is advised to focus on this direction. As they lack the ability to complete the questionnaires, it is advisable to collect data through interviews and researcher test assistance, thus requiring more research time.
2. Future research is advised to investigate the influence of subjects towards DLM. The LM for science and liberal arts may be different, as science involves numerical formulations while liberal arts involves vocabulary. Thus, significant differences may be observed in future studies.

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The Development of Blended Teaching Using Learning Platform in College English Education Under the Influence of AI

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ABSTRACT
The objectives of this research were to: 1) develop blended teaching using a learning platforms in college English education under the influence of AI to have quality, 2) compare the blended teaching using a learning platform in college English education under the influence of AI, and 3) study the satisfaction of students who study blended teaching using learning platforms in college English education under the influence of AI.
The study sample consisted of 35 students selected by purposive sampling from Class 2, in the academic year 2024, majoring in clinical medicine at Inner Mongolia Medical University, China. They are students enrolled in blended teaching using online learning platforms in college English education. The instruments included 1) the Xuexitong Online Learning Platform, 2) a Textbook, 3) an evaluation form regarding the quality of media and content, 4) an achievement assessment (pre-test and post-test), and 5) the Questionnaire on Students' Satisfaction form. Statistics used for data analysis were mean, standard deviation, and a t-test for dependent samples.
The results showed that: 1) the blended teaching using learning platform in college English education under influence of AI as having good quality in term of media, with an average score of 4.47, and excellent quality in term of content, with an average score of 4.73; 2) students who learned the blended teaching using learning platform in college English education under influence of AI as reflected in an average pre-test score of 39.00 points and a higher average post-test score of 87.00 points. This increase in scores from pre-test to post-test was statistically significant at the .05 level; and 3) students were highly satisfied with the blended teaching using learning platform in college English education under influence of AI, with an average satisfaction score of 4.87, representing the highest level of satisfaction.
Keywords: Blended Teaching, Online Learning Platform, College English Education, AI

INTRODUCTION
Background and Statement of the Problem
In higher education, artificial intelligence (AI) is driving transformative change by enabling personalized and adaptive learning experiences, streamlining administrative tasks, and generating data-driven insights. These capabilities make AI a pivotal component in blended teaching—a model that integrates face-to-face and online instruction to enhance flexibility, address limitations of fully online formats (such as delayed feedback and low engagement), and optimize educational outcomes. With the continued evolution of AI, its integration into blended learning is expected to grow in scope and impact. In China, this trend is reinforced by the "Guidelines for College English Instruction (2020 Edition)," which advocate the deep integration of information technology and AI into English teaching to foster individualized and independent learning. As a result, blended learning, supported by intelligent technologies, is positioned to become a principal instructional model in modern higher education.

However, the current state of college English education still faces significant challenges. Currently, the overall design of college English presents a relatively old and single form, lacking distinctive features and failing to meet students' diverse needs. Traditional teaching methods prevail, with teachers positioned at the center and students relegated to passive roles. This dynamic often leads to a lack of motivation, autonomy, and innovative thinking among learners. At the same time, affected by the uneven distribution of educational resources, students in some colleges cannot get high-quality teaching resources, which will lead to uneven education results. The rapid development of information technology has provided rich online teaching resources for college English teaching, but there is still a problem of low efficiency in the use of online resources in daily teaching. Many teachers don not understand the importance and do not have the ability to use online resources for college

English teaching design; in addition, students' English learning outside the classroom is mostly fragmented learning, and they cannot use online resources to build their own English knowledge system efficiently.

To solve these problems, some universities have begun to try to build an AI-enhanced blended teaching model for college English education, aiming to break the limitations of time and space, optimize the allocation of educational resources, and improve the quality and effect of college English teaching. The introduction of an online and offline blended teaching model in college English education can not only reshape the professional role of teachers, but also allow teachers to return to small online classrooms, campuses, and social classrooms.

Research Objectives

The objectives of this research were to: 1) develop blended teaching using a learning platforms in college English education under the influence of AI to have quality, 2) compare the blended teaching using a learning platform in college English education under the influence of AI, and 3) study the satisfaction of students who study blended teaching using learning platforms in college English education under the influence of AI.

Research Questions and Hypothesis

1) Students who study with blended teaching using learning platform in college English education under the influence of AI can increase their academic achievement.
2) Students who study with blended teaching using learning platform in college English education under the influence of AI can improve their learning satisfaction.

LITERATURE REVIEW

Blended learning

It integrates online and traditional classroom teaching, is a key direction for educational reform, providing flexible and personalized learning opportunities. It combines the advantages of both environments through diverse pedagogical approaches and technologies, implemented across activity, course, program, and institutional levels (Caner, 2010). This model offers significant benefits, including flexibility, rich resources, adaptive technologies, and interactive tools that enhance engagement and improve outcomes (Sharma et al., 2022). In the context of college English teaching, blended learning aligns with China's Guidelines (2020) and supports personalized, dynamic curriculum systems (Wang et al., 2018). Its application, characterized by freedom, technology, and interactivity, improves English proficiency and autonomous learning ability, as evidenced in practical implementations theme activities (Gan et al., 2021).

Online learning platforms

Online learning platforms have become integral to modern education, significantly enhancing English language learning by providing realistic communication environments and diverse resources such as videos, audios, and interactive software. These platforms support diverse, flexible, and autonomous learning, emphasizing resource sharing and personalization, helping improve instructional efficiency and student engagement (Chen, 2020). Though existing platforms still face challenges that may affect learning experience and resource integration (Lu, 2019), online learning platforms continue to evolve, supporting more adaptive and collaborative foreign language education.

Artificial intelligence (AI)

AI is driving a transformative shift in education and prompting global strategic initiatives (Dai et al., 2020). Current AI applications in education include intelligent platforms for personalized learning, AI-assisted teaching tools, smart evaluation systems, VR/AR immersive experiences, and interactive robots (Knox, 2020). Dong (2024) further proposes a structured application model for AI in educational contexts. Within English language teaching, AI technologies—supported by big data, cloud computing, and speech recognition—enable personalized and adaptive learning experiences. These tools address individual differences and enhance efficiency through smart classrooms and real-time feedback (Mushthoza et al., 2023).

College English education

From traditional Grammar Translation and Audio-lingual methods to more contemporary Communicative and Task-Based Language Teaching (TBLT) approaches, integrating multiple methods to suit diverse learner needs and contexts is advocated increasingly (Ellis et al., 2020). However, significant challenges persist, including outdated teacher-centered practices, limited proficiency among instructors, large class sizes, and insufficient resources. Students often lack motivation and real-world English use opportunities, while varying proficiency levels complicate instruction. The integration of technology, though beneficial, introduces distractions and may hinder deep, collaborative learning (Krishnan et al., 2020). Research in China emphasizes that successful digital

transformation depends on platform diversity, teacher readiness, and improved interaction models to foster student participation and problem-solving skills (Li & Yang, 2022).

Assessment and evaluation in blended learning

Assessment and evaluation in blended learning focus on course outcomes, learner satisfaction, and student engagement, integrating multidimensional metrics such as academic performance, retention rates, and qualitative feedback (Berzosa et al., 2017). AI is increasingly applied to enhance assessment efficiency and personalization. Furthermore, AI enables personalized feedback and adaptive learning support by analyzing individual progress and providing real-time interventions (Maier & Klotz, 2022). Predictive analytics help identify at-risk students through patterns in behavior and performance, enabling early support to improve retention and outcomes (Alam & Mohanty, 2022).

Technology acceptance and adoption in education

Technology acceptance and adoption are influenced by a range of theoretical models and contextual factors. Key theories include the Technology Acceptance Model (TAM), which emphasizes perceived usefulness and ease of use, and the expanded TAM2 incorporating social influence and cognitive processes. The Combined TAM-TPB model integrates social norms and control beliefs, while the Motivational Model (MM) highlights intrinsic and extrinsic drivers of adoption (Ursavaş, 2022). Social Cognitive Theory (SCT) underscores the role of self-efficacy and observational learning. For students, key factors include perceived utility, intrinsic motivation, peer influence, and access to reliable infrastructure (Khan et al., 2021). Additionally, socio-cultural context and external policy pressures further affect integration efforts. The ADDIE model provides a systematic framework for designing and implementing technology-enhanced instruction, emphasizing analysis, design, development, implementation, and evaluation in an iterative cycle to align with learner and institutional needs. Successful adoption thus depends on addressing both individual beliefs and broader environmental conditions.

Academic achievement

Academic achievement reflects the attainment of educational goals through measures like grades and test scores, is shaped by cognitive, motivational, and instructional factors. Key influences include student motivation, self-regulation, and effective learning strategies (Schunk et al., 2020). In college English education, achievement is assessed through reading, writing, listening, and speaking competencies, increasingly supported by blended and AI-enhanced platforms that enable continuous assessment and personalized feedback (Zou et al., 2021). Critical factors specific to English learning include student engagement, self-regulated learning, technological proficiency, and peer interaction, all of which are facilitated by digital tools and collaborative activities (He et al., 2021). The integration of AI and blended learning provides adaptive, real-time support, helping improve language outcomes by targeting individual learning needs.

Student satisfaction

It is defined as the fulfillment of students' expectations and needs within the educational experience, is a key indicator linked to engagement and academic success. It is commonly assessed through surveys evaluating instruction quality, resource relevance, and support effectiveness (Hew et al., 2020). In technology-enhanced environments—particularly in college English education—satisfaction is significantly influenced by platform usability, real-time feedback, and AI-driven personalization (Al-Fraihat et al., 2020). Key factors for enhancing satisfaction include quality instructor-student interaction supported by timely feedback, user-friendly and accessible learning platforms with diverse multimedia resources, and adaptive AI systems that tailor content to individual needs (Zou et al., 2021). Additionally, peer collaboration through discussions and group activities further enriches the learning experience and boosts satisfaction in language acquisition contexts.

RESEARCH METHODOLOGY

Research Design

This study employs a quantitative, one-group pretest-posttest design to examine the impact of AI-influenced blended teaching via Xuexitong platform on first-year undergraduates in a College English course. Data in numerical form were collected through tests, with structure as follows: a pretest (O_1) was administered, followed by the intervention (X)—implementation of blended teaching using the online platform—and concluded with a post- test (O_2) to measure achievement.

Group: O1 X O2

O1 = Measurement of the pretest score

X = Blended Teaching Using Online Learning Platform in College English Education under the Influence of AI

O2 = Measurement of the achievement of the post-test score

Population and Sample

The study population consisted of 420 first-year Clinical Medicine majors from twelve classes at Inner Mongolia Medical University in the 2024 academic year. Using purposive sampling, a sample of 35 students from Class 2 was selected, all of whom were enrolled in the blended College English course delivered via an online learning platform.

Research Instrument

The research instruments employed in this study on the implementation of blended teaching using the Xuexitong online learning platform in College English education under the influence of AI were carefully selected and developed to ensure comprehensive data collection and validity. The primary tools included the Xuexitong platform itself, the prescribed textbook, a structured framework for online course development and evaluation, achievement assessments, and a student satisfaction questionnaire.

Xuexitong Online Learning Platform

Xuexitong served as the core technological medium for this study. It is a multifunctional online learning platform accessible via mobile, tablet, and computer terminals, supporting a blended learning approach by integrating abundant teaching resources and enabling bidirectional teacher-student communication. Key features utilized included notifications, sign-ins, grouping, discussions, assignments, and data analytics, which facilitated interactive and personalized learning. The platform's ability to host diverse learning materials—such as texts, images, and videos—and support autonomous learning activities like resource searches and course discussions was central to the intervention. Moreover, its data recording and analysis capabilities allowed for timely teaching adjustments and personalized instruction.

Evaluation Form Regarding the Quality of Media and Content Instruments Development and Evaluation

The development and validation of the online course followed a rigorous process grounded in the ADDIE instructional design model (Analysis, Design, Development, Implementation, Evaluation). The course was structured around six core elements: instructional design, teaching resources, learning activities, technical support, learning support, and evaluation/feedback. Course objectives were formulated across three dimensions—knowledge, ability, and educational goals—tailored to unit-specific content. Teaching resources included multimedia materials, real-life case studies, interactive exercises, and AI-enhanced tools for personalized learning paths and automated feedback. Course evaluation involved multi-method assessment: learning analytics from platform usage data, knowledge-based unit and final exams, practical application tasks, student feedback surveys, and comparative analysis with traditional teaching outcomes. Validity was assured through expert reviews using an Item Objective Congruence (IOC) index, with a criterion of IOC > 0.5 for acceptance.

Achievement Assessment (Pretest and Post-test)

The achievement assessment consisted of parallel pretest and post-test instruments, each comprising 20 multiple-choice questions designed to evaluate knowledge and skills acquired during the course. The tests underwent expert validation to ensure congruence with learning objectives (IOC > 0.5), and were piloted to establish psychometric quality—targeting a difficulty index (P) between 0.2–0.8, a discrimination index (D) of at least 0.2, and high reliability (KR-20 ≥ 0.8).

The Questionnaire on Students' Satisfaction Form

A structured questionnaire was developed to measure student satisfaction with the blended learning experience. It contained a closed-ended section using a five-point Likert scale (from 1 = Very Poor to 5 = Highest) to quantify perceptions of course quality, platform usability, and learning support, and an open-ended section for qualitative feedback. The instrument was validated by experts for content appropriateness and objective congruence (IOC > 0.5), and responses were interpreted using defined ranges for mean scores.

DATA COLLECTION AND ANALYSIS

Data Collection

The data collection process involved 35 first-year clinical medicine students who registered for and participated in a one-semester College English online course. Prior to the intervention, a pretest was administered to assess initial proficiency. Following the completion of the online course activities, a post-test was conducted under the same conditions. Both sets of scores were collected for subsequent statistical comparison to evaluate the impact of the blended learning intervention on academic performance.

Data Analysis

Data analysis employed mean differences, standard deviations, and t-tests. Three content and three media experts evaluated the online course materials using mean and standard deviation metrics to assess quality and usability. Pretest and post-test scores were compared via t-test to identify significant differences in student performance and determine the effectiveness of the course. Additionally, student satisfaction with the AI-supported blended learning approach was analyzed using descriptive statistics (mean and standard deviation) to gauge perceived efficiency and acceptance.

RESEARCH RESULT

Results of evaluation of blended teaching using a learning platform in college English education under the influence of AI to have quality.

Table 1 The blended teaching using a learning platform in college English education under the influence of AI to have quality from three media experts.

Item	$\bar{X}$	SD.	Meaning
1. Are the facts, statistics and information accurate and reliable? Are they supported by reliable sources and evidence-based research?	4.33	0.58	Good
2. Is the information presented clearly and simply? Is it easy to understand and explain, even for those without a background in blended teaching?	4.33	0.58	Good
3. How visually appealing is it? Does it use color, images, and graphics effectively to attract attention and convey information?	4.67	0.58	Excellent
4. Does it provide a fully presentation of the blended teaching's influence on students?	4.33	1.15	Good
5. Is it tailored to the target students? Does it take into account the age, interests and background of the target students?	4.67	0.58	Excellent
6. Are there any interactive elements or features in the media that engage the learners and enhance the learning experience?	4.67	0.58	Excellent
7. Does it always maintain consistency of information and reinforce key knowledge and objectives?	4.33	0.58	Good
8. Is it accessible to people with different disabilities, such as the visually impaired? Are there other formats or amenities available?	4.33	0.58	Good
9. Does it include a clear call to action or practical steps that students can take to improve their English skills?	4.33	1.15	Good
10. Is it original and creative and stand out from other similar media? Does it use unique design elements or innovative approaches to convey the knowledge?	4.67	0.58	Excellent
Total	**4.47**	**0.49**	**Good**

Form table 1 , the blended teaching using learning platform in college English education under influence of AI as having good quality in term of media, with an average score of 4.47.

Table 2 The blended teaching using a learning platform in college English education under the influence of AI has quality from three content experts.

Item	$\bar{X}$	SD.	Meaning
1. Does the teaching content adequately develop students' listening skills in English?	4.33	0.58	Good
2. Does the teaching content provide opportunities for students to practice speaking in English?	4.67	0.58	Excellent
3. Does the teaching content include sufficient materials to enhance students' reading comprehension skills?	5.00	0.00	Excellent
4. Does the teaching content effectively guide students in improving their writing skills in English?	4.33	0.58	Good
5. Does the teaching content focus on improving students' ability to translate between English and their native language?	5.00	0.00	Excellent
6. Does the teaching content adequately cover vocabulary learning, including word usage and context?	5.00	0.00	Excellent
7. Does the teaching content provide clear instruction on sentence structure and grammar rules?	5.00	0.00	Excellent
8. Does the teaching content include materials or activities that help students understand cultural differences in cross-cultural	4.67	0.58	Excellent

communication?			
9. Does the teaching content encourage students to apply English grammar rules in practical communication scenarios?	4.33	0.58	Good
10. Does the teaching content include idiomatic expressions or phrasal verbs to support students' understanding of natural English usage?	5.00	0.00	Excellent
Total	**4.73**	**0.29**	**Excellent**

Form table 2 , the blended teaching using learning platform in college English education under influence of AI as having good quality in term of content, with an average score of 4.73.

Results of comparing students' knowledge of blended teaching using a learning platform in college English education under the influence of AI.

Table 3 Compares students' knowledge of blended teaching using a learning platform in college English education under the influence of AI.

Items	n	Total	$\bar{X}$	SD.	t-test	Sig. (2-tailed)
Pre-test	35	100	39.00	17.22	4.44	0.00
Post-test	35	100	87.00	14.13		

**p< .05

Form table 3, students who learned the blended teaching using learning platform in college English education under influence of AI as reflected in an average pre-test score of 39.00 points and a higher average post-test score of 87.00 points. This increase in scores from pre-test to post-test was statistically significant at the .05 level.

Results of the study satisfaction of students who study blended teaching using a learning platform in college English education under the influence of AI.

Table 4 The satisfaction of students who study blended teaching using a learning platform in college English education under the influence of AI

Option	$\bar{X}$	SD.	Meaning
1. The overall effect of the blended teaching mode in College English is satisfactory.	4.91	0.40	Highest
2. The combination of AI and the Xuexitong platform in teaching is helpful for understanding the content of "Advanced College English Comprehensive Course 2".	4.89	0.40	Highest
3. The teaching resources (such as e-books, videos, exercises) on the Xuexitong platform for Unit 1 "Working Holiday Abroad", Unit 2 "Consumption" and Unit 3 "Cultural Difference" meet my needs.	4.94	0.23	Highest
4. The Xuexitong platform can effectively promote interaction and communication in the process of blended teaching.	4.94	0.23	Highest
5. I actively use AI-assisted learning functions (such as intelligent tutoring, speech correction) on the Xuexitong platform.	4.94	0.23	Highest
6. I am satisfied with the teacher's teaching guidance and feedback in the blended teaching mode.	4.91	0.37	Highest
7. The blended teaching mode has improved my English learning ability and performance.	4.94	0.23	Highest
8. The difficulty level of the course content in the blended teaching of these three units is appropriate.	4.94	0.23	Highest
9. I am willing to continue to use the blended teaching mode with the Xuexitong platform and AI assistance in the future.	4.94	0.23	Highest
10. The blended teaching mode using the Xuexitong platform and AI in College English is consistent with my learning expectations.	4.94	0.23	Highest
Total	**4.87**	**0.35**	Highest

Form table 4, students were highly satisfied with the blended teaching using learning platform in college English education under influence of AI, with an average satisfaction score of 4.87, representing the highest level of

satisfaction.

CONCLUSION AND DISCUSSIONS

Conclusion

1) The blended teaching using learning platform in college English education under influence of AI as having good quality in term of media, with an average score of 4.47, and excellent quality in term of content, with an average score of 4.73;
2) Students who learned the blended teaching using learning platform in college English education under influence of AI as reflected in an average pre-test score of 39.00 points and a higher average post-test score of 87.00 points. This increase in scores from pre-test to post-test was statistically significant at the .05 level;
3) Students were highly satisfied with the blended teaching using learning platform in college English education under influence of AI, with an average satisfaction score of 4.87, representing the highest level of satisfaction.

Discussions

1) This research confirms the high efficacy of blended teaching using learning platform in college English education under influence of AI, as evidenced by substantial expert evaluations (average ratings >4.4) and significant student progress (scores rising from 39 to 87). The platform excelled in visual design, interactivity, and content quality, effectively fostering English proficiency development. These findings are consistent with the findings of Jiang et al. (2021), who reported similar advantages of blended teaching in English listening, and Wang (2023), who emphasized AI's contribution in enabling personalized and efficient learning.
2) Expert Evaluations and student outcomes indicate that the platform's strengths in visual appeal, interactivity, and AI-driven features (e.g., intelligent tutoring and speech correction) significantly enhanced engagement and academic performance. These findings resonate with Syakur et al. (2020), who emphasized the significance of multimedia and interactive components, and with Wang (2021) and Jiang et al. (2021), who demonstrated substantial improvements in oral and comprehensive English skills through blended and AI-supported methods.
3) Student satisfaction with the blended learning was exceptionally high (average score 4.87), reflecting strong approval of its content, interactivity, and AI features. This in agreement with Wang (2021), who found that AI assistance increased motivation and engagement, and with Yang et al. (2022), who emphasized the importance of well-designed learning environments. Collectively, the results emphasize that thoughtful technology integration and user experience design are vital in improving student satisfaction and learning effectiveness.

RECOMMENDATIONS

To enhance the platform, it is recommended to incorporate innovative and interactive elements such as gamification and virtual reality to improve students' engagement. Instructional content ought to be strengthened with a greater focus on grammar, vocabulary, and cultural contextualization, and updated frequently based on language teaching research. Teaching strategies should be refined through ongoing feedback to develop personalized learning pathways. For future research, the emphasis should be on developing systematic evaluation mechanisms to track outcomes and satisfaction, as well as identifying best practices to support broader adoption through inter-institutional collaboration.

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The Unseen Observer: The Psychology of Silent Following in Social Media Culture

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ABSTRACT
The digital age has created a new social arena in which identity and existence are defined through visibility. Social media platforms offer individuals opportunities for recognition and validation, yet they also foster a vast population of users who choose to remain silent. The phenomenon known as lurking describes users who observe online content without active participation. Behind this seemingly passive behavior lies a complex web of psychological, social, and cultural dynamics: curiosity, fear of exclusion, social comparison, the pressure of visibility, and the need for privacy are among the central motives shaping it. This study examines the phenomenon of silent following through three theoretical lenses: Eva Illouz's notion of emotional capitalism, Vamık Volkan's theory of large-group identity, and Byung-Chul Han's critique of the transparency society. These perspectives reveal that digital interactions are not purely technological but also deeply emotional and ideological in nature. The silent observer stands at the intersection of desire and restraint - simultaneously a watcher and the watched, a participant who communicates through absence rather than presence. The primary aim of this paper is to demonstrate that silent following should not be regarded as a lack of communication but as an alternative communicative strategy. In an environment saturated with exposure, silence becomes a form of agency - a subtle expression of control, resistance, and emotional self-preservation. Ultimately, the culture of silent following redefines what it means to "exist" online, suggesting that invisibility can be as powerful and communicatively meaningful as visibility itself.
Keywords: social media, lurking, digital identity, emotional capitalism, visibility culture, privacy, communication

1. INTRODUCTION

The digital age has radically transformed how people communicate, build relationships, and construct identity. Individuals today do not simply speak or write to express themselves - they make their existence visible. Social media has become the stage upon which people present their curated selves. Every photo, comment, and shared story forms part of a personal narrative. Yet beneath this flood of visibility lies a vast field of silence: the quiet observers who exist within digital interaction by watching rather than acting.

This study begins with an inquiry into the communicative and psychological significance of that invisible crowd. In the digital realm, existence is no longer confined to exchanges of information, conversation, or visibility; observation, watching, and silence have also become forms of being. The silent follower is a quiet yet omniscient figure on the social stage - both observer and participant, simultaneously inside and outside. This paradoxical position introduces a new tension into modern digital identity: Can I exist without being seen? Psychologically, silent following satisfies both curiosity and self-protection. Individuals gather knowledge about their social surroundings while preserving emotional boundaries. In this way, they sustain social bonds without surrendering their privacy. From a sociological standpoint, this behavior represents a micro-resistance to the culture of visibility. Even when people resist the imperative to "be visible, share, participate," they do not step outside the system; paradoxically, they become part of its most visible structure.

The communicative importance of silent following lies precisely here: in a world obsessed with visibility, invisibility is no longer a lack of communication but an alternative strategy of it. To observe can sometimes speak louder than to comment. Silence may also be seen as a form of digital minimalism - a way of managing emotional energy without sacrificing it to social expectation. Accordingly, this study approaches the phenomenon through three analytical dimensions: psychological (inner motives and emotional strategies), sociocultural (its relation to visibility economies, digital surveillance, and belonging), and ethical (the moral weight of silence). It asks: What psychological needs does silent following fulfill? Can online silence be understood as a new form of social belonging? Does it represent resistance to visibility culture or submission to emotional capitalism?

These questions illuminate the communication paradox of the digital era: while visibility is celebrated as freedom, invisibility has become a form of protection. As Byung-Chul Han notes, “In a transparent society, everything is visible, yet nothing is truly seen.” Under this tyranny of transparency, silent followers use invisibility as their shield.

The study thus treats silent following not merely as a personal choice but as a cultural symptom. Just as people once showed reverence for knowledge by reading quietly in libraries, today they secure their presence by moving silently within digital crowds. This silence is not isolation - it may be a way of restoring balance in an overwhelmingly noisy world. Ultimately, the silent follower reflects both the structure of social media and the condition of modern humanity: a figure who connects without speaking, exists without appearing, and communicates through silence.

2. THEORETICAL FRAMEWORK

2.1. Emotional Capitalism and Silent Following

Eva Illouz (2007) argues that in contemporary societies emotions are regulated by economic and cultural values - a condition she calls emotional capitalism. People no longer circulate only ideas but also their emotional experiences within a market logic. Social media amplifies this process: likes, comments, reposts, and view counts serve as the commodified indicators of feeling.

Within this context, silent following appears to stand outside emotional exchange, yet it is deeply embedded within it. The silent follower, who observes without liking or commenting, is the invisible consumer of emotional economy. Their passivity often functions as a strategy to maintain emotional distance or as a reflex of self-protection from overexposure. As Illouz points out, emotions are no longer “free”; they are governed by cultural codes and digital metrics. Silent following, therefore, can be seen as a micro-form of resistance - existence without emotional display.

2.2. Group Identity and Belonging through Observation

Vamık Volkan’s theory of large-group identity posits that individuals define themselves not only by personal traits but also by emotional attachment to collective entities. Social media has become one of the most dynamic arenas for the formation of these identities. Even without visible engagement, silent followers remain emotionally connected to the groups they observe. By following, they symbolically join.

To follow a political figure, a social movement, or a cultural influencer often means participating without participating. Volkan suggests that such individuals share in the group’s emotional boundaries. Silent following thus constitutes a digital form of belonging based on emotional identification rather than visible interaction. It provides both psychological safety and a sense of inclusion—though this participation remains unseen.

2.3. The Transparency Society and the Power of Invisibility

Byung-Chul Han (2012) argues that contemporary life is dominated by an ideology of transparency. While transparency promises freedom, it actually creates a regime of surveillance in which individuals are constantly observed and measured. Social media is the epicenter of this regime. In a world where everything is shareable and quantifiable, silence becomes an act of existential sabotage.

Silent following, in this sense, is an invisibility strategy against the cult of transparency. Han (2012) argues that compelled self-exposure can erode the subject rather than secure recognition. The silent follower, conversely, sustains existence through quietude. This paradox introduces a new ethical tension in digital life: in a world where visibility no longer guarantees authenticity, silence becomes the last form of autonomy.

At the intersection of these three theoretical approaches, silent following emerges not merely as an individual act but as a cultural symptom. People now communicate through observation and shape their identities through silence.

3. ANALYSIS AND DISCUSSION

3.1. Psychological Dynamics: Curiosity, Comparison, and Emotional Safety

The main emotions driving silent following arise from the tension between the desire to be seen and the need to remain unseen. Curiosity is its core impulse - people collect information about others’ lives to recalibrate their own sense of self. Social psychology calls this social comparison (Festinger, 1954). By observing others, the silent follower unconsciously reconstructs identity. The decision to watch rather than participate often serves as a strategy to preserve emotional safety. This recalls Freud’s notion of libidinal energy conservation: rather than

investing emotional energy outwardly, the individual turns it inward. Silent following, therefore, is not passive but deliberate - an act of self-preservation disguised as withdrawal.

3.2. Sociocultural Dimension: Digital Surveillance and New Forms of Belonging

Social media operates like a digital version of Michel Foucault's panopticon: everyone observes everyone, yet no one knows exactly who is observing whom. Constant visibility compels self-regulation. Silent followers move in the shadows of this panoptic system - unseen prisoners who nonetheless belong to it.

This condition transforms the meaning of belonging. In traditional communities, belonging required active participation; in the digital world, observation-based participation has become a new identity form. By continuously monitoring a group's content, individuals may feel emotionally part of it without engaging directly. This behavior echoes Volkan's concept of emotional investment. Silent following becomes the invisible extension of collective affect.

3.3. Ethical Tension: Visibility, Privacy, and Digital Conscience

Silent following rests on an ethical paradox. On one hand, it expresses the human right to privacy - the right to observe without being forced to interact. On the other hand, constant observation produces asymmetric power relations within digital communication. The invisible follower inadvertently becomes a subject of surveillance - the reverse face of Han's (2012) a coercive transparency regime. While everyone is expected to be visible, some reclaim power through silence.

The ethical dilemma can be phrased as follows: Can I exist without being seen, or is visibility a prerequisite for existence? In the digital age, visibility is no longer a right but an obligation. Silent following becomes an unconscious rebellion against that obligation - an attempt to preserve digital conscience through invisibility.

3.4. The New Language of Silence: Communication through Absence

In the age of transparency, silence is often mistaken for a lack of communication, yet it is anything but. Silence speaks. Anthropologist Edward T. Hall (1976) emphasized that in many cultures, nonverbal signals convey meaning more effectively than speech. Silent following functions as a form of nonverbal communication. Even without reacting or commenting, one's act of observation signals presence. This quiet engagement may express implicit agreement, empathy, or emotional distance.

Such silent communication weaves an invisible social network - millions of users following one another without uttering a word. This does not merely signify existential loneliness; it may represent a new form of collective quietude. The deepest dialogues of the digital age, perhaps, are those conducted without words.

3.5. Educational Technology and Online Learning: Lurking as Vicarious Participation

While "silent following" is typically discussed in relation to social media, the same logic operates in educational technology environments: learning management systems, online discussion boards, MOOCs, and professional learning networks. In these spaces, observation is often a legitimate entry point into participation rather than a deficit. Bandura's social learning theory emphasizes that people learn not only by doing but by observing models and anticipating social consequences; online settings amplify that mechanism because the costs of "speaking" can be permanent, searchable, and publicly judged. (Bandura, 1977).

From the perspective of communities of practice, this observational stance resembles legitimate peripheral participation: newcomers belong by watching the norms of a group, gradually moving toward fuller participation as competence and trust grow. (Lave & Wenger, 1991). In this sense, "lurking" can be reframed as an apprenticeship of discourse, not disengagement. However, educational platforms also introduce a specific pressure that consumer social media does not: participation is frequently assessed. When visibility becomes a grading criterion, silence can be misread as failure rather than a temporary learning strategy. This misreading disproportionately affects learners with language anxiety, first-generation academic trajectories, or previous experiences of public shaming in digital spaces.

Accordingly, a direct implication for educational technology is to distinguish between non-participation and low-visibility participation. Reading, revisiting materials, and tracking peer exchange may represent meaningful cognitive and affective engagement even when the learner does not post. Course design and learning analytics that treat "no posts" as "no learning" risk misclassifying a significant category of students and reproducing inequities for those who learn through observation.

3.6. Applied Platform Examples: Instagram, TikTok, and X

To concretize the argument, consider three brief platform-level vignettes. First, Instagram Stories and profile viewing create a regime of soft traceability: users can follow daily life at intimate proximity while maintaining plausible deniability through non-interaction. A silent follower may watch Stories repeatedly to remain socially informed (and emotionally attached) without triggering relational obligations such as replying, reacting, or revealing presence through public comments.

Second, TikTok's "For You" feed normalizes anonymous consumption through algorithmic curation. Here, silent following is not merely an individual choice; it is structurally encouraged. Users learn cultural codes, trends, and micro-languages by watching, often postponing visible self-expression until they can perform the platform's aesthetic grammar competently. Silence functions as rehearsal.

Third, on X (formerly Twitter), polarized conversation and quote-tweet dynamics increase the perceived risk of exposure. In such climates, silent following can become a rational strategy for information-gathering without identity cost. The user remains politically and socially connected while avoiding the reputational volatility of public speech. Across these platforms, the same psychological mechanism appears: observation provides belonging and knowledge, while silence protects the self from the sanctions of visibility.

3.7. Engaging Counter-Positions: Disengagement, Free-Riding, and Ethical Risk

A robust interpretation of silent following must also take seriously competing views. One line of critique frames lurking as disengagement: a user benefits from collective content without reciprocating, thereby weakening community vitality and reducing the diversity of voices available to the group. Another emphasizes ethical risk: silent observation can enable harassment, parasocial monitoring, or data extraction, especially when it targets vulnerable users. These critiques matter because they mark the boundary between protective privacy and asymmetric surveillance.

The present conceptual framework does not romanticize silence. Rather, it argues that silent following is ethically ambivalent and context dependent. In educational communities, for example, sustained lurking can reduce peer-to-peer knowledge building if it becomes a permanent stance; in activist or at-risk communities, silent following may be vital for safety; in celebrity or influencer cultures, it can slide into voyeuristic monitoring. The analytic task is therefore not to judge silence as inherently good or bad, but to identify the conditions under which it functions as autonomy, as avoidance, or as domination. That distinction is crucial for both platform governance and for digital pedagogy that seeks inclusion without coercive exposure.

4. CONCLUSION AND EVALUATION

4.1. Key Findings

This conceptual analysis advances three integrated findings. First, silent following should be treated as a communicative strategy rather than a communicative absence. In visibility-saturated platforms, withholding interaction can function as agency: an individual manages exposure, regulates emotional labor, and preserves boundaries while remaining socially connected. Second, silence is structurally produced as much as it is personally chosen. Platform architectures—metrics, comment cultures, algorithmic ranking, and public permanence—raise the perceived costs of speaking and normalize observational participation. Third, silent following is ethically ambivalent: it can protect privacy and emotional self-preservation, yet it can also reproduce asymmetric power relations when observation becomes monitoring.

These claims align with, and extend, prior research on "lurking" in online communities. Empirical studies of discussion forums and online groups have shown that non-posting users may still report learning, information gain, and a sense of belonging through reading and tracking exchanges (Dennen, 2008; Nonnecke & Preece, 2000, 2001). The present paper contributes by linking that empirical insight to a broader theory of visibility economies and emotional governance, positioning silent following as a culturally patterned response to transparency pressure rather than a purely individual preference.

4.2. Implications for Educational Technology

For TOJET's readership, the implications are direct. Online learning spaces often equate participation with posting, yet silent learners may be cognitively active and socially attuned while remaining publicly quiet. Course design can reduce the punitive dimension of visibility by offering multiple participation pathways: reflective journals, low-stakes micro-responses, anonymous Q&A channels, or structured "read-and-summarize" roles that legitimate observational engagement. Learning analytics and assessment strategies should therefore differentiate between absence (no access) and silent presence (access with observational engagement), avoiding simplistic inferences from posting counts alone.

4.3. Limitations

This manuscript is conceptual and does not report original empirical data. Accordingly, its claims are interpretive and intended to generate testable propositions rather than causal conclusions. Silent following is also a heterogeneous category: motivations differ by platform (e.g., Instagram versus X), by relationship context (friends, influencers, institutions), and by cultural norms around privacy and self-disclosure. Finally, the ethical evaluation of silence depends on power asymmetries: what counts as self-protection for one user may feel like surveillance to another. These limitations delimit the scope of the argument and indicate where empirical validation is required.

4.4. Future Research

Future studies can operationalize silent following across educational and social platforms by combining digital trace data (views, dwell time, revisits) with qualitative interviews on motivation and emotional cost. Comparative work across cultures and age groups would clarify how privacy norms and large-group identifications shape the choice to remain silent. Finally, the role of AI-driven recommendation systems deserves focused attention: algorithmic feeds not only interpret silent behavior but also amplify it by rewarding consumption patterns, thereby influencing both what learners see and what they choose not to say.

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Understanding How Generative AI Cultivates Self-Directed Learning Capabilities: A Perspective Based on Digital Technology Evolution

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Abstract
The use of digital technologies to support student learning has become a trend in the field of education. However, whether digital technologies can effectively facilitate students' self-directed learning remains a topic of debate in academia. This study employs a meta-analytic approach to examine the effectiveness of digital technologies in promoting self-directed learning among students, while exploring the influence of different moderating variables. A total of 27 articles (including 30 independent studies with 3,711 participants) met the inclusion criteria. The results indicate that digital technologies significantly enhance students' self-directed learning, demonstrating a moderate effect size (Hedges's g = 0.778, 95% CI: 0.510–0.847, $p < 0.05$). Among the moderating variables, the type of digital technology and teaching size showed significant effects, whereas educational stage, subject area, and intervention duration did not exhibit significant moderating effects. Based on the findings, recommendations are proposed regarding the selection of digital technology types, adjustments to teaching size and intervention duration, and targeted considerations for educational level and subject area. This study provides a theoretical foundation and empirical evidence for the scientific application of digital technologies, the cultivation of self-directed learning, and the formulation of educational technology policies.
Keywords: digital technologies, meta-analytic, self-directed learning

1 INTROUCTION

As online education opportunities expand and digital technologies such as artificial intelligence (AI) advance rapidly, self-directed learning (SDL) has emerged as a fundamental skill for individuals to adapt and succeed in the digital era(Morris, 2019) . This shift has also established SDL as an indispensable component of contemporary education(Aulakh et al., 2025) . SDL emphasizes learners' ability to proactively set goals, select strategies, monitor progress, and evaluate outcomes, monitor progress, and evaluate outcomes. In the digital era characterized by rapid knowledge iteration, the significance of SDL has become even more pronounced(Gaol & Prasolova-Førland, 2022). SDL can cultivate students' self-awareness, goal orientation, and sense of mastery during the learning process. These competencies enhance learners' motivation, engagement, and confidence in digital learning environments(Morrison & McCutheon, 2019). Meanwhile, the explosive development of digital technologies - from mobile learning platforms to virtual reality systems and today's generative artificial intelligence - has provided learners with unprecedented learning resources and educational experiences(Gaol & Prasolova-Førland, 2022). Currently, a growing number of educators are integrating digital tools into traditional instructional environments and developing innovative teaching models(Morrison & McCutheon, 2019).

However, the actual efficacy of applying digital technologies to foster students' SDL remains debated. One view is that digital technology can facilitate the development of students' SDL(Lingling, 2024; Rashed Ibraheam Almohesh, 2024). But another view suggests that the role of digital technology in cultivating students' SDL is negligible or even nonexistent(Lee, 2024; Yeh et al., 2022). Existing studies have inconsistent conclusions findings due to differences in samples and technological tools, etc. Therefore, there is a need to integrate existing evidence through meta-analysis to quantify the overall effect of digital technology on SDL and explore key moderating variables to compensate for the limitations of single studies.

Therefore, this study aims to comprehensively evaluate the impact of digital technology on students' SDL through a meta-analysis approach and investigated whether educational stage, subject area, digital technology type, intervention duration, and teaching size moderated the impact of digital technology on students' SDL. This study can provide a theoretical basis and empirical evidence for the scientific application of digital technology, the cultivation of SDL and the development of educational technology policies.

2 LITERATURE REVIEW

2.1 Self-directed learning and digital technology

So far, there is no unified and clear definition of SDL. Based on previous research, perspectives on SDL can be broadly categorized into the capability view and the process view. From the perspective of ability, self-directed learners are able to initiate learning on their own and sustain it independently. Self-directed learners also possess the capacity for self-training, a strong desire for learning, and confidence in their learning abilities. Self-directed learners can apply fundamental learning techniques and strategies, organize appropriate learning steps, and formulate as well as execute learning plans accordingly(Guglielmino, 1977). SDL represents a capability that is particularly crucial for successful living and working in the modern world, offering learners a heightened level of adaptability to constantly changing social and environmental conditions(Jossberger et al., 2010). In addition, from the perspective of process, SDL is a process in which individuals actively, with or without the help of others, judge their own learning needs, formulate learning objectives, determine learning resources, choose learning strategies, implement learning activities, and evaluate learning outcomes(Knowles, 1975). In this process, learners are responsible for controlling their own learning objectives and means to meet the perceived needs of personal goals or the personal environment(Morris, 2019).

Based on the background and requirements of this study, SDL is regarded as a capability in this research. Self-directed learners are capable of autonomous planning, resource integration, strategy selection, and self-evaluation. That is, learners possess the ability to actively judge learning needs, independently set learning objectives, choose learning resources, carry out learning activities, and assess learning outcomes.

Although SDL emphasizes the autonomy and independence of learners, it does not mean that learners study in isolation or are completely cut off from the outside world. Although existing studies have shown that one of the basic elements to support and enhance SDL is assistance, especially the feedback provided by educators, this requires educators to spend a lot of time and energy(Stockdale & Brockett, 2011). The emergence of digital technology has brought great convenience to educators. With the advent of the digital era, the advantages of digital technology have become increasingly evident, especially in the field of education. Digital technologies such as information and communication technology, artificial intelligence, big data, and cloud computing have made the development of many new products in the field of education possible, including software, platforms, and devices(Tang et al., 2022). Digital technology is an open door to new learning methods and choices, which may be beneficial to the improvement of learners' abilities(Schneckenberg et al., 2011). Digital technology has the potential to support students in achieving self-direction, especially by combining SDL and technology to provide sufficient support(Morris & Rohs, 2023). From the development of digital technology to the present, there is a close relationship between the use of digital technology and SDL. SDL has been enhanced and facilitated through technologies such as Web2.0. Web2.0 provides learners with a convenient platform for critical reflection and interaction with social network agents(Anderson, 2007). In the modern world, the interactive functions of generative artificial intelligence (GenAI) encourage student engagement and active learning(Brown et al., 2020). The personalized functions of GenAI can be used to effectively provide tailored learning support(Gilson et al., 2023). The assessment function of GenAI is also capable of evaluating students' learning outcomes and providing feedback, which helps students identify their deficiencies(Chiang et al., 2024). Through these means, digital technology offers students important opportunities to improve their learning abilities and develop relevant skills.

Teaching supported by digital technology can enhance students' participation and enthusiasm in learning, improve their metacognitive and self-monitoring abilities, increase their focus and intrinsic motivation for learning, thereby promoting the development of SDL. For example, Lingling (2024)explored the impact of virtual simulation technology on students' SDL through a quasi-experimental study. The research found that, compared to the control group using traditional teaching methods, the experimental group supported by virtual simulation technology showed a significant improvement in SDL. Rashed Ibraheam Almohesh (2024) employed a quasi-experimental design to evaluate the impact of ChatGPT on the SDL of 250 primary school students from six schools in Riyadh, Saudi Arabia. The results indicated that students in the experimental group who utilized ChatGPT demonstrated higher levels of SDL, suggesting that digital technology plays a positive role in enhancing SDL.

The development of digital technology has sparked excitement while also raising concerns among some people. While digital technology provides numerous conveniences for learners, it may also weaken their basic learning abilities(Hedges, 1981). Excessive reliance on digital technology by learners can lead to a lack of critical thinking(Cooper, 2023) and hinder their independent thinking(Bozkurt et al., 2023). Additionally, when learners are subjected to monitoring through technologies such as data tracking, their anxiety levels may increase, which in turn affects the development of SDL. Although these technologies can enhance learners' short-term engagement, they undermine learners' long-term intrinsic motivation for learning, ultimately hindering the development of learners' SDL. For example, Yeh et al. (2022) investigated the impact of the e-STORY App on SDL among 77 nursing students using a quasi-experimental approach. The experimental results showed that there

was no significant improvement in SDL among the students who used the e-STORY App compared to those in the control group who received traditional teaching. Lee (2024) explored the effectiveness of using ChatGPT as a feedback tool for English job letter writing among 51 Korean university students in a business English course. Survey and interview data indicated that, although students generally expressed satisfaction with the feedback process, its impact on developing SDL was limited. Therefore, it is necessary to clearly explore the impact of digital technology on students' SDL.

2.2 Relevant studies

In recent years, researchers have conducted various reviews and meta-analyses to explore the application of digital technology in the field of education. For example, Zhang et al. (2022)conducted a meta-analysis to study the effectiveness of augmented reality technology in K-12 education for learning outcomes. The research results showed a large overall effect size (g=0.919), indicating that the use of augmented reality has a significant positive impact on the learning outcomes of K-12 students. Ma et al. (2024)employed a literature review method to study the learning effects of nursing undergraduates using digital technology in clinical education. The results indicated that the application of digital technology in clinical education is beneficial to the learning of nursing undergraduates. Sailer et al. (2024)conducted a systematic review of 25 meta-analyses that explored the impact of digital technology on teaching effectiveness. The results showed that the use of digital technology does not in itself change student learning outcomes in higher education. However, when digital technology provides support for specific learning activities, such as flipped classrooms and collaborative learning, learners' cognitive learning outcomes are improved.

In addition, some reviews and meta-analyses have begun to focus on the application of digital technology in cultivating students' specific learning abilities and thinking competencies. Fadda et al. (2022)carried out a meta-analysis to investigate the impact of digital games on the mathematical learning motivation of K-12 students. The research showed that compared with traditional teaching practices, digital games are effective tools in enhancing the mathematical learning motivation of K-12 students (g=0.27). Lan and Zhou (2025)utilized a literature review to explore the role of artificial intelligence applications in self-regulated learning among higher education students. The results demonstrated that artificial intelligence has the potential to promote the deliberate thinking, performance, and reflection phases of self-regulated learning. Seenivasan (2024)reviewed literature on the application of information and communication technology (ICT) in school education. He found that the use of ICT helps students access digital information and course content effectively and efficiently. ICT supports student-centered learning and the development of creative learning environments, providing more opportunities for critical thinking skills.

In general, most of the existing literature reviews and meta-analyses have only explored the impact of digital technology on dimensions related to SDL (such as learning motivation), and there is a lack of research on if digital technology supports the cultivation of SDL. Furthermore, the research is concentrated on specific subjects (such as mathematics, medicine) or educational levels (such as K-12, university). Moreover, previous meta-analyses also lacked research on moderating variables that may affect the impact of digital technology on SDL. Therefore, although previous studies have contributed to understanding the application of digital technology in education, there is still a lack of meta-analyses to comprehensively study the impact of digital technology on students' SDL. To fill these gaps, the main objectives of this study are to investigate the impact of digital technology on students' SDL and explore which variables moderate the effects of digital technology on students' SDL. This study aims to provide guidance and references for educators, teachers, researchers, and technology developers in their practices and research on using digital technology to support SDL. Specifically, the study proposes the following two questions:

RQ1: What is the overall effect of digital technology on students' SDL?

RQ2: What are the moderating variables that influence the effectiveness of digital technology on students' SDL?

3 METHOD

This study employs a meta-analysis approach to discuss the impact of digital technology on students' SDL, and adheres to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. We utilized the Comprehensive Meta Analysis v.3 software for conducting the meta-analysis and adopted the Hedges' g value to calculate the effect size. According to Cohen's Hedges' g standard, 0.2 represents a small effect size, 0.5 indicates a moderate effect size, and 0.8 signifies a large effect size(Hedges, 1981).

3.1 Data sources and search strategies

This study utilized the Web of Science, Google Scholar, Springer, and Elsevier databases as the platforms for literature retrieval. Additional searches were conducted using the "citation search" method to ensure comprehensive coverage of the literature. The search was not restricted to any specific type of literature, but was limited to the timeframe after 2011. The search terms were divided into two groups. The first group of search terms included "Generative AI", "GenAI", "generative artificial intelligence", "LLM", "large language model", "ChatGPT", "chatbot", "digital technology", "educational technology", "technology", "web-based tool", "online platform", "mobile app", and other key terms related to digital technology. The second group of search terms was specifically limited to "SDL", "Self-directed learning". During the search, keywords within each group were connected using the Boolean operator "OR", while the two groups were combined using the Boolean operator "AND".

3.2 Inclusion and exclusion criteria

The criteria for literature selection included: (1)The research addressed the impact of digital technology on SDL; (2)The included literature must be experimental or quasi-experimental designs with comparisons between an experimental group and a control group, and single-group pretest-posttest studies are not included in the scope of this study; (3)The experimental group receives teaching supported by digital technology, while the control group receives traditional teaching; (4)The data in the literature must be complete, including means, standard deviations, sample sizes, etc. The specific screening process is shown in Fig. 1.

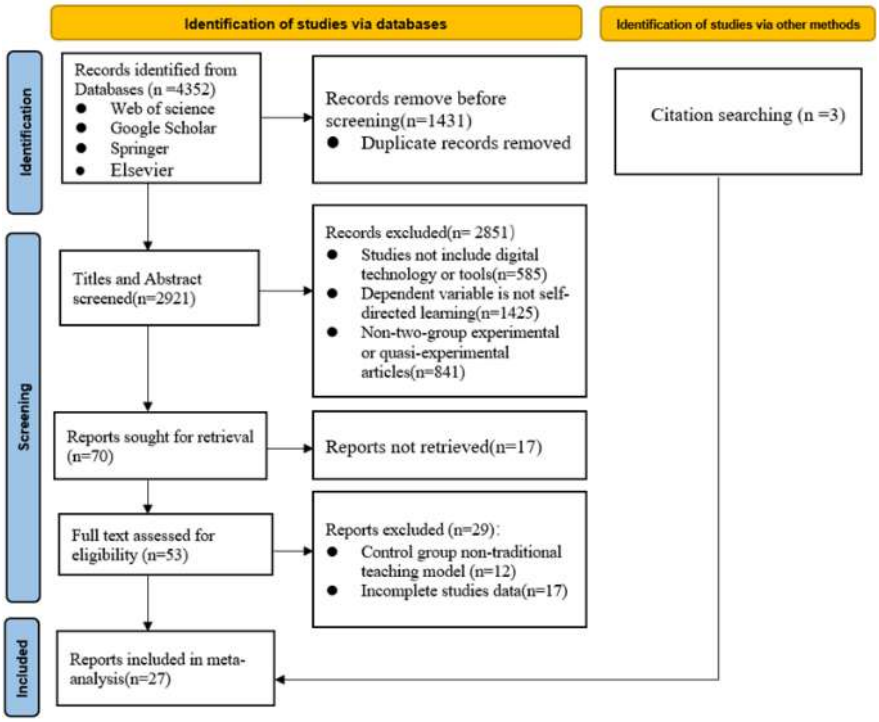

Fig. 1 Literature Search Flowchart

3.3 Coding procedures

The study not only extracted basic information from the included literature, such as article title, author(s), and year of publication, but also conducted characteristic value coding for 27 articles. The content of the characteristic value coding includes learner characteristics (education stage, subject area) and teaching characteristics (digital technology type, intervention duration, teaching size). A total of 27 articles were included in this study, among which some articles had multiple effect sizes. Therefore, there were ultimately 30 effect sizes available for meta-analysis. Two researchers independently coded all the studies separately, and the Cohen Kappa coefficient was 0.92, indicating that the coding results were valid(Cohen, 1968). After completing the coding process, the researchers discussed the disputed sections and reached a unified agreement. The specific results of the characteristic value coding are shown in TABLE 1. Initially, this study categorized digital technologies without AI involvement into two categories based on the literature included: content delivery type (i.e., digital technologies primarily for one-way knowledge transmission) and collaborative inquiry type (i.e., digital technologies that can sense user behavior and respond adaptively). In addition, AI as a transformative force(Xu & Ouyang, 2022), needs to be analyzed as an independent type of digital technology. Therefore, the study adds a

category for intelligent question-and-answer (i.e., digital technologies that rely on AI to provide dynamic responses to user inquiries and offer personalized solutions) for discussion. Therefore, the final classification of digital technology types is divided into three categories: intelligent question-and-answer, content delivery, and collaborative inquiry.

TABLE 1 Characteristic value coding

Variable		Category	Number of studies
Learner characteristics	Educational stage	1.Primary	6
		2.Secondary	4
		3.University	20
	Subject area	1.Humanities and social sciences	14
		2.Medical science	13
		3.Industrial science	3
	Technology type	1.Intelligent Question-and-Answer type	7
		2.Content delivery type	17
		3.Collaborative inquiry type	6
Teaching characteristics	Intervention duration	1. 1~3 weeks	4
		2. 4~6 weeks	8
		3. 7~9 weeks	7
		4.More than 9 weeks	11
	Teaching size	1. 1~30	3
		2. 31~60	5
		3. 61~90	12
		4. More than 90	10

3.4 Publication bias

To ensure the validity of the research conclusions, a publication bias test was conducted based on 30 effect sizes before proceeding with the meta-analysis, resulting in the funnel plot shown in Fig. 2. As shown in Fig. 2, the 30 included effect sizes are relatively evenly distributed on both sides of the funnel plot, indicating that there may be no publication bias in the study. To further confirm the presence of publication bias, the study employed the Fail-Safe Number for examination. The results showed that the Fail-Safe Number was 3478, which was far greater than the permissible limit of 5k+10 (where k is the number of effect sizes included in the analysis). In addition, the study also adopted the Egger linear regression test and the Begg rank correlation test to explore the issue of publication bias. The results showed that the p-value for the Egger linear regression test was 0.646, and the p-value for the Begg rank correlation test was 0.521, both of which were greater than 0.05. Therefore, there is no publication bias in the samples of this study, and meta-analysis can be carried out.

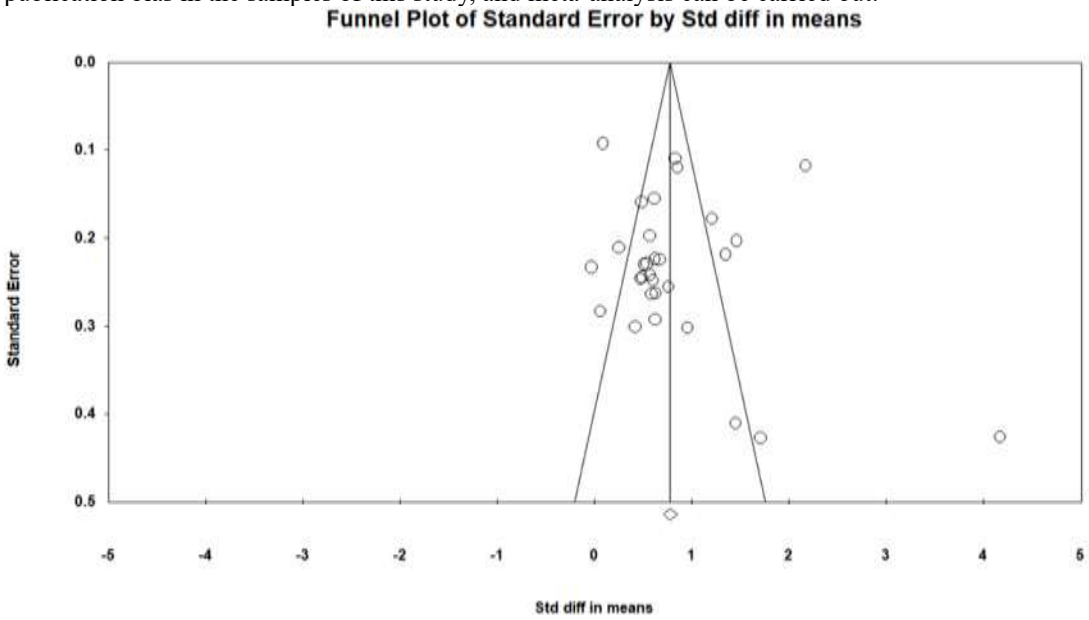

Fig 2. Funnel Plot

3.5 Heterogeneity analysis

Heterogeneity tests aim to explore the impact of individual differences on the dependent variable, with the purpose of examining whether different studies have integratability or consistency. This study utilized both fixed-effect and random-effect models to analyze the included literature. By referring to the statistical values of the Q test and I^2 test, the most appropriate model is determined to ensure the accuracy and reliability of the analysis results. The results of the heterogeneity test are shown in TABLE 2, where Q=331.249, I^2=91.249%, and p=0.000<0.1, indicating the existence of heterogeneity among the studies. Therefore, to effectively address the differences in effect sizes between samples, this study adopted a random-effects model for analysis.

TABLE 2. OVERALL EFFECT SIZE

Model	N	Hedges's g	95% confidence interval		Null test		Heterogeneity				T^2
			Lower limit	Upper limit	Z	P	Q-value	df (Q)	p	I^2	
Fixed	30	0.625	0.484	0.966	12.255	0.000	331.249	29	0.000	91.249	0.628
Random	30	0.778	0.510	0.847	6.717	0.000					

4 RESULT

4.1 The Overall Impact of Digital Technology on Self-Directed Learning

As shown in TABLE II, under the random-effect model, the overall effect size was 0.778 (95% CI: 0.510–0.847, Z = 6.717, p < 0.05), indicating that the overall impact of digital technology on students' SDL reached a moderate level. The 95% confidence interval of the random-effect model was [0.510, 0.847], which did not include 0, suggesting that the impact of digital technology on students' SDL was unlikely to be due to chance. In short, digital technology played a significant and relatively strong positive role in promoting students' SDL.

4.2 Moderator analysis findings

The study further examined the potential moderating effects of two categories of variables: learner characteristics and teaching characteristics. Learner characteristics included two variables: education stage and subject area, while teaching characteristics included three variables: technology type, intervention duration, and teaching size. Detailed data are shown in TABLE 3.

TABLE 3. Effect Size of Moderating Variables

Variables	Effect size and 95% CI				Null test		Group difference
	N	g	Lower	Upper	Z	P	
Educational stage							
1.Primary	6	0.875	0.541	1.209	5.130	0.000***	Q=0.662 P=0.718
2.Secondary	4	0.685	0.349	1.021	3.995	0.000***	
3.University	20	0.824	0.505	1.143	5.061	0.000***	
Subject area							
1.Humanities and social sciences	14	0.952	0.615	1.288	5.547	0.000***	Q=3.817 P=0.148
2.Medical science	13	0.760	0.345	1.175	3.591	0.000***	
3.Industrial science	3	0.554	0.327	0.781	4.792	0.000***	
Technology type							
1. Intelligent question-and-answer type	7	1.201	0.641	1.760	4.208	0.000***	Q=3.526 P=0.039*
2.Content delivery type	17	0.509	0.329	0.749	5.969	0.000***	
3.Collaborative inquiry type	6	0.852	0.101	1.605	2.222	0.026*	
Intervention duration							
1. 1~3 weeks	4	0.462	0.236	0.688	4.001	0.000***	Q=5.199 P=0.158
2. 4~6 weeks	8	1.055	0.248	1.863	2.561	0.000***	
3. 7~9 weeks	7	0.864	0.493	1.234	4.572	0.000***	
4.More than 9 weeks	11	0.768	0.380	1.156	3.882	0.000***	
Teaching size							

1. 1~30	3	1.574	0.994	2.154	5.322	0.000***	Q=10.631 P=0.014*
2. 31~60	5	0.897	0.486	1.308	4.278	0.000***	
3. 61~90	12	0.769	0.394	1.144	4.018	0.000***	
4. More than 90	10	0.524	0.240	0.808	3.612	0.000***	

*p <0.05,***p <0.001

4.2.1 Educational stage

To explore the impact of digital technology on students' SDL across different educational stages, this study categorized the educational stages into primary school, secondary school, and university based on the included literature. The analysis revealed that digital technology had varying degrees of positive effects on students' SDL across these three educational stages. Specifically, digital technology demonstrated strong and statistically significant positive effects on SDL among primary school students ($g = 0.875$, $p < 0.05$) and university students ($g = 0.824$, $p < 0.05$). For secondary school students, the effect was moderate but still statistically significant ($g = 0.685$, $p < 0.05$). However, the overall differences in the effects of digital technology on SDL across the three educational stages were not statistically significant ($Q = 0.662$, $p = 0.718 > 0.05$). Therefore, educational stage did not significantly moderate the impact of digital technology on students' SDL.

4.2.2 Subject area

To investigate the impact of digital technology on students' SDL across different subject areas, this study classified the included literature into three categories: humanities and social sciences, medicine, and engineering. The analysis revealed varying degrees of positive effects of digital technology on students' SDL across these subject areas. Specifically, digital technology demonstrated a strong and statistically significant positive effect on SDL in humanities and social sciences ($g = 0.952$, $p < 0.05$). In medicine ($g = 0.760$, $p < 0.05$) and engineering ($g = 0.554$, $p < 0.05$), the effects were moderate yet still statistically significant. However, the overall differences in digital technology's effects on SDL across these three subject areas were not statistically significant ($Q = 3.817$, $p = 0.148 > 0.05$). Consequently, subject area did not serve as a significant moderator of digital technology's impact on students' SDL.

4.2.3 Technology type

To examine the impact of different types of digital technology on students' SDL, this study categorized the digital technologies into three types based on the included literature: content presentation, collaborative inquiry, and intelligent question-and-answer. All three types of digital technologies demonstrated positive effects on students' SDL, though to varying degrees. Specifically, intelligent question-and-answer ($g = 1.201$, $p < 0.05$) and collaborative inquiry ($g = 0.852$, $p < 0.05$) technologies showed strong and statistically significant positive effects on students' SDL. Content presentation technology ($g = 0.509$, $p < 0.05$) exhibited a moderate yet still statistically significant positive effect. Moreover, the overall differences in the effects among these three types of digital technologies were statistically significant ($Q = 0.278$, $p = 0.039 < 0.05$). Therefore, the type of digital technology significantly moderates its impact on students' SDL.

4.2.4 Intervention duration

To examine the impact of digital technology on students' SDL across different intervention durations, this study classified the intervention periods into four categories based on the included literature: 1-3 weeks, 4-6 weeks, 7-9 weeks, and more than 9 weeks. Digital technology demonstrated varying degrees of positive effects on students' SDL across these intervention periods. The analysis revealed statistically significant positive effects with varying effect sizes: strong effects were observed for interventions lasting 4-6 weeks ($g=1.005$, $p<0.05$) and 7-9 weeks ($g=0.864$, $p<0.05$), while moderate yet significant effects were found for shorter (1-3 weeks; $g=0.462$, $p<0.05$) and longer durations (more than 9 weeks; $g=0.768$, $p<0.05$). However, the overall analysis showed no statistically significant differences in digital technology's effects on students' SDL across different intervention durations ($Q=5.199$, $p>0.05$). Therefore, intervention duration did not significantly moderate the impact of digital technology on students' SDL.

4.2.5 Teaching size

To investigate the impact of digital technology on students' SDL under different teaching sizes, this study categorized teaching sizes into four groups based on the included literature: 1-30 participants, 31-60 participants, 61-90 participants, and more than 90 participants. Digital technology had a positive impact of varying degrees on students' SDL across these three teaching sizes. Specifically, in teaching sizes of 1-30 participants ($g=1.574$, $p<0.05$) and 31-60 participants ($g=0.897$, $p<0.05$), digital technology had a high significant positive impact on students' SDL. In teaching size of 61-90 participants ($g=0.769$, $p<0.05$) and more than 90 participants ($g=0.524$, $p<0.05$), digital technology had a moderate significant positive impact on students' SDL. Overall, there were significant differences in the impact of digital technology on students' SDL across different teaching scales

(Q=10.631, p=0.014<0.05). Therefore, teaching size can significantly moderate the impact of digital technology on students' SDL.

5 DISCUSSION

To address the first research question, our meta-analysis included 27 studies on digital technology supporting students' SDL, encompassing a total of 30 effect sizes. The results indicated that digital technology has a moderate positive impact on students' SDL, suggesting significant potential for enhancing students' SDL through digital technology.

Possible reasons include: Firstly, digital technology provides students with abundant learning resources through the internet, databases, and other means. Students can independently choose learning content and adjust their learning pace according to their interests or needs, breaking through the temporal and spatial constraints of traditional classrooms. As relevant research has pointed out, the richness of online resources enables learners to actively construct knowledge networks rather than passively accept fixed course content(Hmelo-Silver et al., 2007). The support of digital technology for student learning resources meets the core elements of SDL, namely self-setting learning goals and autonomous selection of resources(Knowles, 1975), thereby stimulating students' interest and initiative in learning, which is a significant driving force for SDL. Secondly, powerful digital technology offers convenience for teachers to cultivate students' SDL. Teachers can use digital technology (e.g., teaching management systems, online testing tools) to accurately assess and fully understand students' learning situations, so as to decide whether to take intervention measures to assist students' SDL and timely adjust teaching plans and optimize teaching models(Walan, 2020). Moreover, digital technology can help teachers create an SDL environment suitable for students' characteristics (e.g., immersive learning environments), optimizing students' learning experiences and enabling learners to engage in more interesting and participatory SDL experiences. In addition, the diverse tools and platforms of digital technology have promoted students' SDL. For example, intelligent learning applications can provide personalized learning suggestions and feedback based on students' learning behaviors and data, as well as functions such as simulated tests and practice exercises to help students consolidate knowledge and improve skills. Learning management systems can assist students in organizing and managing their learning courses, tasks, and progress. Students can use these systems to organize learning content and resources, conduct efficient information processing, and record their learning outcomes for self-assessment. The diverse digital tools provide effective support for students, enabling them to better grasp the direction of learning, improve self-management, and enhance SDL.

Similarly, GenAI supports students through interactive dialogue capabilities, providing real-time answers and feedback that allow learners to progress at their preferred pace. GenAI offers broad accessibility across platforms, enabling students to explore and utilize open educational resources flexibly. By tailoring content recommendations to individual needs, GenAI further personalizes the learning experience. These integrated features enhance students' autonomy and ability to manage their own learning, thereby strengthening their capacity for self-directed learning.

The research results affirm the application value of digital technology in cultivating students' SDL. Therefore, the education sector needs more investment and effort to promote the application of digital technology in SDL cultivation. We should not overly worry about the negative impacts of digital technology, particularly GenAI, but must encourage teachers and educators to dare to utilize, reasonably utilize, and innovatively utilize digital technology to support students' SDL.

To address the second research question, this study further explored potential moderating variables, which were divided into student characteristics (educational stage, subject area) and teaching characteristics (digital technology type, intervention duration, teaching size). Among these, digital technology type and teaching size significantly moderated the impact of digital technology on students' SDL.

Regarding educational stage, digital technology showed better effects on SDL for primary and university students compared to secondary students. Primary students are in a critical period of cognitive development, with greater plasticity in their SDL development and predominantly concrete thinking(Hartshorne & Germine, 2015). Digital technology can transform abstract knowledge into more intuitive visual representations, which aligns with their cognitive characteristics and attracts their attention. Additionally, primary students easily gain a sense of accomplishment and confidence from using digital educational games, thereby increasing their learning engagement. This explains the better SDL outcomes observed in Primary students. Consistent with the findings of Han et al. (2022), university students possess higher digital literacy and greater access to digital devices, along with prior experience and proficiency in using digital technology(Garzón & Acevedo, 2019), enabling them to fully leverage these tools for SDL.

In contrast, secondary students face several challenges. First, in the regions studied, most secondary students experience significant academic pressure due to transition to higher education, which may lead them to prioritize rote learning over SDL skill development(Bound et al., 2009). Second, secondary students are in the developmental stage of adolescence. Secondary students exhibit greater emotional volatility and susceptibility to external distractions(Demkowicz et al., 2024), resulting in insufficient self-management when using digital technology for learning and difficulty adhering to study plans. Furthermore, current research on SDL cultivation primarily focuses on university students, with limited attention to secondary students. Future research needs to emphasize the development of students' SDL at the secondary stage. This may require collaborative efforts from society, families, and schools to provide additional support and guidance for cultivating SDL in secondary students.

Regarding subject area, digital technology showed better effects on SDL for students in the humanities and social sciences compared to those in medicine and engineering. This contrasts with previous findings, such as Bašić et al. (2023), who reported higher student interest and acceptance of digital technology when applied to natural sciences. The discrepancy may stem from the nature of learning content in different fields. Humanities and social sciences often emphasize the analysis and understanding of texts, history, culture, and social phenomena(Marcone, 2022), which require considering the diversity and complexity of real-world contexts. Digital technology can effectively create authentic, complex scenarios for discussion and exploration, facilitating SDL in these disciplines.

In contrast, medicine and engineering prioritize standardized experimental processes and specialized technical skills(Barlösius, 2019). These fields rely more on practical experience and professional guidance, posing higher demands for equipment and technical support compared to humanities and social sciences. Consequently, the application of digital technology to SDL in these areas may be more limited. Overall, digital technology demonstrates significant positive effects on SDL across disciplines. This insight suggests that educators can leverage digital tools for interdisciplinary teaching to cultivate SDL. Additionally, there is a need to explore and select digital technologies tailored to the specific needs of different academic fields to better support students' SDL.

Regarding digital Technology Type, this study found that different types of digital technology have a significant positive impact on students' SDL. While some research suggests that the most common challenge in using digital technology in classrooms is students' lack of skills in using it rather than questions about which technology to use(Seenivasan, 2024), our results underscore the importance of providing targeted digital technologies for SDL.

Specifically, intelligent question-and-answer technologies and collaborative inquiry technologies outperform content-delivery technologies in promoting SDL. As an emerging form of digital technology, intelligent question-and-answer tools leverage AI to offer personalized learning content and interactive experiences. These technologies significantly enhance learning efficiency, motivation, and knowledge construction(Ng et al., 2023), while also transforming teaching strategies and sparking greater interest and participation(Huang et al., 2023), thereby intelligent question-and-answer technologies can foster SDL. Collaborative inquiry technologies create immersive environments that enable deep collaboration, knowledge co-creation, and improved engagement, while cultivating problem-solving skills. In contrast, content-delivery technologies, which primarily provide one-way information transmission, lack personalization, flexibility, and practicality. They may fail to meet diverse learning needs, limiting their effectiveness in supporting SDL.

This finding highlights the critical role of educators in selecting appropriate digital technologies. When designing instructional activities, educators should prioritize aligning technology types with teaching objectives, embrace artificial intelligence applications in education, and emphasize designs that integrate theory and practice.

Regarding intervention duration, SDL outcomes were better under 4-6 weeks and 7-9 weeks of intervention compared to 1-3 weeks or more than 9 weeks. A moderate intervention period allows students to fully understand and familiarize themselves with the digital technology while maintaining high learning efficiency. During this time, teachers are more likely to invest greater resources and effort into the teaching process(Sung et al., 2016).

In contrast, shorter interventions (e.g., 1-3 weeks) may leave students insufficiently familiar with the technology. Students often need time to adapt and effectively integrate new tools into their learning practices(Ganesh et al., 2022). Additionally, SDL, as a complex competency, may not improve significantly in the short term. Longer interventions (e.g., over 9 weeks) risk diminishing student engagement due to reduced novelty(Chauhan, 2017), increased cognitive load, and greater challenges for teachers to control extraneous variables(Ganesh et al., 2022). This suggests that teachers should ensure students use digital technology adequately within a reasonable

timeframe, avoiding both brief or excessive use. Overall, since intervention duration does not significantly moderate the impact of digital technology on SDL, teachers can flexibly arrange teaching schedules based on practical instructional needs.

Regarding teaching size, interventions in 1-30 and 31-60 student groups outperformed those in 61-90 and over 90 student groups. Sun and Zhou (2024) also concluded that moderate-sized classes can leverage the advantages of digital technology more effectively. In smaller or medium-sized classes, teachers can better integrate digital tools for targeted guidance, as they have more time and energy to manage the class and control learning pace(Bucea-Manea-Țoniș et al., 2022). In contrast, large-scale teaching often leaves teachers unable to adequately monitor each student's SDL, leading to insufficient supervision and personalized support. Students may fail to fully utilize digital technology for SDL(Hobert et al., 2023), and the massive volume of learning data could also cause technical errors. In general, the teaching size is determined more by the actual teaching situation and is constrained by real conditions, making it difficult to adjust artificially. Therefore, educators should prioritize innovative digital teaching methods and enhance their instructional management skills when facing large-scale classes to foster SDL. At the same time, technologists must continuously optimize the data capacity of digital tools to address scalability challenges.

6 CONCLUSIONS

This study investigated the effectiveness of digital technology in enhancing students' SDL, analyzing 30 effect sizes from 27 studies involving 3,711 participants across diverse groups. Meta-analysis results indicate that digital technology has a moderately significant positive impact on SDL. Among moderating variables such as educational stage, subject area, digital technology type, intervention duration, and teaching size, significant differences were observed in digital technology type and teaching size. Specifically, the use of digital technologies and interventions in 1-30 student classes yielded the greatest improvements in SDL.

This reveals us that: firstly, teachers with the necessary knowledge and skills can venture to attempt the use of digital technology in SDL development, as this study has demonstrated the positive effects of digital technology in students' SDL. Second, AI, as a revolutionary force(Xu & Ouyang, 2022), has likewise brought convenience to SDL. Teachers must seize the opportunities brought by AI and continue to learn and study the application of AI in teaching. In addition to this, it is also important to focus on the impact of teaching scale and try to promote small class sizes in SDL training to optimize the effect of digital technology. Finally, although the analysis of moderating variables showed no significant moderating effect of educational stage, subject area, and intervention duration, teachers should also use digital technologies under appropriate conditions. Relatively speaking, digital technologies demonstrate less effective application among secondary students. Teachers, families, and the community need to focus on providing appropriate guidance to secondary students to help them make full use of digital technologies for SDL. Digital technology has different effects on students' SDL under different subject areas, and it is necessary for researchers to continuously develop and improve digital technology to suit the needs of learning in different subjects. Teachers also need to rationalize the amount of time students use digital technology to avoid using it for too short or too long. This study confirms the positive role and potential of digital technology in students' SDL development. This study provides theoretical guidance on how to optimize digital technology teaching and SDL activities, as well as a practical basis for digital technology educational applications and related policy development.

However, there are some limitations to this study. First, the meta-analysis included a limited amount of literature, which may have led to an incomplete view of this study. Future research should expand the databases searched to broaden the scope of literature retrieval, thereby accessing a wider range of data sources and enhancing the scientific rigor of the study. Second, the moderating variables chosen for the study were not comprehensive. For example, gender and geography may also moderate the impact of digital technology on students' SDL. Future research can continue to explore possible moderating variables in depth to draw more comprehensive findings. In addition, this study examines SDL as a competency. However it is not possible to neglect to explore the impact of digital technologies on SDL from a process viewpoint. Finally, the long-term validity of the findings of this study may be limited due to the rapid development of digital technology. Therefore, more relevant research is needed to provide a sustained focus on emerging digital technologies. For example, AI technology is rapidly evolving, and due to the limited amount of relevant literature that could be included, the study failed to focus on the effects of AI on students' SDL, and subsequent research needs to be focused on and refined.

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Acceptance of Artificial Intelligence Tools Among Undergraduates: An Application of the Technology Acceptance Model

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SUMMARY
This study investigated the application of the Technology Acceptance Model (TAM) to assess the acceptance and adoption of Artificial Intelligence tools in educational contexts. The research focused on analyzing the attitudes of university students towards the implementation of AI technologies in teaching and learning processes. **Methodology:** The study used the TAM theoretical framework, focusing on two main constructs: perceived usefulness and perceived ease of use as predictors of intention to use AI tools in education. Correlational and median difference statistical analyses were applied to examine the relationships between these variables in a sample of students. **Key findings:** Results revealed significant correlations between *perceived usefulness* and *intention to use AI*, as well as between *perceived ease of use* and *behavioural intention*. Inferential analysis demonstrates that the external variables *prior experience with technology* and *institutional support* influence *perceived usefulness*, *perceived ease of use* and *intention to use* AI tools in university higher education. In addition, hierarchical regression was used to analyze the moderation of external variables in the TAM model, finding that previous experience with technology significantly enhances the relationship between perceived usefulness and intention to use ($\beta = .35$, $p = .001$), increasing the explained variance to 53% in the final model. On the other hand, student participants, grouped into *academic faculties*, show significant differences in the perception of the TAM variables. **Conclusions:** The study confirms the applicability of the TAM model in the educational context for AI technologies, suggesting that both perceived benefits and usability and institutional support are critical factors in promoting the successful adoption of these tools in academic settings.
Keywords: TAM, Artificial Intelligence, University Higher Education

INTRODUCTION

The integration of Artificial Intelligence (AI) in higher education is transforming traditional teaching and learning paradigms (Zawacki-Richter et al., 2019). However, the adoption of these tools has not been uniform across universities, generating debate about their effectiveness and acceptance.

Problematic situation

Internationally, the integration of digital technology in education has allowed the democratization of access to information, expanding educational coverage and implementing interactivity through learning environments (Araujo Bedoya et al., 2024), which is redefining the future in terms of learning (Vera & García-Martínez, 2022). This technological adoption has generated a paradigm shift in the integration of educational technology (Gros et al., 2020), which has undoubtedly led universities to consider its challenges and opportunities (Carrión Salinas & Andrade-Vargas, 2024).

The implementation of AI tools in higher education varies significantly. Holmes et al. (2019) and Pedreño Muñoz (2022) say that there has been an increase in the adoption of AI in education globally, with countries such as the United States, Spain and China adopting these technologies as intelligent tutoring systems (ITS) and being welcomed by education stakeholders; while, during the 2020-2025 period, generative artificial intelligence has been adopted as a teaching strategy that improves teaching and learning.(Echeverria Quiñonez & Otero Mendoza, 2025).

In Latin America, the integration of technology in university education is in its early stages, with challenges related to technological infrastructure and teacher training (Holmes et al., 2019; Luckin et al., 2016; Pedreño Muñoz, 2022), as well as the student perception indicated by Morocho Cevallos et al. (2023) who state that only 70% of students in the Ecuadorian public sector and 65% in the private sector have identified improvements in teaching methodology using AI tools, showing a variability in the perceptions and experiences of students, who in turn have identified improvements in their performance and academic participation.

At the local level, it has been observed that universities are beginning to experiment with AI tools, but their widespread adoption still faces barriers, including the adoption and willingness to use AI by university students, of which no Salvadoran studies have been conducted, leading to the next general research question: What are the factors that influence university students' acceptance of artificial intelligence tools according to the Technology Acceptance Model (TAM)?

The specific research questions that guide the objectives of this study are presented below:

1. how do perceived usefulness and perceived ease of use influence university students' intention to use AI tools?
2. What role do external variables, such as prior experience with technology and institutional support, play in the acceptance of AI tools?
3. Are there significant differences in the acceptance of AI tools among students from different academic faculties?

Objectives

Overall objective

To analyze the factors that influence the acceptance of artificial intelligence tools by university students using the Technology Acceptance Model (TAM).

Specific objectives

1. Examine the relationship between perceived usefulness, perceived ease of use, and intention to use AI tools in the university context.
2. Assess the impact of external variables such as previous experience with technology and institutional support on the acceptance of AI tools.
3. Compare the acceptance of AI tools among students from different academic faculties.

Hypothesis system

H1: Perceived usefulness of AI tools is positively related to intention to use by university students.
H2: Perceived ease of use of AI tools is positively related to intention to use by university students.
H3: External variables, such as previous experience with technology and institutional support, are positively related to perceived usefulness and perceived ease of use of AI tools.
H4: There are significant differences in the acceptance of AI tools among students from different academic faculties.

Justification

This study is relevant to the academic and scientific community as it provides crucial information on the factors that influence the adoption of AI tools in higher education. The results inform educators, university administrators and educational technology developers on how to improve the implementation and use of these tools. In addition, the study contributes to the literature on the application of TAM in the context of emerging technologies in education.

Literature review

Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM), proposed by Davis (1989), is widely used to explain the adoption of new technologies. The TAM postulates that the intention to use a technology is mainly determined by two factors: perceived usefulness and perceived ease of use. Thus, King & He (2006) consistently confirm their main constructs as predictors of technology adoption.

Previous studies have applied the TAM in the context of higher education. For example, Morales Chan et al. (2018) used TAM to investigate the adoption of cloud-based tools by MOOC students, finding that perceived ease of use and perceived usefulness influence attitudes towards cloud-based tools used in a MOOC. Scheler et al. (2019) used an extension of the TAM to examine the acceptance of digital learning technologies among university teachers. Their findings suggest that perceived usefulness and perceived ease of use are significant predictors of usage intention. Chau identified TAM as one of the most influential models in research on technologies applied to online education or web-based learning (Chen, Zou, et al., 2020, citing Chau, 1996).

Applications of the Technology Acceptance Model (TAM) over the 2020-2025 period have demonstrated adaptability and continued relevance in explaining the adoption of emerging technologies in higher education (Cabero-Almenara et al., 2018). Extensions of the TAM developed during 2022-2023 have incorporated constructs specific to AI tool acceptance, including variables such as positive attitudes among faculty and

institutional support (Robles Morales, 2025), ethics and trust as moderating variables, and subjective norms as a quadratic variable (Mustofa et al., 2025).

Recent meta-analyses (2024-2025) confirm that perceived usefulness and perceived ease of use maintain their predictive power, while additional factors such as self-efficacy, social norms, and enjoyment emerge as significant predictors of perceived usefulness and ease of use of technology (Santini et al., 2025).

Along the same lines, validation studies of TAM instruments for mobile applications have reported highly positive perceptions and increasing willingness to use educational technologies (León-Garrido et al., 2025).

Technology Acceptance Model (TAM) Extensions

The Technology Acceptance Model (TAM), proposed by Davis (1986), has undergone multiple extensions and refinements since its original conception, with the aim of improving its explanatory power and adapting it to various technological and organizational contexts. These extensions have arisen to address limitations identified in the original model and to incorporate additional factors that influence the acceptance and use of emerging technologies.

TAM2: Theoretical Extension of the Original Model

TAM2 represents the first major extension of the original model, developed by Venkatesh & Davis (2000) with the purpose of explaining in more detail the antecedents of perceived usefulness and providing a more complete understanding of the factors that influence technological acceptance. This extension incorporates two main categories of determinants: social influence processes and cognitive instrumental processes. *Social influence processes* include *subjective norm* (the individual's perception of whether important people think he or she should use the system), *voluntariness* (the degree to which use is perceived as non-compulsory), and *image* (the degree to which use enhances status within the social group). For their part, *cognitive instrumental processes* comprise *job relevance* (degree to which the individual believes the system is applicable to his or her job), *quality of results* (degree to which the system executes relevant tasks correctly), and *demonstrability of results* (tangibility of the results of system use) (Venkatesh & Davis, 2000). Empirical validation of TAM2 was conducted through four longitudinal field studies in different organizations, demonstrating that social influence factors are particularly important during the initial stages of implementation, while cognitive instrumental processes maintain their relevance over adoption time (Venkatesh & Davis, 2000).

TAM3: Comprehensive Integration of Determinants

TAM3, proposed by Venkatesh & Bala (2008), represents a comprehensive integration that incorporates both the elements of TAM2 and the determinants of perceived ease of use, thus providing a holistic view of the factors influencing technological acceptance. This extension identifies *anchors* (variables that act as initial reference points) and *adjustments* (modifications based on direct experience with the system) as explanatory mechanisms of perceived ease of use. Anchors include *computer self-efficacy* (judgment of one's own abilities to use computers), *perceived external control* (beliefs about the availability of resources and organizational support), *computer anxiety* (degree of apprehension toward computer use), and *computer playfulness* (degree to which interactions with computers are perceived as fun). Adjustments include *perceived enjoyment* (extent to which the use activity is perceived as pleasurable) and *objective usability* (comparison of systems based on the actual effort required to complete specific tasks) (Venkatesh & Bala, 2008). TAM3 has demonstrated predictive robustness in diverse organizational and technological contexts, providing a comprehensive theoretical framework for understanding both the cognitive and experiential antecedents of technological acceptance (Venkatesh & Bala, 2008).

UTAUT: Unified Theory of Acceptance and Use of Technology

The Unified Theory of Acceptance and Use of Technology (UTAUT) was developed by Venkatesh et al. (2003) as a result of the conceptual and empirical integration of eight prominent technology acceptance models, including TAM, TAM2, the Theory of Reasoned Action, the Motivational Model, the Theory of Planned Behavior, Social Cognitive Theory, the Theory of Diffusion of Innovations, and a combined model of TAM and TPB. UTAUT proposes four direct determinants of usage intention and behavior: *performance expectancy* (the degree to which the individual believes that using the system will help them achieve improvements in job performance), *effort expectancy* (the degree of ease associated with using the system), *social influence* (the degree to which the individual perceives that important others believe they should use the new system), and *facilitating conditions* (degree to which the individual believes that organizational and technical infrastructure exists to support the use of the system) (Venkatesh et al., 2003). In addition, UTAUT incorporates four key moderating variables: *gender*, *age*, *experience*, and *willingness to use*, which moderate the relationships between the main determinants and the dependent outcomes. Empirical validation of UTAUT showed that this model explains approximately 70% of the

variance in intention to use, significantly exceeding the explanatory power of previous individual models (Venkatesh et al., 2003).

UTAUT2: Extension for Consumer Contexts

UTAUT2 represents a specific extension of UTAUT developed by Venkatesh et al. (2012) to address the particularities of technology adoption in consumer contexts, where individuals act as end users rather than organizational employees. This extension incorporates three additional constructs that reflect the specific motivations and constraints of consumers. The new constructs include *hedonic motivation* (fun or pleasure derived from using the technology), *price value* (consumers' cognitive trade-off between the perceived benefits of applications and the monetary cost of using them), and *habit* (the extent to which people tend to perform behaviors automatically due to prior learning). Additionally, UTAUT2 eliminates the moderating variable of voluntariness, since in consumer contexts, use is inherently voluntary (Venkatesh et al., 2012). Empirical validation of UTAUT2 in mobile technology contexts demonstrated substantial improvements in the explanatory power of the model, achieving an explained variance of 74% for intention to use and 52% for usage behavior (Venkatesh et al., 2012).

Specific Extensions for Educational Contexts

Various studies have developed specific adaptations of TAM and its extensions for educational contexts, recognizing the particularities of the academic environment and the specific characteristics of students and teachers as technology users. These adaptations have incorporated variables such as *technological self-efficacy*, *attitudes toward online learning*, *institutional support*, and the *quality of the educational system*. Abdullah & Ward (2016) developed an extension of TAM specifically for e-learning, integrating the factors of experience, subjective norm, enjoyment, computer anxiety, and self-efficacy as antecedents of perceived usefulness and perceived ease of use.

Artificial Intelligence in Education

In the field of AI in education, Zawacki-Richter et al. (2019) conducted a systematic literature review, identifying promising applications in areas such as intelligent tutoring and automated assessment. However, they also pointed out the need for more empirical research on the use of these technologies in higher education. Similarly, Zhi & Wang (2024) express a favourable attitude of EFL learners towards AI to enhance language learning.

The state of the art provides an overview of the various applications, benefits and challenges of AI in education. From personalisation of learning to automated assessment, AI is transforming the educational landscape. However, it also highlights important ethical and practical considerations that must be addressed for a successful and responsible implementation of AI in education:

1. Personalisation of Learning: AI systems are being developed to tailor the content, pace and approach to learning to the individual needs of each learner. Luckin et al. (2016) argue that this personalisation can significantly improve learning outcomes by providing more relevant and effective educational experiences. Recent studies in the period 2020-2025 indicate that generative AI has revolutionized the creation of educational materials, enabling the automated generation of adaptive and personalized content tailored to individual learning needs (Romani Pillpe et al., 2025).
2. Intelligent tutoring systems: Intelligent tutors use AI to provide immediate feedback and personalised support to students. VanLehn (2011) states that these systems can be as effective as tutoring by a human, giving value to guided practice and immediate feedback. Bravo Ortega (2025), in a systematic review of the period 2021-2025, identified that AI-based platforms provide more accurate and contextualized feedback, while freeing teachers from routine tasks.
3. Predicting academic performance: Advanced learning analytics algorithms represent another significant growth area in the application of AI. Siemens (2013) highlights how AI is improving the ability to analyze student progress in real time, enabling more timely and effective interventions. These tools can predict future student performance, identify learning patterns and provide valuable insights for educators. Furthermore, Luan & Tsai (2021) indicate that these models can accurately identify students at risk of academic failure, allowing for early interventions and personalised support; while a systematic review of the literature in 2020-205 determined that AI applications improve educational outcomes by offering the possibility of massive processing of academic data (Modesto Acosta et al., 2024).
4. Continuous and adaptive assessment: AI is also transforming assessment methods in education, adjusting learning content and practices in real time to the level of knowledge demonstrated by the learner, based on the results of student learning analysis (Cuenca Aguilar, 2022).
5. Virtual Assistants in Education: Goel & Polepeddi (2018) analyzed the use of AI-based virtual assistants in higher education. Their case study on Jill Watson, a virtual teaching assistant used at the Georgia Institute of Technology, demonstrated that AI chatbots can effectively handle student queries, freeing up time for human instructors to focus on more complex tasks. Similarly Luna Fox & Paredes Rosado (2024)

identified studies in 2020-205 that favor their use as 24/7 academic support tools to address student queries.

6. AI and Accessibility in Education: Drigas & Ioannidou (2012) explored how AI can improve accessibility in education for students with disabilities. Their review highlighted the application of AI tools, such as intelligent tutoring systems, for students with dyslexia, dysgraphia and dyscalculia and augmentative communication tools for students with speech disorders. Likewise, Ruiz Muñoz et al. (2025) detected a notable advance in the use of technology to improve cultural and linguistic adaptations to the local environment.
7. Ethics and Privacy in Educational AI: Zawacki-Richter et al. (2019) and Idowu (2024) conducted a systematic review of the literature on AI in higher education, focusing on ethical and privacy implications. They identified key concerns, such as student data protection and transparency in algorithmic decision-making, highlighting the need for clear policies and guidelines for the ethical use of AI in education. Holmes et al. (2019) raised concerns about confidentiality and the ethical use of mass collection and analysis of students' personal data by AI systems.
8. Teacher literacy. In their systematic review corresponding to the period 2020-2025 Luna Fox & Paredes Rosado (2024) determined that teacher training in advanced digital competencies persists as one of the significant challenges in the use of these technologies.

Digital Pedagogy and Educational Transformation

Digital pedagogy and educational transformation represent an emerging paradigm that redefines teaching and learning processes in 21st-century higher education, characterized by the critical and strategic integration of digital technologies that transcend the mere instrumental use of technological tools (Sancho-Gil et al., 2020). This transformation involves a profound reconceptualization of the roles of teachers and students, promoting active, collaborative, and personalized methodologies that respond to the demands of a digitalized society (Almenara & Gimeno, 2019). This transformation requires not only adequate technological infrastructure, but also an institutional cultural change that favors pedagogical innovation and the development of critical digital skills, positioning higher education institutions as active agents in the construction of sustainable and equitable digital educational ecosystems (Bond et al., 2018; García-Peñalvo, 2021). This transformation and digital pedagogy implies:

1. Emerging Conceptual Frameworks. Digital pedagogy has undergone rapid transformation during the period 2020-2025, initially driven by the need to respond to the health emergency and subsequently consolidated as a technology-based educational model (Coreas-Flores & Romero-Argueta, 2024). The transformation of remote teaching due to the emergency (2020-2021) towards structured digital pedagogical models (Pozo et al., 2024) marked a milestone in higher education, setting new standards for technological integration in teaching-learning processes.
2. Consolidation of Hybrid Models. The period 2022-2023 was characterized by the consolidation of hybrid educational models with a multimodal approach, combining digital resources in enriched experiences that favor different learning styles (Mayorga-Ases et al., 2025). During this stage, the growth of microlearning and microcredentials transformed traditional university education paradigms, promoting modular education through non-linear learning paths and curriculum personalization as part of lifelong learning (Arroyave Villa, 2024).
3. Teacher Digital Competencies. National frameworks for teacher digital competencies were established as a strategic priority, with specific training programs developed for the effective integration of educational technologies (Berrú Torres et al., 2025). The national digital education strategies implemented during this period prioritized institutional transformation and the creation of digital educational ecosystems (Gros Salvat & Cano García, 2021).
4. Integration with AI. Currently (2024-2025), AI-mediated learning experiences represent the frontier of digital pedagogy (Miao & Holmes, 2024), facilitating the creation of adaptive digital collaborative environments and lifelong learning platforms that respond dynamically to the individual and group needs of students, in response to which UNESCO intrinsically requires a human-centered approach to AI. In the context of artificial intelligence, digital pedagogy takes on additional dimensions of complexity by incorporating adaptive systems that enable personalized learning, automated assessment, and immediate feedback, generating new challenges related to technological acceptance, teacher digital competencies, and ethics in the use of educational algorithms (Zawacki-Richter et al., 2019).

Operationalization of variables

1. Dependent variable: Intention to use AI tools
   Indicators: Expected frequency of use, willingness to use AI tools in academic tasks
2. Independent variables:
   a) Perceived usefulness

Indicators: Perception of improvement in academic performance, efficiency in task completion.

b) Perceived ease of use
Indicators: Ease of learning, clarity of user interface

c) Understanding of AI technology in education
Indicators: Perceived benefits, perceived risks

3. External variables:
   a) Previous experience with technology.
   Indicators: Level of familiarity with digital tools, frequency of use of technology in learning.
   b) Institutional support.
   Indicators: Availability of resources, training for teachers and students on the use of AI.
   c) Academic faculty.
   Indicators: Academic faculty, integration of technology into the curriculum.

METHODOLOGY

Research design

A quantitative, cross-sectional, correlational, quantitative research design was used.

Population and sample:

The population consists of students enrolled in a university higher education institution in El Salvador**.** The sample consisted of 190 university students from various academic faculties, selected at convenience based on their availability at the time of data collection.

Instruments

A questionnaire was developed based on validated TAM scales (Al-Adwan et al., 2023; Davis, 1986, 1989) adapted to the specific context of AI tools in higher education. The questionnaire included sections for each study variable, with items measured on a 5-point Likert scale, where 1 is the maximum value of disagreement and 5 the maximum value of agreement, a scale that facilitated quantitative analysis using descriptive and inferential statistics. Section 1 collects essential demographic information, including academic faculty, to allow comparisons between different areas of study; sections 2-3 address the external variables identified in the study (Previous Experience with Technology and Institutional Support), while sections 4-6 represent the core constructs of the TAM (Perceived Usefulness, Perceived Ease of Use, and Intention to Use). Section 7 includes questions identifying the benefits perceived by students regarding the use of AI in education. Finally, section 8 seeks to identify the risks perceived by students arising from the implementation of AI in their academic training.

Procedure

The questionnaire was administered online via the QuestionPro platform. It was previously validated by experts and informed consent was obtained from participants prior to data collection.

Data analysis

The information collected in the survey was exported to a database for processing using Perfect Statistical Professional Presented (PSPP) statistical software. The reliability of the questionnaire, shown in Table 1, was determined using the internal consistency method based on Cronbach's alpha, which measured the degree of internal correlation between the 34 non-demographic items, achieving a result of ,94, which is very high (Palella Stracuzzi & Martins Pestana, 2012, p. 169).

Table 1: *Internal consistency of the instrument*

Variable	Cronbach's alpha	Number of elements
Previous experience with technology	,82	4
Institutional Support	,82	5
Perceived Usefulness	,92	5
Perceived Ease of Use	,86	5
Intention to Use	,91	4
Perceived Benefits	,90	5
Perceived Risks	,86	6

Descriptive statistics were used to calculate the mean response for each study variable and position it as the students' perception of it. These data can be reviewed in Table 2.

In this sense, *previous experience with technology* was calculated by obtaining the mean of the Likert scale responses in the questions associated with the variable; it was then classified as follows: 1 to 2 = *With low previous experience*, 3 = *With intermediate experience*, 4 to 5 = *With high previous experience*.

For the variable *Intention to use AI tools*, the mean was calculated and classified as follows: 1 to 2 = *Low intention to use AI tools*, 3 = *Medium intention to use AI tools*, and 4 to 5 = *High intention to use AI tools*.

For the variable *Perceived usefulness*, the mean was calculated and categorized as follows: 1 to 2 = *Low usefulness*, 3 = *Medium usefulness*, and 4 to 5 = *High usefulness*.

Ease of use was calculated as follows: 1 to 2 = *Difficult to use*, 3 = *Moderate ease of use*, 4 to 5 = *Easy to use*.

Institutional support was calculated as follows: 1 to 3 = *No institutional support*, 4 to 5 = *Institutional support*.

To measure *Perceived Benefits*, the mean was calculated and classified as follows: 1 to 2 = *Low perception of Benefits* when using AI tools, 3 = *Medium perception of Benefits* when using AI tools, and 4 to 5 = *High intention of Benefits* when using AI tools.

Finally, to measure *Perceived Risks*, the mean was calculated and categorized as follows: 1 to 2 = *low perceived risk* when using AI tools, 3 = *medium perceived risk* when using AI tools, and 4 to 5 = *high perceived risk* when using AI tools.

FINDINGS

Correlational analyses using Spearman's coefficient revealed that the central constructs of the Technology Acceptance Model (perceived usefulness and ease of use) maintain significant positive relationships with the intention to use artificial intelligence tools in educational contexts, with perceived usefulness being the strongest predictor (Mias, 2018). The results showed that contextual factors such as previous experience with technology and differences between academic faculties had weak associations with the main variables, while institutional support emerged as a moderately influential element, particularly in the perception of usefulness. Additionally, it was confirmed that the intention to use is strongly associated with perceived benefits and weakly associated with risks identified by students, suggesting that the acceptance of AI tools in higher education is mainly determined by the perception of academic value and ease of implementation, with institutional support acting as a facilitator of the technology adoption process.

Table 2 shows the Kolmogorov Smirnov (KS) test, whose results indicate that nonparametric statistical methods should be applied, since the data do not belong to a normal distribution.

Spearman's correlation was calculated to check whether the *intention to use* is related to *perceived usefulness* and *perceived ease of use*, measured according to Mias (2018). See Table 3 and Figure 1.

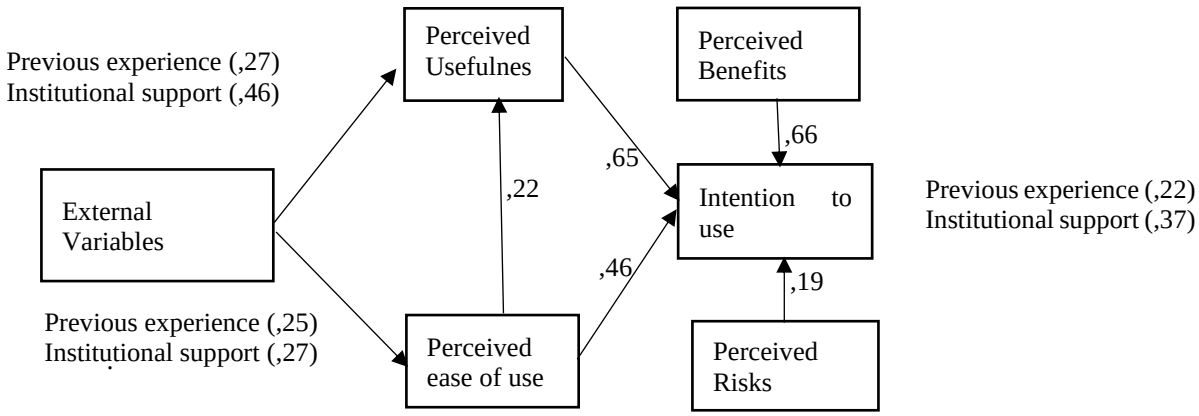

Figure 1: *Technology Acceptance Model*

The correlation between *perceived usefulness* and *intention to use* AI tools (H1) is rho = ,65, which is a *high positive correlation (Mias, 2018)*. This is because students are more willing to adopt AI tools when they perceive them as useful for their academic activities, including significantly improving their academic performance, self-regulating their learning, efficiently solving tasks, and improving the quality of their academic work.

Table 2: *Descriptive Statistics*

	Previous Experience with Technology	**Perceived Institutional Support**	**Perceived usefulness**	**Intention to Use**	**Ease of Use**	**Benefits Perceived**	**Risks Perceived**
N Valid	190	190	190	190	190	190	190
Lost	0	0	0	0	0	0	0
Low / No	5.8%	38.9%	2.6%	3.2%	5.3%	3.2%	14.2%
Intermediate	15.8%		15.8%	28.9%	28.4%	24.7%	48.9%
High / With	78.4%	61.1%	81.6%	67.9%	66.3%	72.1%	36.8%
Mean	2.73	1.61	2.79	2.65	2.61	2.69	2.23
Standard Error of the Mean	.04	.04	.03	.04	.04	.04	.05
Median	3.00	2.00	3.00	3.00	3.00	3.00	2.00
Mode	With high previous experience	With institutional support	High usefulness	With high intention to use AI tools	Easy to use	High perception of benefits of using AI tools	Medium perceived risk when using AI tools
Std Dev	.56	.49	.47	.54	.59	.53	.68
Variance	.32	.24	.22	.29	.34	.28	.46
Curtosis	2.79	-1.81	4.09	.50	.52	1.22	-.84
Asymmetry	-1.96	-.46	-2.17	-1.22	-1.23	-1.46	-.31
Interval	2.00	1.00	2.00	2.00	2.00	2.00	2.00
Minimum	With low previous experience	No institutional support	Low usefulness	With low intention to use AI tools	Difficult to use	Low perception of benefits of using AI tools	Low perceived risk when using AI tools
Maximum	With high previous experience	With institutional support	High usefulness	With high intention to use AI tools	Easy to use	High perception of benefits of using AI tools	High perceived risk when using AI tools
Kolmogorov-Smirnov Z	6.49	5.48	6.74	5.81	5.65	6.10	3.61
Asymptotic Significance (2 tails)	.000	.000	.000	.000	.000	.000	.000

Table 3: *Spearman's Correlation*

Factors	Intention of use of AI tools	Perceived usefulness	Ease of use
Perceived usefulness	,65		
Perceived ease of use	,46	,40	
Previous experience with technology	,22	,27	,25
Institutional support	,37	,46	,27
Perceived benefits	,66	,51	,40
Perceived risks	,19	,14	,21

Regarding the correlation between *perceived ease of use* and *intention to use* AI tools (H2) is rho = .46, which is considered a *moderate positive correlation*, which indicates that, while important, it is not as crucial as *perceived usefulness*.

Statistical tests show that *previous experience with technology* and *institutional support* are external variables to the TAM model that show a correlation as follows:

Previous experience with technology has a *low positive correlation* with *perceived usefulness* (rho=,27), *ease of use* (rho=,25), and *intention to use* (rho=,22) of AI tools in education; while *institutional support* shows a *low correlation* with *intention to use* (rho=,37) and *ease of use* (rho=,27), but a *moderate correlation* with *perceived usefulness* (rho=,46).

The *low positive correlation* between the *intention to use* AI tools and external variables, such as *previous experience with technology* (rho=,22) and *institutional support* (rho=,37), remains important but not crucial, highlighting the importance of considering contextual factors in the implementation of AI tools in higher education.

These correlations led to the development of H3; a Kruskal-Wallis test was performed to compare the influence of *previous experience with technology* on *perceived usefulness* (X^2=14.72, p<,05), *ease of use* (X^2=11.91, p<,05), and *intention to use* (X^2=9.751, p<,05). This means that the null hypothesis of independence between *previous experience with technology* and the TAM variables cannot be accepted. This influence stems from the fact that students have already had contact with the use of digital technologies applied to education in the last three years, which allows them to feel comfortable exploring new technologies for their learning on their own and using them for their academic activities.

Similarly, the U-Mann Whitney test was applied to compare *institutional support* as a predictor of *perceived usefulness* (U=2724.50, p<,001), *ease of use* (U=3170, p<,001) and *intention to use* (U=2778, p<,001). This means that the null hypothesis of independence of institutional support cannot be accepted; therefore, AI acceptance behavior depends on *institutional support*. This is because the university provides its students with the necessary resources to learn how to use AI tools and has trained teachers who support them and encourage the use of this technology for learning.

To test H4, the Kruskal-Wallis test was performed to compare the faculty groups with the TAM variables, revealing that there are no significant differences between *academic faculties* and *perceived usefulness* (X^2=9.03, p>,05), *ease of use* (X^2=3.25, p>,05), and *intention to use* (X^2=4.79, p>,05); therefore, the academic faculty is not a determining factor for the perception of the TAM variables. These results coincide with the findings of Zawacki-Richter et al. (2019) and Chen, Xie, et al. (2020), who found in a systematic review that AI is interdisciplinary; that is, it does not affect the perception of the variables in the TAM model. These results confirm that institutional AI implementation strategies can be developed with unified approaches that do not require significant differentiation by faculty, thus optimizing resources and technology adoption efforts.

Continuing with the analysis of the results, a hierarchical regression model was developed to evaluate the moderation of the variables *Previous Experience* and *Institutional Support* with the TAM variables. To do this, the variables were centered by subtracting their respective means to reduce multicollinearity and facilitate interpretation. These centered values were used to create the interaction terms of the TAM variables with the moderating variables.

The hierarchical regression analysis shows that *perceived usefulness* and *ease of use* are robust predictors of the *intention to use* AI tools, while *previous experience with technology* and *institutional support* only become

relevant when they interact with the main predictors. The final model explains 53% of the variance in the *intention to use*.

The results of the three hierarchical models analyzed to predict the *intention to use* AI tools in higher education are presented in tables 4 - 8.

Table 4: *Hierarchical models of the intention to use AI tools:*

Model	Variables incluided
1	Perceived usefulness, Ease of use
2	Perceived usefulness, Ease of use, Previous experience with technology, Institutional support
3	All of the above + Interactions (Usefulness × Experience, Ease × Experience, Usefulness × Support, Ease × Support)

Table 5: *Model Adjustment Statistics*

Model	R	R^2	Adjusted R^2	Standar Error	F (df)	p
1	.70	.48	.48	.39	87.49 (2,187)	<.001
2	.70	.49	.48	.39	44.49 (4,185)	<.001
3	.73	.53	.51	.38	25.38 (8,181)	<.001

The final model (Model 3) explains 53% of the variance in intention to use, showing a substantial improvement by including interaction terms.

Regression Coefficients and Significance

Table 6: *Model 1: Main predictors*

Variable	B	Std. Error	Beta	t	p
(Constant)	.29	.18	.00	1.60	.111
Perceived usefulness	.65	.07	.56	9.55	<.001
Ease of use	.21	.05	.23	3.88	<.001

Table 7: *Model 2: Adding external variables*

Variable	B	Std. Error	Beta	t	p
(Constant)	.23	.20	.00	1.16	.249
Perceived usefulness	.60	.08	.52	7.85	<.001
Ease of use	.20	.05	.22	3.73	<.001
Previous experience with technology	.03	.05	.03	0.48	.632
Perceived institutional support	.10	.07	.09	1.47	.143

Table 8: *Modelo 3: Including interactions*

Variable	B	Std. Error	Beta	t	p
(Constant)	-.23	.32	.00	-.72	.474
Perceived usefulness	.73	.11	.63	6.39	<.001
Ease of use	.23	.05	.25	4.30	<.001
Previous experience with technology	.05	.06	.05	0.83	.406
Perceived institutional support	.05	.07	.05	0.82	.413
Interaction between usefulness and previous experience	.35	.11	.31	3.25	.001
Interaction between ease of use and previous experience	.28	.11	.22	2.51	.013
Interaction between usefulness and institutional support	.22	.20	.10	1.08	.281
Interaction between ease of use and institutional support	.15	.11	.08	1.33	.185

The results present the model with the variables P*revious Experience in Technology* and *Institutional Support* as moderators of the TAM variables, finding that:

- *Perceived usefulness* and *ease of use* are significant and consistent predictors of *intention to use* across all models ($p < .001$).
- *Previous experience in technology* and *institutional support* are not significant direct predictors ($p > .05$), but their interactions with the main predictors are:

  - T*he Utility* × *Previous Experience* (β = .31, p = .001) and *Ease* × *Previous Experience* (β = .22, p = .013) interactions are significant, indicating that the effect of *utility* and *ease of use* on intention to use is stronger in students with greater *technological experience*.
  - Interactions with *institutional support* do not reach statistical significance.
- The final model (Model 3) increases the explained variance (R^2 = .53), demonstrating the importance of considering moderating effects.

CONCLUSIONS

The results of this research provide solid empirical evidence that should guide change in organizational culture toward pedagogical innovation as an institutional value, the development of specific pedagogical policies and strategies to maximize the successful adoption of artificial intelligence tools in the university context.

The *high* correlation between *intention to use* and *perceived usefulness* (rho = .65) and the *moderate* correlation with *ease of use* (rho = .46) reveal patterns of acceptance that require structured and differentiated institutional responses. This finding (rho = .65) is in line with previous research and instrument validation on the adoption of educational technologies (Chen, Zou, et al., 2020; Gálvez-Marquina et al., 2024; Scherer et al., 2019) and recent meta-analyses confirming a high relationship between TAM variables and the acceptance and adoption of educational AI tools (Ali et al., 2024); while rho = .46 is because students are willing to put effort into learning how to use AI tools if they perceive the potential usefulness is positive and moderate, which is close to the results obtained by Navarro et al. (2023) compared with a rho = ,56 and Criollo-C et al. (2023) who identified that students consider that emerging technologies are directly proportional to their academic performance so they are willing to learn to use them.

These findings can be considered when formulating strategies for more effective implementation of AI in higher education, thus contributing to the evolution of teaching and learning methods in the digital age.

1. The variables of the Technology Acceptance Model (TAM) are *positively related* to university students' acceptance of the use of AI tools in education.
2. The external variables of *previous experience with technology* and *institutional support are positively related* to the TAM variables, and are also predictors of the acceptance of AI in university higher education.
3. The academic faculties of the participating students do not affect the acceptance of AI tools in university higher education given their transversality, validating the universal applicability of the TAM for AI tools regardless of the specific field of study.

These findings are consistent with other studies that emphasize the importance of context in the adoption of educational technologies (Holmes et al., 2019, p. 161), suggesting that the type and quality of previous experience modulates its influence on intention to use. Criollo-C et al. (2023) found that technological familiarity acquired during 2020-2023 acts as a catalyst for the adoption of new educational technologies. The phenomenon has been conceptualized by Morocho Pintag et al. (2025, p. 2842) as *fostering AI skills* "essential for maximizing the benefits of AI and digitization in society, promoting their adoption in a responsible and equitable manner".

As for institutional support, recent studies demonstrate its critical role as an enabler of adoption. Khushalani (2025) reported that institutions that provide proactive academic support enhance human-centered services. Recent empirical evidence consistently supports these findings. Coreas-Flores & Romero-Argueta (2024) found that students perceive virtual learning environments that institutionally support their academic processes as useful. For its part, the group on artificial intelligence in higher education at the Diálogo Interamericano (2025) identified that higher education institutions have implemented good practices to ensure the adoption of AI, including: curriculum adaptation, adjustments to their assessment strategies, teacher training, and student support (face-to-face tutoring, expanded access to devices and resources, and partnerships to reduce the digital divide).

Higher education institutions should develop implementation policies that recognize the differential importance of the factors identified in this study. The predominance of *perceived usefulness* as the main predictor suggests that institutional policies should prioritize clear and tangible demonstration of the academic benefits of AI tools over ease of use. This implies establishing impact assessment frameworks that document improvements in academic performance, learning efficiency, and the quality of student work.

Evidence on the influence of *institutional support* on *perceived usefulness* (rho = .46) calls for the establishment of regulatory frameworks that not only authorize the use of AI but also actively promote its responsible adoption. Policies should include clear protocols for student data protection, algorithmic transparency, and equity in

technological access. In addition, it is essential to establish educational AI ethics committees to oversee implementation and continuously evaluate the impact of these technologies on the academic community.

The findings on the dependence of *usefulness* and *ease of use* on *institutional support* justify a budget redistribution that prioritizes investment in educational AI infrastructure. Institutions must allocate specific resources for the acquisition of AI tool licenses, the maintenance of technological infrastructure, and, crucially, the creation of specialized technical-pedagogical support units that act as facilitators of adoption.

This same positive correlation highlights the critical need to develop teacher training programs that go beyond basic technical training. Teachers require specialized training in three areas: technical skills to operate AI tools, pedagogical skills to integrate AI into existing teaching methodologies, and ethical skills to manage the moral and professional implications of using AI in education.

These programs should include practical workshops where teachers can directly experiment with AI tools in simulated teaching contexts, pedagogical innovation labs where they can develop specific applications for their disciplines, and spaces for ethical reflection on the transformative impact of AI on their professional roles.

Institutions should create support ecosystems that include pedagogical innovation centers with staff specialized in educational AI, networks of innovative teachers who share experiences and best practices, priority access to premium AI tools for pedagogical experimentation, institutional time for experimentation and development of AI skills, and academic recognition systems that value pedagogical innovation with AI.

On the other hand, the results regarding students' willingness to invest effort when they perceive usefulness demand training strategies that emphasize concrete academic benefits rather than technical ease. Institutions should develop AI literacy programs that include practical demonstrations of improved academic performance, workshops on specific tasks for each degree program, and peer-to-peer mentoring sessions where students with greater technological experience support their peers.

The evidence of insignificant differences between faculties, contrary to international patterns, suggests a unique opportunity to develop cross-cutting but contextually relevant curriculum integration methodologies. Each faculty should develop specific use cases that demonstrate how AI can solve particular academic problems in their discipline, create interdisciplinary collaborative projects that leverage convergence in attitudes toward AI, and establish pedagogical experimentation labs where students and teachers co-create innovative applications.

The findings on the influence of *prior experience* (low but significant correlations) indicate the need for learning paths that take into account varying levels of technological competence. Institutions should implement digital skills assessment systems upon admission, technology leveling programs for students with less experience, specialized tutorials in educational AI available throughout the academic cycle, and physical and virtual spaces dedicated to experimentation with AI tools.

Regarding the implementation of these initiatives, empirical evidence suggests a phased approach that begins with pilot projects in areas of greatest receptivity, continues with gradual expansion based on evidence of success, and includes ongoing evaluation of the impact on TAM variables. Each phase should include feedback mechanisms that allow for real-time adjustments, rigorous documentation of best practices, and systematization of lessons learned for replication in other areas.

The *intention to use* AI tools among university students is mainly determined by *perceived usefulness* and *ease of use*. However, these effects are significantly enhanced in students with greater *prior experience* in technology, suggesting the need for differentiated training and support strategies. Institutional support, although relevant in the literature, did not show significant direct or moderating effects in this model.

The results of the hierarchical regression model confirm the centrality of *perceived usefulness* and *ease of use* as predictors of the *intention to use* AI tools, with significant moderating effects of prior experience with technology.

The hierarchical model analyzed shows that *perceived usefulness* and *ease of use* are the most robust predictors of AI *usage intention*, explaining up to 53% of the variance ($R^2 = .53$). These results are consistent with international findings:
In the present study, *perceived usefulness* and *ease of use* are found to be the main predictors of *intention to use*. The hierarchical model analyzed shows that *perceived usefulness* ($\beta = .63–.56$) and *ease of use* ($\beta = .25–.23$) are the most robust predictors of AI *usage intention*, explaining up to 53% of the variance ($R^2 = .53$). These results

are above the values reported in meta-analyses and systematic reviews on TAM in educational AI contexts, where *perceived usefulness* has a coefficient of β = 0.374, while *ease of use* does not have a significant impact (Vivanco Enriquez et al., 2025). The variance explained by the model is also above $R^2 = 0.435$ reported internationally by Torres Nabel & Basilio Rizo (2025), which reinforces the validity and robustness of the results obtained.

Although *prior experience* with technology did not show a significant direct effect on *intention to use*, relevant moderating effects were identified: the interaction between *perceived usefulness* and *prior experience* (β = .31, p = .001), and between *ease of use* and *prior experience* (β = .22, p = .013) were significant. This indicates that the impact of the main TAM predictors is stronger in students with greater technological experience.

These findings are consistent with recent research that has incorporated moderation analysis and multivariate models, which shows that prior experience amplifies the relationship between *usefulness/ease of use* and *intention to use* (Acosta-Enriquez et al., 2024). Similarly, they have reported that students with less *prior experience* with technology have higher expectations of effort in relation to their *intention to use* AI in higher education. For their part, Choudhary et al. (2025) identified that students in technical careers, who by their nature have more experience with the use of technology, show more favorable attitudes toward the adoption of AI in higher education.

In contrast to some of the literature, *institutional support* did not show any significant direct or moderating effects on the *intention to use* in the model analyzed. Although the literature recognizes *institutional support* as a key facilitator for AI adoption (García-Peñalvo, 2021; Zawacki-Richter et al., 2019), several recent studies have found that its impact is mainly manifested through improved perceptions of *usefulness* and *ease of use*, rather than as a direct predictor of *intention to use*, as expressed by Zhao et al. (2025), who identified that *institutional support* improves *ease of use* (β = 0.288, p < 0.001) and *perceived usefulness* (β = 0.179, p < 0.001). The findings of Zhao et al. (2025) explain 47.8% of the variance in student attitude (R2 = 0.478) and 59.5% in *intention to use* (R2 = 0.595). *Institutional support* in the form of resources, training, and encouragement is essential to bridge the gap between students' technical skills and technology adoption by leveraging *institutional support* infrastructure (Sova et al., 2024). This suggests that *institutional support* should be operationalized in a more specific and visible way to directly influence *adoption intent*. This implies that universities can offer training and instruction among students, fostering environments in which they feel confident to learn and use AI tools like any other technological support in the classroom (Ifenthaler & Schweinbenz, 2013).

In summary, the results of this research provide a solid empirical basis for the development of institutional strategies that not only promote the initial adoption of AI tools but also ensure their sustainable and scalable integration into the educational ecosystem. Evidence on the importance of students' prior experience in using technology and institutional support as moderators of intention to use based on perceived usefulness and ease of use offers higher education institutions an evidence-based roadmap for successfully addressing educational digital transformation, positioning them as leaders in the responsible and innovative integration of artificial intelligence in 21st-century higher education.

For future research, it is recommended:

- Explore the acceptance of AI tools in different cultural and geographical contexts.
- Investigate the long-term impact of AI tool use on learning outcomes.
- Examine the ethical and privacy implications of using AI in higher education.

Limitations

This study has several limitations that should be considered when interpreting the results. First, the cross-sectional design used prevents establishing causal relationships between the variables of the Technology Acceptance Model and the adoption of AI tools. The sample was limited to students from a specific geographic region of El Salvador, which significantly restricts the generalization of the findings.

Generalization beyond the Salvadoran context faces particular challenges due to cultural differences, technological infrastructure, and educational systems that characterize developing countries. Cultural factors may moderate the relationships proposed by TAM, especially in societies with different individualistic/collectivist values and levels of trust in technology. In addition, digital divides and varying degrees of digital literacy prevalent in the region limit the direct transferability of these results to contexts with different levels of technological development.

The exclusive use of self-report measures is another significant limitation. These instruments are susceptible to social desirability bias, personal presentation, and memory errors when recalling previous interactions, which can

distort reported perceptions of the *usefulness* and *ease of use* of AI tools. Self-report measures often overestimate actual technology use and show weak correlations with objective performance assessments.

It is recommended that future research incorporate longitudinal designs, diversify samples geographically and culturally, and triangulate self-report data with objective measures of technology use to improve the validity and generalizability of findings.

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