TAMSAAL
ISSN Print: 3007-5939
ISSN Online: 3007-5947
Volume 4, Number 9, 2026, Pages 244 – 272
Journal Home Page
https://tamsaal.pk/index.php/tamsaal/index

Investigating Pre-Service Teachers' Experiences with AI Chatbots for Improving Digital Literacy in Quality Education

Aiza Noreen Mohil[1], Dr. Asad Ali Manzoor[2]

[1]*Scholr Department of Education University of Narowal Email: aizaamir061@gmail.com*
[2]*Lecturer Department of Education University of Narowal Email: asad.manzoor@uon.edu.pk*

ARTICLE INFO

Article History:

Received:	*July*	*13, 2026*
Revised:	*September*	*05, 2026*
Accepted:	*September*	*12, 2026*
Available Online:	*September*	*17, 2026*

Keywords:
AI chatbots, Digital literacy, Pre-service teachers, Teacher education, Quality education, Educational technology

Corresponding Author:
Dr. Asad Ali Manzoor
Email:
asad.manzoor@uon.edu.pk

DOI: *https://doi.org/10.59075/tamsaal.v4i9.200*

ABSTRACT

This research Investigate the experiences of pre-service teachers with AI chatbots aimed at enhancing digital literacy for quality education at the Department of Education, University of Narowal. The research was utilized a qualitative phenomenological design that aimed to delve into how BS and M.Phil students perceived the role of AI chatbots in developing their digital skills, confidence, and instructional readiness. Data collection was through semi structured interviews from(n=20)thirty participants including twelve BS and eight M.Phil students of Fall 2026 semesters. The researcher made use of NVivo 12 for conducting a thematic analysis of the interview data and word cloud to signify the major ideas. The purpose of the research was to investigate the perceived usefulness, challenges in using AI chatbots, and adoption of AI chatbot in digital literacy practices. The findings were revealing the AI chatbots have the potential to support reflective learning, problem solving and technology integration among the pre service teachers. The research also uncovers barriers including limited training, ethical issues, and access. The research provided evidence informed insights to enhance the AI tools integration in curriculum and professional preparation of teacher education. These results were meant to inform policymakers and teacher educators to design efficient digital literacy programs aligned with quality education goals.

© 2026 The Authors, Published by ULLR. This is an Open Access Article under the Creative Common Attribution (CC-BY 4.0)

Introduction

Innovations in technology continuously alter classroom practicesand the way teachers are expected to undertake their professional duties. In contemporary classrooms dominated by technology, instructors must upgrade their methods and utilize electronic tools for teaching, assessment, and communication in addition to classroom management. Technology in Education refers to the integration of technology into the education arena that has boosted the need for a digital-savvy educator who possesses pedagogic capabilities. Consequently, the future teacher education programs are focusing on the preparation of teacher candidates with the knowledge, confidence, and skills to participate in digitally enhanced learning.

Artificial Intelligence on education is one of the most influential technological developments among other technology innovations. In addition to the personalized instructions, immediate responses along with interactive learning experiences, the AI applications are presenting various opportunities towards the betterment of teaching and learning processes. In the new field of AI, chatbots play a crucial role by engaging users and offering instant support through conversational interaction. According to Winkler and Sollner (2018), AI chatbots are smart digital assistants that communicate with learners like humans, offering support, answering questions, and giving feedback like humans do. Because they are interactive, they may be used either as tools to enhance learning or as tools to supplant learning. AI chatbots offer a variety of services for education. Teachers are using various tools and technologies that encourage students to participate in the learning process by giving them the opportunity to ask questions, explore ideas and get help based on personal needs. According to a study in 2020 by Fryer and Carpenter, chat-bots can promote autonomy, engagement and flexibility. Interacting with AI chatbots provides pre-service teachers with meaningful opportunities to build their technological confidence and see how technology can be integrated into teaching practices. Future teachers can use AI-supported resources to experiment which can give them valuable experience and can help them use technology effectively.

Today, professional teachers in the classroom are expected to be digitally literate. The European Commission (2018) defined digital literacy as the knowledge, skills, and attitude, as well as the ethical understanding of using digital technologies. For would-be instructors, digital literacy isn't just using technology or surfing the internet for info. They include the ability to critically evaluate digital resources, create technology-based learning resources, communicate through digital platforms and select appropriate technology according to learning objectives. Teachers who want to provide meaningful and technology-supported learning opportunities must possess these competencies.

Problem of the Statement

Global education frameworks highlight the necessity of digital literacy for teacher readiness. However, several teacher education programs have not distinctly articulated strategies for the development of such competencies (European Commission, 2018; UNESCO, 2021) Pre service teachers are highly skilled at using technology, although the level of use can vary widely as they enter training. Studies suggest that different teachers at the 'pre-service' level receive limited guided practice with more advanced and innovative educational technologies, such as artificial intelligence (AI) tools among other subjects (Kimmons & Hall, 2016; Ortega, 2022). While AI chatbots may be beneficial in supporting personalized learning, there is little research on the digital experiences, practices and literacies of the preservice teachers with the use of these tools (Holmes et al., 2021). Teacher educators are at risk of adopting artificial intelligence technologies without empirical evidence that demonstrates pedagogical value or the alignment with quality education goals. This knowledge gap is a barrier to embedding AI chatbots into teacher preparation, as well as preparing confident educators who make effective use of digital technologies in a range of learning contexts (Van Deursen & Helsper, 2015). Through an examination of pre service teachers' experiences with AI chatbots, we will identify best practices to strengthen digital literacy development within quality teacher education.

Significance of the Study

This research provides educational research data on the experiences of trainee teachers with AI chatbots, and how AI knowledge is being utilized. This broadens conceptualizations of literacy in teacher education beyond competency checklists to engage in authentic engagements with AI tools. These results can help teacher educators understand the conditions that enable or hinder digital skill development (Ng, 2015).Most especially in contexts where quality education outcomes are a high priority. This study will contribute to curriculum design, instructional strategy, and technology policy in teacher education by identifying challenges and enablers. Policymakers can leverage these insights to assist in building guidelines for digital literacy standards that include Ai based tools. This research can also assist educators in preparing the future teachers with confidence and competence to use devices to enhance learning outcomes (Fryer & Carpenter, 2020).

Research Objectives

1) To explore the perceptions of pre-service teachers regarding the use of AI chatbots for developing digital literacy skills.

2) To evaluate how interaction with AI chatbots influences pre-service teachers' confidence and competence in digital instructional practices.

3) To identify the barriers and supports that shape pre-service teachers' experiences with AI chatbot tools inteacher education programs.

Research Questions

1) What perceptions do pre-service teachers hold about the effectiveness of AI chatbots for improving digital literacy?

2) How does engagement with AI chatbots impact pre-service teachers' confidence in using digital tools for teaching and learning?

3) What challenges and enablers do pre-service teachers encounter when using AI chatbots in their professional preparation?

Review of Related Literature

Digital literacy is an essential skill of the 21st century educator, which is the ability to access, evaluate, and create digital content, as well as communicate with technology (European Commission, 2018). The notion of digital literacy in teacher education is not limited to operational capacity; rather, it expands to the use of technology in pedagogical practices to enhance student learning (Ng, 2015). The fast-growing artificial intelligence (AI) contains a range of tools that can help improve digital literacy. In a broader picture, AI chatbots are gaining recognition as tools that offer interactive, personalized, and real-time learning support (Winkler & Söllner, 2018). Although there has been a lot of research into the use of AI tools in general education, not much has been done on the experience of pre-service teachers with an AI Chatbot. This literature review offers a critical overview of the research into AI chatbots, their use in teacher education, and their role in digital literacy. In identifying the existing gaps in the

literature and placing the present study in that context, the study will provide a backdrop for understanding how AI-based chatbots may provide quality education through pre-service teacher development.

Artificial Intelligence (AI) is one of the key aspects of this digital revolution. AI technologies are being utilized in educational settings to better support personalized learning, to automate educational processes, to deliver intelligent feedback to students, and to improve educational decision making. AI-powered systems can interpret user interactions, create responses, and offer adaptive support based on the learner's needs, facilitating more dynamic and responsive engagement. Unlike traditional digital tools that often simply deliver content, AI-driven systems can process user interactions, generate responses, and deliver adaptive support tailored to the learner's needs. Education, much like other sectors, has seen AI open new avenues for enhancing teaching effectiveness and student engagement in their academic pursuits (Holmes et al., 2019). AI chatbots are programs with artificial intelligence that use artificial intelligence to process language and give instant answers to inquiries. AI chatbots could serve as virtual learning assistants in educational settings, offering explanations, answering questions, aiding learning tasks, and helping with independent learning. The features of AI chatbots are especially relevant for teacher education, since pre service teachers need to learn how to master them in order to acquire digital skills in the context of their practical experiences with emerging technologies (Winkler & Söllner, 2018).

Evolution and Role of Artificial Intelligence in Education

Artificial Intelligence (AI) was introduced in the mid 1960's when it was determined that machines could mimic certain aspects of human intelligence: reasoning, learning, decision making, and problem solving. Early AI studies were on building a system able to carry out specific intellectual functions based on predetermined rules and logic. These were mostly symbolic AI systems, using hard-coding of rules to let machines deal with structured problems (Russell & Norvig, 2021). These early systems were not very adaptable, but they laid the groundwork for future work on intelligent technologies. In the early years of the development of AI, there were limited applications in the field of education, but over the years these spread and were expanded with the introduction of computer assisted instruction. Researchers started using the principles of AI in the field of education during the 1970s and 1980s with the use of intelligent tutoring systems (ITS). These were among the first to develop systems to help create personalized learning environments with instructional support akin to human tutors. Intelligent tutoring systems aimed to determine the level of knowledge of the student and determine the defects in their learning and give them personalized feedback according to their needs (Woolf,2009). Intelligent tutoring systems sought to develop adaptive learning experiences with computer systems that "reacted" to the learner's responses, as opposed to the fixed content of traditional computer based learning systems. This was a major transition from technology being merely a vehicle to deliver content to technology being an interactive learning partner.

Artificial Intelligence in the Context of Educational Technology

One of the most significant uses of AI in education is the development of AI chatbots, which are becoming a novel form of digital assistant to aid in teaching, learning, and professional growth.AI technologies are rapidly evolving and revolutionizing the learning landscape, enabling technologies to engage with students, offer individual support, and contribute to the

creation of knowledge. One of the most important advances in this technological revolution is the implementation of AI chatbots, which allows users to communicate with computer systems in a manner similar to human communication. These intelligent systems are intended to mimic human conversation through chatting or speech, and enable the user to ask questions, clarify, and get immediate answers. Unlike conventional digital learning materials which deliver static content, AI chatbots leverage sophisticated computational strategies to produce dynamic responses, tailored to the users' requirements and interactions.

AI chatbots are powered by natural language processing (NLP), machine learning and artificial intelligence algorithms. The power of natural language processing allows chatbots to comprehend human speech, understand user intent, and generate appropriate responses. These systems can learn from the data and interactions with users, continuously improving their performance uusing machine learning algorithms. Using these technologies, AI chatbots can read questions, understand the content, and respond in a manner similar to human beings. In an educational context, these capabilities enable chatbots to serve as dynamic education assistants, offering information, answering academic questions, assisting in problem-solving tasks, and guiding learners throughout their educational journey (Winkler & Söllner, 2018). Recent advances in AI have made its applications in education more widespread. Previous educational chatbots were primarily created to deliver pre-stored answers from small databases. Today, however, Chatbots have been given far more capabilities with the advent of modern generative AI that can grasp information-rich queries, create original content, elucidate complex concepts, summarize educational material, and even provide context-specific feedback. The advancements have made AI chatbots more helpful in formal and informal learning settings. Kasneci et al.(2023) noted that Generative Artificial Intelligence has opened up new avenues in education such as personalized learning, enhanced information access, and teacher and student support in academic tasks and highlighted its importance for tomorrow.

The educational value of AI Chatbots in teaching and learning

AI’s rapid evolution brings forth a range of opportunities to enhance teaching and learning methods and revolutionize educational practices. AI chatbots are interactive, adaptive, and accessible and as such, have been a major talking point in the realm of AI applications. AI chatbots are intelligent conversational learning assistants which give out information, feedback, explanations, and guidance with human-like interactions. These tools can be used in educational environments to support pre service teachers, teachers and students to enhance learning experiences, improve instructional practices, and build critical digital skills. AI chatbots have also been recognized for their potential to support personalized learning, learner autonomy, engagement, instruction, and development of digital literacy (Fryer & Carpenter, 2020; Holmes et al., 2021).

One of the most significant educational benefits of AI chatbots is personalized learning. In traditional education systems, teachers are usually expected to adhere to a one-size-fits-all method of teaching and providing educational services to students, regardless of their special needs and/or differences. But students have various prior knowledge, learning speed, interest and educational needs. AI chatbots overcome this challenge by offering personal answers to learners' questions, preferences, and levels of understanding. These systems are capable of interpreting user interactions and responding to matches with individual users' needs. This adaptive

capability helps to develop more student-centered learning experiences in which learners can get support based on their individual learning situations.

Digital Literacy in the context of teacher training

The Education sector has undergone digital transformation, and this has had a profound impact on the nature of education and has altered the expectations held for the teaching profession. Digital technologies, artificial intelligence, e-learning platforms, learning management systems and digital communication tools have grown to open up new opportunities for teaching and learning. In the modern educational setting, teachers should not merely act as lecturers and subject experts but should also take on other roles that are required to help the students. Rather, they must be facilitators of learning who have the ability to identify, assess and adopt digital technologies in a way that enhances learning practices, can be used with a wide range of learners and can improve learning outcomes. It has transformed digital competence into a key competence that teachers need as part of their professional requirements, especially for the pre service teachers who are entering technology-rich classrooms.

Digital literacy amongst pre service teachers is not limited to knowing how to use digital devices or running basic software applications. It is the integration of a range of technical skills, thinking skills, ethics, and pedagogy. Ng (2015) described digital literacy as having three key aspects: technical, cognitive and social emotional. Technical literacy is the capacity to interact with digital technologies and cognitive literacy is the capacity to appraise, analyze and produce information with digital resources. Social emotional literacy is about being responsible, ethical and safe in digital environments. The dimensions illustrate that digital literacy is actually a complicated competency which entails teachers being critical and responsible users of technology. Digital literacy is an essential prerequisite for pre service teachers to build confidence in the use of technology and to create innovative learning experiences. Teachers who have high digital literacy can better choose digital resources, plan activities with the help of technology and adjust the teaching methods according to the needs of students. Digital literacy also helps teachers assess the impact of digital tools as well as identify if a particular technology facilitates meaningful learning or if it simply introduces technology into the classroom.

Contribution of AI Chatbots to Quality Education

AI chatbots have the potential to contribute significantly to quality education by supporting personalized learning, improving instructional efficiency, and increasing access to educational assistance. AI chatbots offer interactive communication, allowing users to ask questions, get explanations, and get quick answers, unlike traditional digital media where users just receive the information and cannot ask questions or get feedback. The interactive capability of AI chatbots proves beneficial for both teachers and students. AI Chatbots have one significant benefit: customized learning assistance. In traditional classrooms the ability to give one to one attention to each learner is often limited. AI chatbots can solve this problem by providing personalized explanations and answers to the learners' needs. Holmes et al. (2021) emphasized the use of AI to optimize educational services based on the needs of the learners, thereby improving personalized learning. Pre service teachers get to experience personalized learning and learn the potential application of AI chatbots in the classroom.

AI chatbots can also enhance instructional planning and teaching preparation. Teachers who are planning to teach can leverage AI to brainstorm lesson concepts, create learning activities, structure lesson content and experiment with various teaching methods. These experiences can help build their pedagogical creativity and confidence. Fryer and Carpenter (2020) noted that with the use of chatbot technologies, learning engagement can be supported by providing interactive support and motivating learners to engage in knowledge construction activities. Another crucial aspect of AI chatbots is their role in enhancing access to educational resources. AI tools help teachers and learners get explanations, examples, and learning materials, without relying solely on traditional sources. This adaptability facilitates the ongoing development and enhancement of the teaching profession. For pre service teachers, AI chatbots can be used as professional learning assistants, aiding their preparation for future assignments in the classroom.

Finally, AI chatbots could potentially play a role in inclusive education by offering extra support to a variety of learners. Digital technologies can provide flexible learning opportunities for students of varying learning needs and abilities. Technology can be used to assist inclusive education, provided it is put in place based on learners' needs and with the adequate preparation of teachers, according to UNESCO (2021). While these advantages suggest that AI chatbots can play a role in enhancing the quality of education, their impact relies on responsible implementation. Information created by AI has the potential for inaccuracies, and over-reliance on AI tools could have a negative impact on critical thinking skills. This means teachers need to learn to assess AI-generated content and use technology as a powerful assistive tool, not one that replaces their own expertise. An ethically aware, digitally competent workforce and institutional support are essential for the effective incorporation of AI.

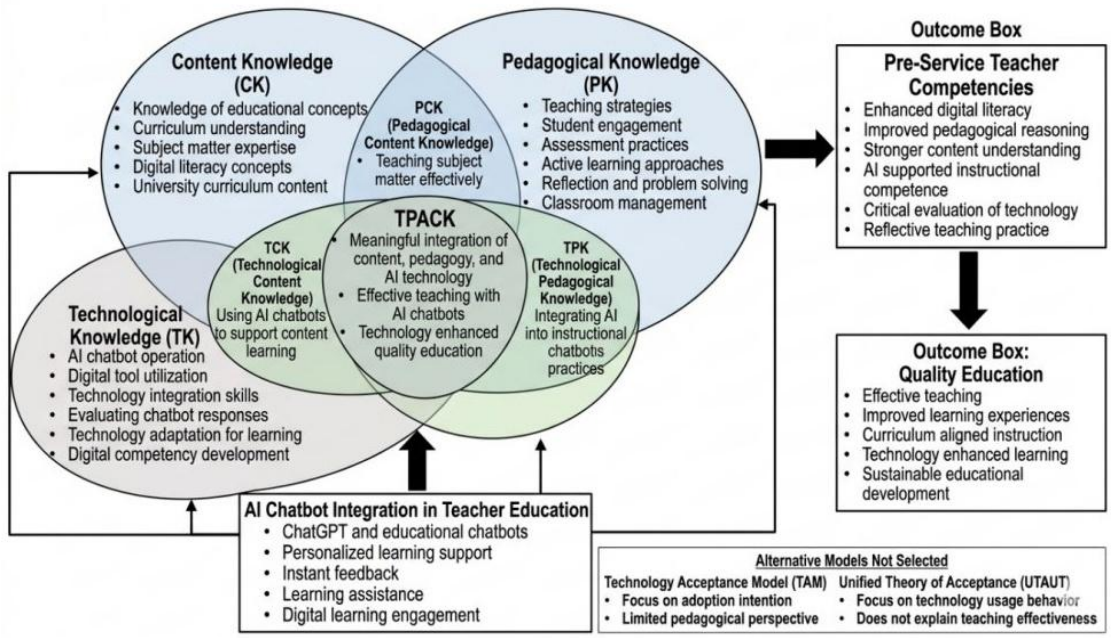
AI chatbots are a promising application of technology in support of teachers' professional development, helping teachers to improve their digital competence, and generating more interactive learning environments, overall. But, the educational value of these technologies depends on the preparedness of the teachers to utilize these technologies. Therefore, AI Chatbot experiences must be an integral part of teacher preparation programs to equip the future educators with the ability to use AI responsibly and effectively. Researches on AI chatbots in teacher education recently shows several prospects and challenges. Chatbots have been used to support lesson planning, resources navigation, professional reflection learning, enable pre-service teachers to develop problem solving, reflective thinking as well as enhance their digital literacy (Zhaoet al., 2025). AI chatbots, for instance, can simulate classroom situations whereby pre-service teachers are asked to make instructional decisions and reflect on their actions, thus developing pedagogical content and technological competence.

Additionally, chatbots provide an opportunity for teacher candidates to make mistakes and learn from them in a low-stakes environment (Fryer & Carpenter, 2020). Despite this, several issues arise, including unequal accessibility of technology, inconsistency in chatbot design, and insufficient integration in formal curricula. The existing studies are deficient in moral considerations such as data privacy, algorithmic bias and transparency in AI processes. Hence, it is necessary to conduct research for examining the lived experiences of pre-service teachers in structured contexts (Emoocs, 2025).

Theoretical Framework

For this study researcher will use the Technological Pedagogical Content Knowledge (TPACK)framework (Mishra & Koehler 2006). TPACK proposes that effective teaching using technological tools takes place at the intersection of CK, PK and TK. Within this scheme, CK means knowledge of the content; PK comprises teaching strategies, assessment as well as learner engagement; and TK concerns the effective use of digital tools, such as AI chatbots. TPACK fits this study very well because it focuses not only on whether pre-service teachers use chatbots but also on how the use of chatbots can combine all three areas, namely pedagogical reasoning, content knowledge and digital literacy development. Alternative frameworks, such as Technology Acceptance Model (TAM), are mainly focused on a behavioral intention and adoption but it does not integrate pedagogical issues hence, these are not applicable for studying educational impact. The TPACK framework provides an understanding of how AI chatbots can help pre-service teachers develop competencies to achieve Quality Education.

Figure 1: Theoretical Framework



The researcher picked TPACK framework for the study because it not only examines technology use but technology use in a meaningful manner along with pedagogy and content knowledge. According to TPACK framework, AI chatbots are not just digital technologies; they are also instruments for enhancing pedagogy, content and digital fostering at the same time. The framework enables the researcher to examine the manner in which pre-service teachers integrate these knowledge domains in practice while reflecting on their experiences and considering the circumstances under which AI chatbots contribute to quality education. In this context, other alternative theoretical models such as the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology focuses only on behavioral intentions, uptake, and the perceived utility of technology. Although valuable for explaining the reasons

behind technology use by individuals, these models do not inform pedagogical decision-making or the interplay with content knowledge, thus limiting our understanding of AI chatbots' educational impacts. In contrast to this, TPACK offers a view of technology adoption that embraces both teaching effectiveness and curriculum appropriateness.

Research shows that AI chatbots can help with engagement, adaptive scaffolding and reflective learning practices (Fryer & Carpenter, 2020; Labadze et al., 2023). Chatbots in teacher education have the potential to enhance digital literacy, which reinforces skills to navigate, evaluate and create digital content while enhancing pedagogical reasoning (Zhao et al., 2025).These benefits are well noted in literature. However, integration from a pedagogical perspective is not consistent. Likewise, the lived experiences of pre-service teachers with chatbots also remain underexplored. Underexplored are the ethical, contextual, and infrastructural factors governing the adoption of chatbots which identify the need for research studies using authentic experience with structured teacher education programs. Through the identification of these gaps, the present research helps advance understanding of how AI chatbots can be used purposefully to enhance the digital literacy, confidence and professional capabilities of pre-service teachers which help enhance quality education.

The literature being reviewed is highlighting that artificial intelligence, digital literacy, teacher education as well as quality education are related concepts that have gained significance in these times. The artificial intelligence of things educates and instructs the students. Artificial Intelligence (AI) is the simulation of human intelligence processed by machines especially computer systems. Artificial Intelligence chatbots have become significant educational tools as they help learners communicate with digital systems through natural language. Based on research, AI chatbots can support students by providing explanations, answering questions, helping with academic tasks and teaching them to learn on their own (Winkler & Söllner, 2018).

Research proves that the implementation of chatbot teaching with respect to education positively correlates with the development of digital literacy of teachers and learners. Digital literacy is now much more than just computer skills. According to the European Commission, having digital competence refers to the ability to communicate, solve problems, manage information, and use technology professionally. According to UNESCO (2021), teachers are expected to design technology supported learning environments, select suitable digital resources, and prepare students for participation in a digitally connected society. Thus, digital literacy has been recognized as an essential tam competency or professional prerequisite for teachers. Moreover, the literature highlights that pre service teachers are a key group for educational digital transformation because their knowledge and experiences with technology influence classroom practices. Teacher education programs should offer fruitful opportunities to future teachers to engage with technologies and get confidence in technology-oriented practices. Nevertheless, earlier studies have suggested the inability of many teacher education programs in developing higher digital competencies among pre service teachers due to the lack of opportunities, support and training (Kimmons & Hall, 2016).

Research Materials and Methods

Research Design

The research was use a qualitative research design to examine the pre-service teachers' experiences with AI chatbots and how it impacted their digital literacy. A qualitative approach was selected to obtain participants' perspectives, experiences and reflections in an open-ended manner, which cannot be captured through a quantitative approach (Creswell & Poth, 2018). The focus was on gaining rich and meaningful insights into how pre-service teachers in the Department of Education, University of Narowal, engaged with AI chatbots and the advantages and challenges they face and strategies for enhancing digital literacy (Piran & Tran, 2024). The phenomenological approach was appropriate for the study because it explores lived experiences, how they make sense of things, and how people use technology. This design approach helped to understand the subjective experience of BS and M.Phil education students and the AI chatbots (Flick, 2018).

Population of the Study

The pre-service teachers studying in the Department of Education, the University of Narowal, comprising BS and M.Phil students comprised the population. The selection of participants who had experienced AI chatbots in the context of their digital literacy or teaching practice modules was done through purposive sampling

Sampling Procedure

In qualitative research, a population is the totality of individuals who possess the required characteristics for a given research problem (Chali et al., 2022). Meanwhile, a sample is that subset which has been chosen from the population for data collection (Bhandari, 2023).According to Patton (2015), qualitative studies most often use non-probability sampling techniques because their aim is qualitative information, not statistical generalizations (Creswell & Creswell, 2018). Purposive sampling is one of the most commonly used sampling strategies where participants are selected based on their knowledge, experience and relevance to the subject matter (Creswell & Creswell, 2018).

Research Instrument

The main tool utilized was semi-structured interview guide based on the objective of the study. The questions was aligned with the study of AI chatbot's experience, digital literacy enhancement and pedagogical. To guarantee the content validity of the guide, it was reviewed by two experts in educational research. During the interview, probing questions was used to ensure that you answer your response in-depth (Yin, 2018)

Data Analysis Procedure

Analysis of the data was use through *NVivo 12* software. Coding was done manually through thematic analysis. Thematic analysis was select in order to find repeated patterns, concepts and relationships in participants' stories, thus allowing the researcher to interpret experiences and perceptions meaningfully (Braun & Clarke, 2006).

Thematic Analysis Procedure

Data was interpreted using thematic analysis by the study. This research was refrain from counting on the software and will read and think upon the data. The process will consist of many steps. First, the interviewer was become familiar with all the transcripts/notes by repeated reading. Initial impressions will be recorded in a book. Second, open coding was done. This research was underline sentences and phrases that have significance to the research questions. In the margins, small labels will be inscribed to reflect concepts such as entrepreneurial skills, the motivational drive of teachers, challenges posed by AI, and student mindset. Third, Codes that are similar was grouped into categories. For instance, all codes referring to creativity, problem solving and innovation will go under one category. Codes outlining insufficient training, resources, and curriculum restrictions were form the next category. Fourth, the categories were developed into broader themes. Future Needs and Institutional Barriers, Role of AI in Teaching, Pedagogical Methods Enabling Entrepreneurship, and Teachers' Understanding of Job Creation could be possible themes. Fifth, the themes were evaluated by the researcher to see if they fit. Researcher was choosing quotes from the participants for each theme. The investigator will explain how this theme answers the research question and objectives.

Data Analysis and Interpretations

This chapter offers an in-depth analysis and interpretation of the qualitative data collected from pre-service teachers regarding their digital literacy and quality education in AI chatbots' perception and experience. In-depth study of the interview data was done through thematic analysis which involve coding, counting, developing of themes and interpretation. The analysis produced patterns about the perceived effectiveness, educational benefits and challenges of AI chatbots in teacher preparation program.

Research Question 1: What perceptions do pre service teachers hold about the effectiveness of AI chatbots for improving digital literacy?

The interview data was thematically analysed which indicates pre service teachers have value for AI chatbot to improve their digital literacy. AI chatbots serve as readily available learning partners who assist people in acquiring technological skills, managing information, and boosting confidence to use technology for educational use, said participants. The analysis revealed three main themes: Growth of Digital Competence, Assistance in Independent Learning, and Issues Associated with the Optimization of AI Chatbots. The following is a presentation of the themes and sub-themes.

Theme 1: Enhancement of Digital Skills

Participants consistently stated that chatbots aided the development of digital literacy skills. They said that with an AI tool, they can become increasingly more adept at using technology and digital environments for studying and other academic purposes

Sub Theme 1.1: Improved Information Searching and Evaluation Skills

Many participants noted that AI chatbots helped them learn how to search for information as well as evaluate the relevance of digital content. Users reported that interactions with chatbots offered them different sources of information and posed a challenge to responses.

Participant 2 said that; *the past, I used to search quite randomly on the internet before using AI c hatbots. The chatbot taught me to ask better questions and recognize useful information in a mor e timely manner, I found."*

Another participant 4 stated, *"AI tools guided me in comparing information from multiple sources. As a result, I am better able to judge whether or not information is reliable."*

Given these responses, AI chatbots may produce information literacy which is an important part of digital literacy.

Sub Theme 1.2: Increased Familiarity with Digital Technologies

Participants also highlighted that the use of AI chatbots enhanced their exposure to technology. Often using artificial intelligence tools made them at ease with digital platforms and technical applications.

Participant 1 reported, *"Using chatbots have increased my confidence in exploring new digital applications as I am used to how advanced technology works now"*

Likewise, another participant 3 stated, "I *discovered a lot of digital capabilities I never used before. This experience enhanced my grasp of technology".*

The results show that AI chatbots can be useful instruments for enhancing technology awareness among future teachers.

Theme 2: Support for Independent Learning

A different major theme was the potential of AI Chatbots to facilitate autonomous and self-directed learning. Participants perceived the AI chatbots as readily accessible learning assistants who do not need teacher intervention for educational development.

Sub Theme 2.1: Immediate Feedback and Guidance

Participants often express that it is convenient to get instant responses from AI chatbots. The students thought that the feature was useful to clarify concepts and solve academic queries.

Participant 5 commented, *"When I faced difficulty understanding a concept, the chatbot provided explanations immediately. This saved time and supported my learning."*

Participant 7 stated, *"The instant feedback encouraged me to continue learning independently because I did not have to wait for assistance."*

The findings suggest that immediate feedback provided by AI chatbots may enhance learner engagement and digital learning experiences.

Sub Theme 2.2: Encouragement of Self Directed Learning

AI chatbots are making learning more responsible for several participants as they explained this sentiment. Through these tooIs, they researched topics, explained things, and digitally practiced on their own.

Participant 6 claimed, *"The chatbot motivated me to undertake self-studying. I began to use educational resources and digital tools by myself"*

Participant 8 said, *"I had a tutor whenever I wanted. It was like a tutor." This has boosted my confidence in digital learning"*

The study demonstrates that Artificial Intelligence Chatbots may promote learner's autonomy which is an important aspect of digital literacy and skills development.

Theme 3: Challenges in Effective Utilization of AI Chatbot

While the participants generally perceived the digital literacy chatbots positively, they reported some challenges to their effective use of the AI chatbots.

Sub Theme 3.1: Concerns Regarding Accuracy of Information

Many participants mentioned that the responses generated by AI were not always correct. For this reason, they stressed calling information received from chatbots into question.

Participant 1 stated, *"Occasionally, the chatbot supplies inaccurate data. "Before usingthe answers, I found out, it's important to verify them"*

According to Participant 10, *"I do not completely trust everything that comes my way because some information is better to be verified from a proper academic source"*

According to the results, critical evaluations skills are still important for learning AI technologies.

Sub Theme 3.2: Need for Training and Digital Guidance

Through the participants, it was underscored that training on effective use of AI tools in the classroom was essential.

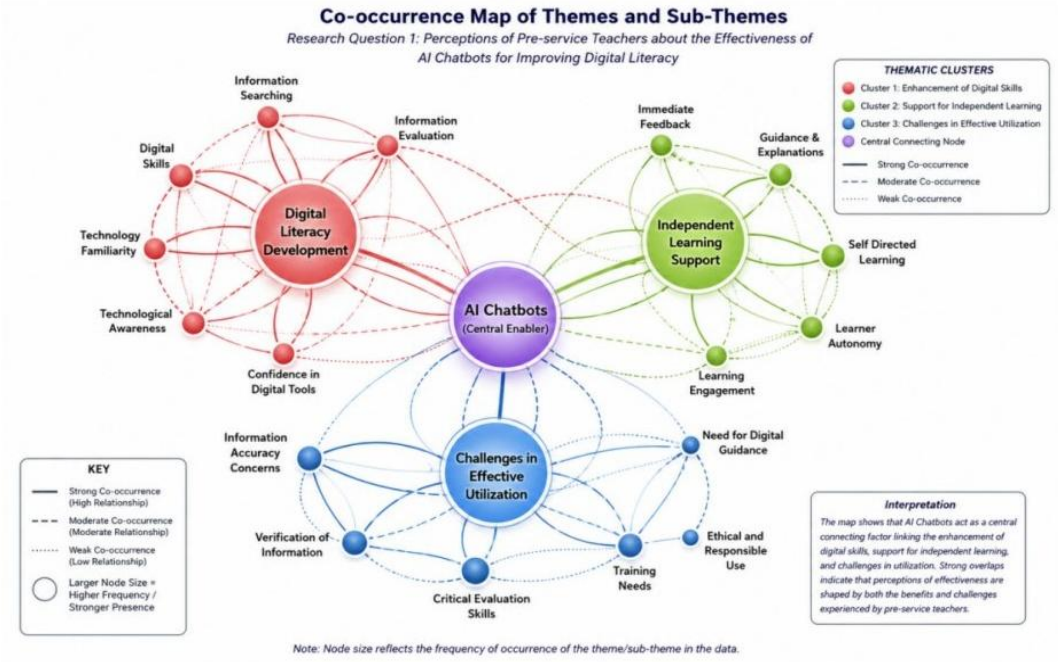
According to Participant 2, *"Many students misuse AI chatbots without having proper knowledge of them Training will help us get better results"*

According to participant 6, *"teacher education programs must guide towards ethical and effective use of AI technologies".*

Responses indicate that their educational value could be enhanced with institutional support and formal training.

The study has found that pre service teachers believe that AI chatbot is an effective tool for enhancing digital literacy. AI chatbots helped participants look for information, become more tech-savvy, learn independently, and receive instant feedback. Additionally, AI chatbots helped to build confidence in engaging with digital technologies or supported the development of independent learning skills. Nonetheless, participants mentioned that the messages could be misleading and proper training and guidance may be needed. According to the results, if AI chatbots are used in a planned manner in teacher education programs, they can significantly strengthen digital literacy of preservice teachers.

Figure 2: ***Co-occurrence map of RQ1***



As denoted by figure 2 of co-occurrence map, AI chatbots emerged as a central connecting concept linking all major categories. Size and placement of nodes reflect importance and frequency of themes, while the connecting lines illustrate strength of relationship between the themes. From the analysis, three core thematic clusters emerged: One is the enhancement of digital skills. Another is the help with self-learning. And the other is the problems with effective use of an AI chatbot.

Research Question 2: How does engagement with AI chatbots impact pre service teachers' confidence in using digital tools for teaching and learning?

The analysis of interview data showed that engagement with AI chatbots enhanced pre service teachers' confidence in leveraging digital technologies for educational purposes. In essence, participants enumerated enhanced efficacy in technology, improved instructional decision-making, and experimentation with digital resources dueto their ongoing interactions with AI tools. The three main themes that emerged from the thematic analysis were the growing confidence in the use of digital technologies, enhancing digital teaching practices, and developing professional readiness for technology-based teaching.

Theme 1: Increased Confidence in Digital Technology Use

According to the participants, conversing with an AI chatbot assured them of their digital skills. Numerous users articulated that AI tools made it easier for them to use the digital resources because they would not get it wrong.

Sub Theme 1.1: Reduction of Technology Related Anxiety

Multiple respondents affirmed that their initial hesitation while using the tool was real. Nevertheless, consistent engagement with AI chatbots brought down their anxiety and upped their willingness to use tech.

Participant 11 expressed, *"Previously, I used to be anxious about advanced technology and using it. The chatbot offered assistance every time I required help, making me more comfortable with digital tools"*

As per Participant 13, *"I feared making mistakes with technology (9 words) The chatbot instilled confidence in me as I could ask anything freely and learn at my own pace."*

According to these responses, AI chatbots create a low risk environment in which they feel confident to experiment.

Sub Theme 1.2: Improved Technological Self Efficacy

After interacting with AI chatbots, respondents felt more confident using different types of online applications. The participants in the study concluded that the experience enhanced their capacity to solve technology problems on their own.

Participant 12 comments, *"Using AI chatbots has helped me a lot over the years, especially in many of the digital platforms and educational applications"*

According to participant 14, *"I am now capable of learning new technologies on my own because AI tools helped me develop problem solving skills."*

The study finds that engaging with AI chatbots helps pre service teachers develop a higher technological self-efficacy.

Theme 2: Enhancement of Digital Pedagogical Practices

Participants expressed that AI chatbots helped in instilling confidence in the use of technology in the teaching and learning processes. Teachers considered AI tools excellent vehicles for lesson planning, content creation, and delivering instruction.

Sub Theme 2.1: Confidence in Designing Digital Learning Activities

Given that we're busy often not everyone has enough time to think and find creative ideas of their own. According to Participant 15, *"The facilities to generate ideas for classroom activities, assignments, and learning materials."*

The chatbot assisted me in developing lesson activities and discussion questions. It made me more confident in designing technology supported lessons.

The participant 17 noted, *"I learnt about unique methods to integrate digital resources into teaching. This helped me be more prepared for future classrooms"*

According to the findings, AI chatbots could enhance confidence in lesson planning and planning of online lessons.

Sub Theme 2.2: Improved Decision Making in Teaching Practices

Participants also reported that AI chatbots enabled them to examine other forms of teaching and instructions.

Participant 16 has spoken thus, *"When I create lessons, I use the chatbot to consider lesson methods. It assists me with improving learning choices"*

Participant 18 commented, *"The chatbot presents suggestions that prompt me to consider critically the teaching and learning activities"*

AI chatbots can facilitate reflective practice and support teacher decision making, the evidence suggests.

Theme 3: Development of Professional Readiness for Technology Integrated Teaching

AI chatbots were perceived as means that prepared students for the professional world of a digitally enhanced classroom.

Sub Theme 3.1: Readiness for Modern Classroom Demands

Many participants felt that AI chatbots helped them with technology expectations in today's classrooms.

Participant 2 noted, *"Schools are becoming more equipped with technology. My use of AI chatbots has trained me to meet these educational future demands"*

Participant 4 stated, *"Future educators require digital competence, I think. AI tools assisted me in acquiring skills for modern-day teaching"*

Involvement with the AI chatbots is found to help students become more employable.

Sub Theme 3.2: Motivation to Explore Emerging Technologies

After utilizing AI chatbots, study participants were more interested in learning about ICT.

Participant 3 observed, *"The pleasant encounter made me look into other educational technologies that can further teaching and learning"*

Participant 5 clarified., *"The educational feature of AI chatbots motivated me to keep up with technological changes."* The AI chatbot experience could facilitate the continuous professional learning as well as technological curiosity.

The research findings indicate that use of AI Chatbots positively influence pre service teachers' confidence in using digital tools for teaching and learning. The participants experienced less anxiety related to technology, felt more capable in using technology, were more confident at designing digital learning activities, and improved their instructional decision making. Furthermore, engagement with the AI chatbot improved professional readiness to teach in technology integrated classrooms and provoked participants to explore the new e-learning technologies. Overall, the results indicate that AI chatbots can be effective learning supports

enabling pre service teachers to become more confident and competent in digital instructional practices thus contributing to quality teacher preparation in the digital age.

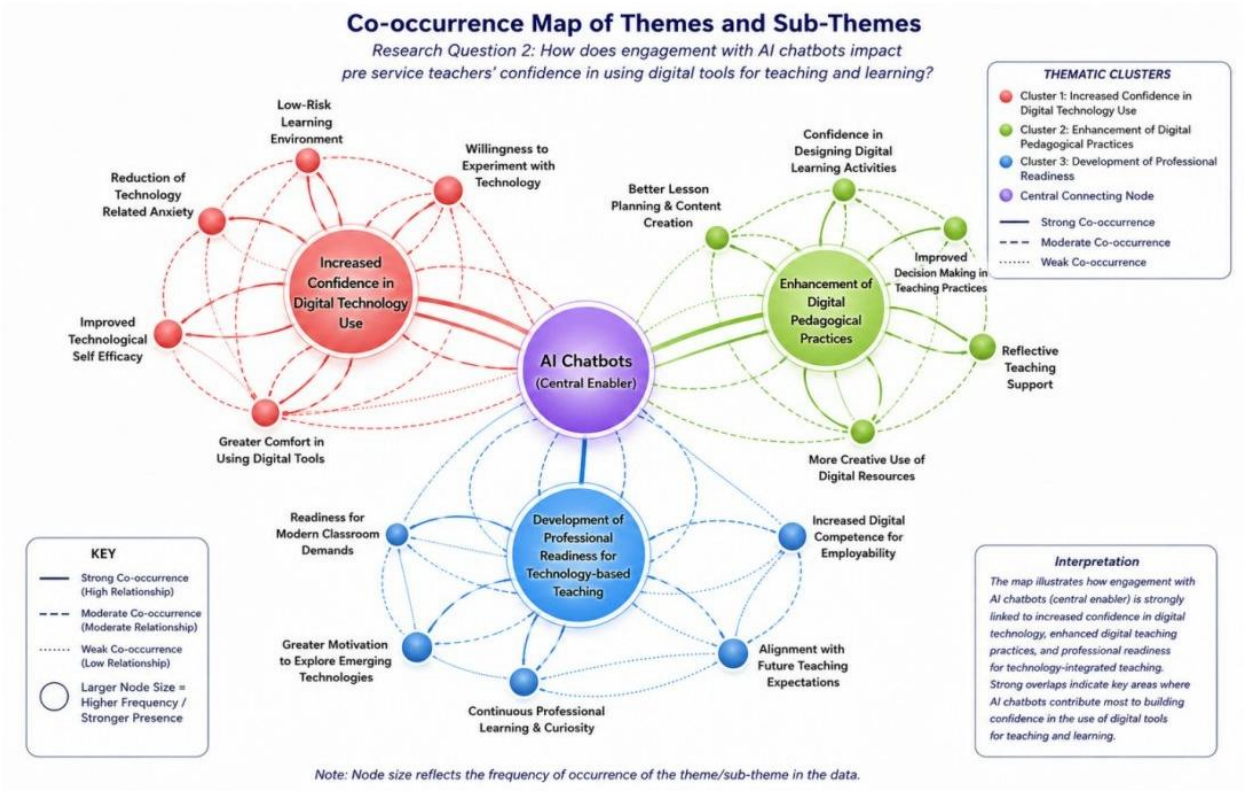


Figure 3 of co-occurrence shows the analysis enlightening pre-service teachers' confidence in the use of digital tools and teaching-learning by engaging with AI chatbot. The map indicates that AI Chatbots are in the central position as the primary connector linking the three major thematic clusters - Increased Confidence in Using Digital Technologies, Improved Digital Pedagogical Practices, and Development of Professional Readiness to Teach with Technology. The prominent positioning of AI Chatbots signifies their omnipresence across all themes. This shows that participants have repeatedly linked their conversation with AI technologies to the improvement in technological assurance, teaching ability and professional readiness.

Research Question 3: What challenges and enablers do pre service teachers encounter when using AI chatbots in their professional preparation?

Analysis of data from the interview found that the pre service teachers faced opportunities and challenges while using the AI chatbots in their professional preparation. The participants indicated that the AI Chatbots provided effective support for learning, lesson planning, and skill development. Nevertheless, other obstacles restrained the successful integration of these technologies into teacher education. The data illustrated two overarching issues: Enablers of AI Chatbot Usage and Barriers to Effective Use of AI Chatbots. These themes were further sub divided into multiple themes.

Theme 1: Enablers Supporting AI Chatbot Use

Participants pointed to various enablers for engaging with AI chatbots for their professional learning experiences.

Sub Theme 1.1: Easy Access to Information and Learning Resources

The instant availability of learning resources, teaching assets, and explanations from AI chatbots was commonly cited by participants. Due to this, they were good at meeting learning needs.

As participant 19 explains, *"Whenever I needed information on an educational strategy or concept, I got a quick reply on the chatbox. It made learning much easier"*

According to participant 15, *"The chatbot helped me quickly find relevant info. It spared time and enhanced my lesson preparation productivity"*

The responses imply that access and convenience are important enabling factors of pre service teachers' use of AI chatbots.

Sub Theme 1.2: Personalized Learning Support

A lot of participants appreciated AI chatbots' one-on-one assistance. According to them, AI tools answered their specific learning requirements and gave suggestions that were tailored towards their queries.

A participant explained 20, *"My learning needs were appropriately responded to by the chatbot. I was free to ask questions as often as I liked"*

participant 13 stated, *"The virtual learning environment provided me with an academic assistant whenever I needed one"*

The study's results indicate that individualized support promotes learner engagement and better prepares them for their profession.

Sub Theme 1.3: Support for Lesson Planning and Instructional Design

All participants found AI chatbot educational as it allows them to come up with teaching ideas, classroom activities, and learning materials.

According to Participant *17,"The chatbot assisted me in creating lesson plans and classroom activities. It provided creative ideas that I could adapt for teaching."*

Participant 15 remarked, *tools helped me to organize lesson plans and develop teaching resourc es better and faster"*

The study's evidence indicates that AI chatbots are capable of helping to pedagogical planning and creativity of future teachers.

Sub Theme 1.4: Continuous Availability and Immediate Feedback

Participants asserted that AI chatbots were available at any time to help them whenever they desired.

Participant 11 responded, *"I could reach the chatbot at all times of the day. The ability to learn beyond school hours was helpful"*

Participant 3 remarked, *"Quick feedback helped me to resolve the problem and continue learning without delay"*

According to the findings, continuous access and timely feedback are significant contributors to learning.

Theme 2: Challenges Hindering Effective Utilization of AI Chatbots

Participants after realizing so many benefits when using AI chatbots in teacher education they also saw some limitations.

Sub Theme 2.1: Concerns Regarding Accuracy and Reliability

Uncertainty regarding the accuracy of AI generated content was the most reported challenge. Participants were worried about relying only on the chatbot.

Participant 5 Reported, "At times, the chatbot gives seemingly accurate information, but it can later be incorrect."

According to Participant 13, *regularly double check the info since I cannot trust AI 100% on eve rything"*

The responses indicate that using AI chatbots for educational purposes creates concerns regarding information reliability.

Sub Theme 2.2: Limited Knowledge and Training

Some participants said that they had not received any formal instruction on using AI chatbots for academic and professional tasks. As stated by participant 6

“We have a lot of experience using AI tools by ourselves, but there is a lack of guidance on how to use it responsibly and effectively.”

as per participant 19.

The students should be trained through the teacher education programs so that best benefits of AI technology.

The results show a lack of training may restrict the learning value of AI chatbot usage.

Sub Theme 2.3: Ethical and Academic Integrity Concerns

Participants expressed anxiety about over-reliance on AI tools and possible misapplication of AI tools in academics.

According to Participant *7, "Certain learners might depend too much on the responses generated by AI instead of learning"*

Participant 11 noticed, *"It is vital to maintain ethical guidelines on the use of the technology so that it does not affect learning quality of students"*

The significance of ethical AI policies in the teacher education is established by these findings.

Sub Theme 2.4: Technical and Access Related Issues

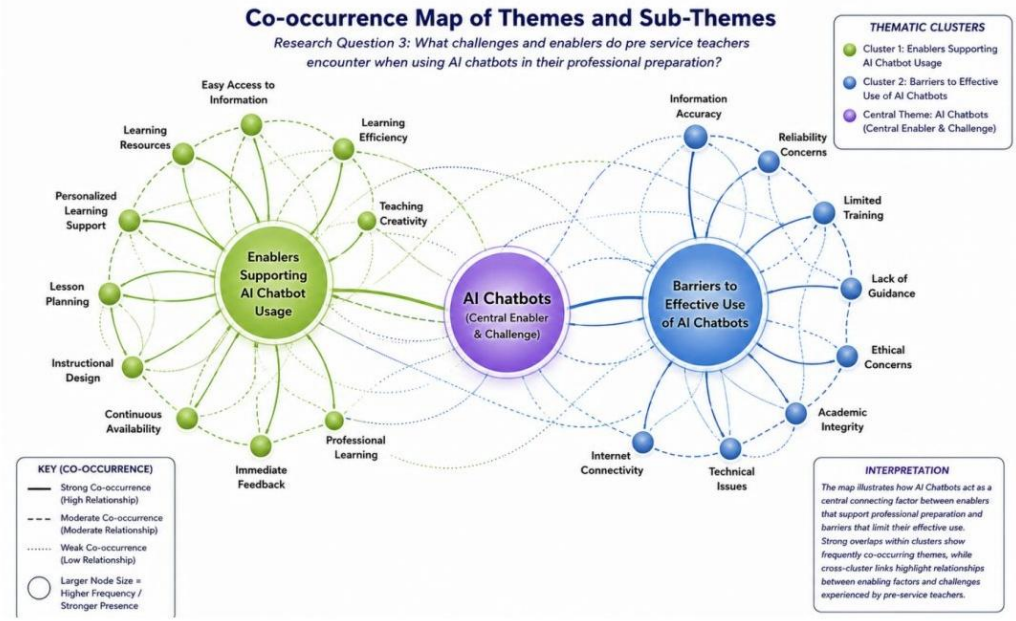
Many participants faced technical issues concerning the internet connection and the inability to access some advanced AI features.

Participant 14 revealed, *"Problems with the internet sometimes hinder the AI Chatbot from working on the assignment"*

Participant 20 mentioned, *"Certain advanced features come with a paid subscription which is not affordable for every student.*

The co-occurrence map (figure 4) identifies AI Chatbots as the central node that links enabling and challenging experiences of pre-service teachers during their professional preparation. The large central node suggests that AI chatbots were the most mentioned concept across participants' interviews and associated with all vital themes during thematic analysis. The green cluster represents the Enablers Supporting AI Chatbot Usage. Positive experiences arose from easy access to information and learning resources, along with personalized learning support. Moreover, lesson planning and instructional design were aided. Users also welcomed constant availability, feedback, professional learning, and teaching creativity.

Figure 4:Co-occurrence Map of RQ3



Discussion

The purpose of this research was to examine the experiences of pre service teachers with the use of AI Chatbots and its effects on digital literacy development, confidence in using digital instruction and professional preparation. The results provided the pre service teachers' general perceptions of AI chatbots as digital learning tools which contribute to their technological competence, independent learning and preparation for technology integrated classrooms. A few difficulties were also pointed out such as, accuracy in the information, lack of formal training, ethical issues and technological limitations. The results are then presented in terms of the research goals and theories of digital literacy, technological self-efficacy, and technology integration in teacher preparation.

Perceptions of Pre Service Teachers Regarding the Effectiveness of AI Chatbots for Improving Digital Literacy

The study results reveal that Pre Service Teachers' perceptions of the effectiveness of AI Chatbots in enhancing digital literacy are positive. The findings of the study show that the perceptions of Pre Service Teachers regarding the effectiveness of AI Chatbots in enhancing the digital literacy are positive. The first goal of the study was to investigate the pre service teachers' perceptions about the effectiveness of an AI chatbot in acquiring digital literacy skills. The results showed that the participants perceived AI chatbots as useful in improving various aspects of digital literacy such as information search, digital communication, technological awareness, and critical appraisal of digital information. Around 80% of participants stated that their experience with AI chatbots enhanced their understanding of navigating digital environments and boosted their confidence in using novel technologies. The results align with the definition of digital literacy put forward by the European Commission (2018) as a synthesis of knowledge, skills and attitudes needed to effectively and responsibly use digital technologies. The present results indicate that by involving users in the process of using information, verifying the information, and using digital resources for learning, AI chatbot engagement goes beyond basic digital literacy to fostering digital literacy. The findings also corroborate the view of Ng (2015) that digital literacy has three components: 'technical, cognitive and social'.

Influence of AI Chatbot Engagement on Confidence and Digital Instructional Practices

This study examines how AI Chatbot Engagement impacts confidence and digital instructional practices. This study aims to explore the effects of AI Chatbot Engagement on the confidence and digital instruction practices. The second goa1 of the study was to explore the impact of AI chatbot interaction on pre service teachers, in terms of their confidence and competency in adopting digital tools for teaching and learning. The research revealed that interaction with AI chatbots boosted technological confidence and decreased anxiety about using unfamiliar digital tools. Participants shared how AI chatbots created a safe space that allowed them to experiment, learn from failures, ask questions, and solve problems. The result can be explained based on Social Cognitive Theory of Bandura (1986) which one of its concepts is self-efficacy. This theory says that people build confidence, when they have a positive experience, feedback and supportive environments. AI chatbot interaction gave pre service teachers ongoing opportunities for digital skills practice, for feedback, and for slowly building up confidence in their digital skills.

Challenges and Enablers Affecting AI Chatbot Use in Professional Preparation

The third goal of the study was to pinpoint challenges and supports that impact pre service teachers' experience using AI chatbots. The results indicated that there were several enablers for using the integration of AI chatbots in the classroom, such as the availability of information, personalized learning support, immediate feedback, and instruction planning. One of the biggest enablers was the ability to get immediate support. Participants appreciated the opportunity to get feedback from other participants and the teacher without relying 100% on the teacher. This discovery is in accordance with the principles of Connectivism theory proposed by Siemens (2005) where states that learning in the digital age is the process of interacting with technology networks and information sources. AI Chatbots are a new type of digital learning connection, where learners can access knowledge and build it via technological support interaction.

One of the biggest challenges mentioned was the lack of training opportunities for participants. While they saw the potential of AI chatbots, there were fewer of them with specific instructions on how to use and do it well and in an ethical manner. This finding aligns with the study conducted by Kimmons and Hall (2016) which suggested that teacher education programs sometimes do not afford opportunities for substantive engagement with sophisticated educational technologies. Structured AI training is not available, which leaves a disparity in the use of technology and effective pedagogy. The results indicate that teacher training institutions should go beyond giving access to AI tools and establish systematic training programs centered on the themes of AI literacy, ethical utilization, prompt development, information evaluation and integration strategies in the classroom. Some of the concerns raised were also academic integrity issues and overreliance on AI-generated responses. The following concerns suggest the need for ethical principles for successful integration of AI. Initiatives for developing digital literacy should thus incorporate the skills of safe and responsible technology use, critical thinking, and awareness of the constraints of AI.

Relationship of Findings with Theoretical Framework

The results of this study are highly related to the digital literacy framework and digital technology integration theories. In the context of digital literacy, the use of AI chatbots for engagement enabled pre service teachers' technical competence, information literacy assessment skills and confidence in the use of digital technologies. The results show that AI literacy is a crucial aspect of digital literacy in the modern context of teacher education. The Social Cognitive Theory accounts for the enhancement of technological self-efficacy among the participants as a result of the interaction with AI chatbots. After repeated practice, feedback, and positive digital experiences, pre service teachers gained confidence in their capacity to use technology in teaching. The results also corroborate the TPACK framework principles. AI chatbots played a role not just in the dissemination of technology knowledge but also in bridging technology to pedagogical practices. AI chatbots helped construct integrated technological pedagogical knowledge in planning lessons, instructional design, and classroom activities.The results indicate that, with proper training, ethical considerations, and institutional backing, AI chatbots can be a valuable asset for teacher preparation to build digitally competent teachers. The study shows the potential that AI chatbots have to enhance pre service teachers’ digital literacy, confidence, and preparedness. AI Chatbots were seen by participants as learning partners that complemented their technological skills, promoted self-learning, and facilitated digital education approaches. The current results build on the body of knowledge by offering

evidence of the potential role of AI chatbots in teacher education, if utilized well. The results, however, are also a reminder that technology can't ensure better learning outcomes. Teacher preparation programs must create and build a framework that integrates digital literacy instruction, pedagogical advice, ethical considerations, and institutional support to enable effective integration of AI into education. With these resources, AI chatbots can help in cultivating future educators who can create impactful digital learning experiences and adapt to the challenges posed by technology in the classroom.

Conclusion

The current research focused on the use of AI Chatbots to promote digital literacy, technological self-confidence and professional readiness of pre-service teachers. In the context of growing need for digitally competent teachers to be able to properly use new technologies in education, the study was carried out. With the continued impact of AI in teaching and learning spaces, it is critical to have insight into how future teachers experience and use AI based tools for the development of effective teacher education programs. The study results showed that in general, pre service teachers had a positive view of the use of AI chatbots as tools to enhance digital literacy. The participants indicated that the AI chatbots improved their skills in searching, accessing, assessing, and utilizing digital information to support their learning. AI chatbots allowed participants to interact with digital technologies in a real and meaningful way, enhancing their technological awareness and promoting meaningful interactions with digital learning resources. The results show that the use of AI chatbots can enhance digital literacy, going beyond technical skills to include critical thinking, information evaluation, and responsible technology use. The study also found that the use of the AI chatbot for engagement positively impacted the confidence of the pre service teachers in using digital tools for teaching and learning. The study adds to the body of knowledge on AI chatbots in teacher education and how they can contribute to the development of digital competence, thereby offering empirical insights into the experiences of pre service teachers. It recognizes the need to train teachers who are not just able to use technology, but are also critical and responsible decision makers in the digital learning environment. Education is continuing to realize the benefits of artificial intelligence, and teacher preparation programs need to help future teachers develop the knowledge, confidence and ethical understanding to be able to use AI tools effectively.

Further research is recommended to explore the potential long-term effects of the use of AI chatbots on the teaching practices and outcomes of educators and students. Comparative views between various groups of teachers, among educational levels and across institutional contexts are other areas that could be explored in future studies. Experimental and longitudinal research designs can offer more evidence of the impact of AI based interventions in the development of digital competence through time. Furthermore, other studies could explore models for effective AI literacy education and policy frameworks to facilitate safe integration of AI in teacher training. In conclusion, this study demonstrates that AI chatbots are a potentially valuable educational innovation to enhance the digital literacy and professional readiness of pre service teachers. With proper training, ethical guidelines, and institutional support, AI chatbots can be valuable resources for educating future teachers to respond to the demands of technology-filled classrooms and contribute to quality education in the digital era.

Recommendations

The following recommendations are based on the study's results on the effect of AI chatbots on improving digital literacy, technological confidence and professional preparation of pre service teachers:

1. The use of an AI chatbot in learning activities should be integrated into teacher education institutions, thus giving pre service teachers practical experiences in using artificial intelligence in teaching.
2. Teacher education programs need to develop a set of structured lessons, activities, and tasks for pre service teachers in order to develop AI literacy. The contents of these programs should center around effective use of an AI chatbot, development, assessment of AI generated information, ethics and practical applications in the classroom. Future teachers can benefit from this training to prepare them with knowledge and confidence in the responsible integration of AI.
3. Digital literacy programs in institutions should go beyond the dimensions of technology. The pre service teachers must be knowledgeable on critical evaluation of digital information, responsible use of technology, being data aware, and effective selection of digital resources. The following is a good example of why AI literacy needs to be part of the digital competence standards for future teachers.
4. Teacher education institutions (TEIs) should offer practical tasks, simulation lessons, and technology-based projects on AI chatbots to pre service teachers to motivate them to interact with AI chatbots. Constant use of AI tools can build technological confidence and facilitate future teachers' awareness of the educational applications of technology.
5. AI chatbots should be integrated properly in academic and professional environments through establishment of clear policies and ethical guidelines. The following guidelines should encompass concerns about academic honesty, appropriate usage, fact-checking information, privacy, and over-reliance on AI-generated content.
6. Teacher educators need professional development to enhance their knowledge and skills about AI and its use in education. Good teacher educators can teach pre service teachers more effectively on how to apply AI technologies in teaching.
7. Institutions should make digital resources and reliable internet facilities and required technological infrastructure available in an equitable manner. AI chatbot learning experiences can be constrained by having only limited access to technology, especially for students who do not have much digital access.
8. Pre service teachers need to think critically and confirm the responses that are produced by AI before using them in education. Teacher preparation programs must focus on information evaluation skills for responsible and accurate use of AI technologies.
9. Future teachers should be urged to leverage AI chatbots to create new teaching methods, plan teaching activities, develop teaching materials, and cater for students with various learning difficulties. Institutions should encourage practices for integrating AI to improve teaching quality, not supplant teachers' professional judgment.

References

1. Alramlawi, S., Alturki, N., & Kuhail, M. A. (2023). Interacting with educational chatbots: A systematic review. *Education and Information Technologies,* 28, 973-1018.https://doi.org/10.1007/s10639-022-11177-3
2. Babbie, E. (2016). The practice of social research (14th ed.). Cengage Learning.https://doi.org/10.1017/CBO9781107415324.004
3. Baker, R. S., & Hawn, A. (2022). Algorithmic bias in education. *International Journal of Artificial Intelligence in Education,* 32, 1052-1092.
4. Bandura, A. (1986). Social foundations of thought and action: A social cognitive theory. Prentice Hall.
5. Bhandari, P. (2023, June 21). Population vs. sample | Definitions, differences & examples.Scribbr. https://www.scribbr.com/methodology/population-vs-sample/
6. Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology,* 3(2), 77-101. https://doi.org/10.1191/1478088706qp063oa
7. Bryman, A. (2016). Social research methods (5th ed.). Oxford University Press.https://doi.org/10.1093/he/9780198722774.001.0001
8. Celik, I. (2023). Towards intelligent-TPACK: An empirical study on teachers' professional knowledge to ethically integrate artificial intelligence into education. *Computers in Human Behavior, 138,* 107468.
9. Chali, M. T., Eshete, S. K., & Debela, K. L. (2022). Learning how research design methods work: A review of Creswell's Research Design: Qualitative, Quantitative and Mixed Methods Approaches. The Qualitative Report, 27(12), 2956-2960.https://doi.org/10.46743/2160-3715/2022.5901
10. Chen, L., Chen, P., & Lin, Z. (2020). Artificial intelligence in education: A review. IEEE *Access,*8, 75264-75278.
11. Chiu, T.K.F., Moorhouse, B. L., Chai, C. S., & Ismailov, M. (2023). Teacher readiness for artificial intelligence education: Implications for teacher education and professional development. *Computers and Education1: Artificial Intelligence, 4,* 100121.
12. Chiu, T.K.F.,Xia,Q.,Zhou, X., Chai, C. S., & Cheng, M. (2023). Systematic literature review on opportunities, challenges, and future research directions of artificial intelligence in education. Computers and Education: Artificial Intelligence, 4, 100118.
13. Creswell, J. W., & Poth, C. N. (2018). Qualitative inquiry and research design: Choosing among five approaches. Sage Publications.
14. Creswell, J. W., & Poth, C. N. (2018). *Qualitative inquiry and research design: Choosing among five approaches* (4th ed.). Sage Publications.
15. Darling Hammond, L., Hyler, M. E., & Gardner, M. (2017). Effective teacher professional development. Learning Policy Institute.
16. Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. MIS Quarterly, 13(3), 319-340.
17. EMOOCS 2025. (2025). AI chatbots for educators: Transforming online learning in higher education. *Digital Education: Shaping Sustainable Lifelong Learning for All in the Era of AI.*
18. Ertmer, P. A., & Ottenbreit Leftwich, A. T. (2010). Teacher technology change: How knowledge, confidence, beliefs, and culture intersect. *Journal of Research on Technology in Education,* 42(3), 255-284.

19. European Commission. (2018). DigComp 2.1: The digital competence framework for citizens.Publications Office of the European Union.
20. European Commission. (2018). *DigCompEdu: European framework for the digital competence of educators.* Publications Office of the European Union.
21. Flick, U. (2018). Doing qualitative research (3rd ed.). SAGE Publications.https://doi.org/10.4135/9781526415416
22. Fryer, L. K., & Carpenter, J. P. (2020). Bots for learning: A framework for designing chatbots to support learning. *Educational Technology Research and Development,* 68(3), 1015-1048.https://doi.org/10.1007/s11423-020-09757-1
23. Fryer, L. K., & Carpenter, R. (2020). Bots as language learning tools. *Language Learning &Technology,* 24(2), 1-17.
24. Guest, G., Bunce, A., & Johnson, L. (2006). How many interviews are enough? *Field Methods,*18(1), 59-82. https://doi.org/10.1177/1525822X05279903
25. Hattie, J., & Timperley, H. (2007). The power of feedback. Review of Educational Research,77(1), 81-112.
26. Hew,K.F., & Brush, T. (2007). Integrating technology into K-12 teaching and learning: Current knowledge gaps and recommendations. *Educational Technology Research and Development,* 55, 223-252.
27. Holmes, W., Bialik, M., & Fadel, C. (2019). *Artificial intelligence in education: Promises and implications for teaching and learning.* Center for Curriculum Redesign.
28. Holmes, W., Porayska Pomsta, K., Holstein, K., Sutherland, E., Baker, T., Shum, S. B., Santos,O.C., Rodrigo, M. M., Cukurova, M., Bittencourt, I. I., & Koedinger, K. R. (2022).Ethics of AI in education: Towards a community wide framework. *International Journal of Artificial Intelligence in Education,* 32, 504-526.
29. Instefjord, E. J., & Munthe, E. (2017). Educating digitally competent teachers: A study of integration of professional digital competence in teacher education. Teaching and Teacher Education, 67, 37-45.
30. Ji, Z., Lee, N., Frieske, R., Yu, T., Su, D., Xu, Y., & Fung, P. (2023). Survey of hallucination in natural language generation. *ACM Computing* Surveys, 55(12), 1-38.
31. Kallio, H., Pietilä, A. M., Johnson, M., & Kangasniemi, M. (2016). Systematic methodological review: Developing a framework for a qualitative semi-structured interview guide.*Journal of Advanced Nursing,* 72(12), 2954-2965. https://doi.org/10.1111/jan.13031
32. Kasneci, E., Sessler, K., Küchemann, S., Bannert, M., Dementieva, D., Fischer, F., Gasser, U.,Groh, G., Günnemann, S., Hüllermeier, E., & Kasneci, G. (2023). ChatGPT for good? On opportunities and challenges of large language models for education. *Learning and Individual Differences, 103,* 102274.
33. Kasneci, E., Sessler, K., Küchemann, S., Bannert, M., Dementieva, D., Fischer, F., et al. (2023).ChatGPT for good? On opportunities and challenges of large language models for education. Learning and Individual Differences, 103, 102274.
34. Kimmons, R. (2017). Teacher preparation students' experiences with digital literacy. Jouurnal of *DigitalLearning in Teacher Education,* 33(4), 128-137.https://doi.org/10.1080/21532974.2017.1344310
35. Kimmons, R., & Hall, C. (2016). Emerging technologies and teacher preparation: Developing digital competence in teacher education. Educational Technology Research and Development.

36. Knowles, M. S. (1975). Self-directed learning: A guide for learners and teachers. Association Press.
37. Koehler, M. J., Mishra, P., & Cain, W. (2013). What is technological pedagogical content knowledge? Journal of Education, 193(3), 13-19.
38. Koehler, M. J., Mishra, P., Kereluik, K., Shin, T. S., & Graham, C. R. (2013). The technological pedagogical content knowledge framework. In J. M. Spector et al. (Eds.), *Handbook of research on educational communications and technology* (pp. 101-111). Springer.
39. Kothari, C. R. (2004). Research methodology: Methods and techniques (2nd revised ed.). New Age International.
40. Kumar, R. (2019). Research methodology: A step-by-step guide for beginners (5th ed.). SAGE Publications. https://doi.org/10.4135/9781526451166
41. Luckin, R., Holmes, W., Griffiths, M., & Forcier, L. B. (2016). *Intelligence unleashed: An argument for AI in education.* Pearson.
42. McCarthy, J., Minsky, M., Rochester, N., & Shannon, C. E. (1955). A proposal for the Dartmouth summer research project on artificial intelligence.
43. Miles, M. B., Huberman, A. M., & Saldaña, J. (2014). Qualitative data analysis: A methods sourcebook (3rd ed.). SAGE. https://doi.org/10.4135/9781473957989
44. Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. Teachers College Record, 108(6), 1017-1054.
45. Moorhouse, B. L., & Kohnke, L. (2023). The impact of ChatGPT on education: Teachers'perspectives and practices. *Journal of Education and Technology.*
46. Moser, A., & Korstjens, I. (2018). Series: Practical guidance to qualitative research. Part 3:Sampling, data collection and analysis. European Journal of General Practice, 24(1), 9-
47. 18. https://doi.org/10.1080/13814788.2017.1375091
48. Moustakas, C. (1994). *Phenomenological research methods.* Sage Publications.
49. Ng, D. T. K., Lee, M., Tan, R. J. Y., Hu, X., Downie, J., & Chu, S. K. W. (2021).Conceptualizing AI literacy: An exploratory review. Computers and Education: Artificial Intelligence, 2, 100041.
50. Ng, W. (2012). Can we teach digital natives digital literacy? Computers & Education, 59(3),1065-1078.
51. Ng, W. (2015). New *digital technology in education: Conceptualizing professional learning for educators.* Springer.
52. Oliveira, A., et al. (2022). Pre-service teachers' perceptions and intentions regarding the use of chatbots.*Computers & Education:Artificial Intelligence, 4,* 100119.https://doi.org/10.1016/j.caeai.2022.100119
53. Ortega, A. (2022). Digital competence and technology confidence among pre service teachers.Education and Information Technologies.
54. Ortega, L. (2022). Pre-service teachers' digital literacy and professional readiness. *Journal of Teacher Education,* 73(1), 75-89.
55. Ortega, M. (2022). Digital competence and technology confidence among pre service teachers.Education and Information Technologies.
56. Patton, M. Q. (2015). Qualitative research & evaluation methods (4th ed.). SAGE Publications.https://doi.org/10.4135/9781452272047

57. Piran, M. J., & Tran, N. H. (2024). Enhancing research methodology and academic publishing: A structured framework for quality and integrity. arXiv.https://doi.org/10.48550/arXiv.2412.05683
58. Redecker, C. (2017). *European framework for the digital competence of educators:DigCompEdu.* Publications Office of the European Union.
59. Robson, C., & McCartan, K. (2016). Real world research (4th ed.). Wiley. https://doi.org/10.10
60. Russell, S., & Norvig, P. (2021). *Artificial intelligence: A modern approach* (4th ed.). Pearson.
61. Salkind, N. J. (2017). Exploring research (8th ed.). Pearson. https://doi.org/10.1016/C2015-0- 02788-3
62. Saunders, M., Lewis, P., & Thornhill, A. (2019). Research methods for business students (8th ed.). Pearson.
63. Sekaran, U., & Bougie, R. (2020). Research methods for business: A skill-building approach (8th ed.). John Wiley & Sons.
64. Siemens, G. (2005). Connectivism: A learning theory for the digital age. *International Journal of Instructional Technology and Distance Learning*, 2(1), 3-10.
65. Siemens, G., & Baker, R. S. J. D. (2012). Learning analytics and educational data mining: Towards communication and collaboration. *Proceedings of the 2nd International Conference on Learning Analytics and Knowledge*, 252-254.
66. Teo, T. (2011). Factors influencing teachers' intention to use technology: Model development and test. *Computers & Education*,57(4), 2432-2440
67. Tlili, A., Shehata, B., Burgos, D., et al. (2023). What if the devil is my guardian angel: ChatGPT as a case study of using chatbots in education. Smart Learning Environments, 10, 15.
68. Tondeur, J., Aesaert, K., Prestridge, S., & Consuegra, E. (2017). A multilevel analysis of what matters in the training of pre-service teacher's ICT competencies. *Computers &Education*, 122, 32-42.
69. Tondeur, J., Aesaert, K., Pynoo, B., van Braak, J., Fraeyman, N., & Erstad, O. (2017). Developing a validated instrument to measure preservice teachers' ICT competencies.British Journal of Educational Technology, 48(5), 1029-1044.
70. Tondeur, J., van Braak, J., Sang, G., Voogt, J., Fisser, P., & Ottenbreit Leftwich, A. (2012).Preparing pre service teachers to integrate technology in education: A synthesis of qualitative evidence. *Computers & Education*, 59(1), 134-144.
71. UNESCO. (2018). UNESCO ICT competency framework for teachers. UNESCO.
72. UNESCO. (2018). *UNESCO ICT competency framework for teachers.* UNESCO.
73. UNESCO. (2021). *AI and education: Guidance for policy makers.* UNESCO.
74. UNESCO. (2021). *Recommendation on the ethics of artificial intelligence.* UNESCO.
75. UNESCO. (2024). *Artificial intelligence and education: Guidance for policy makers.* UNESCO.
76. Van Deursen, A. J. A. M., & Helsper, E. J. (2015). A nuanced understanding of digital inequalities. *Computers in Human Behavior*, *48*, 323-329.
77. VanLehn, K. (2011). The relative effectiveness of human tutoring, intelligent tutoring systems,and other tutoring systems. *Educational Psychologist*, 46(4), 197-221.
78. Vygotsky, L. S. (1978). Mind in society: The development of higher psychological processes.Harvard University Press.

79. Winkler, R., & Söllner, M. (2018). Unleashing the potential of AI in education. *Information Systems Journal*, 28(6), 1122-1159.
80. Winkler, R., & Sollner, M. (2018). Unleashing the potential of chatbots in education.
81. Proceedings of the International Conference on Information Systems.
82. Woolf, B. P. (2009). *Building intelligent interactive tutors: Student centered strategies for revolutionizing e-learning.* Morgan Kaufmann.
83. Yin, R. K. (2018). Case study research and applications: Design and methods (6th ed.). SAGE Publications. https://doi.org/10.4135/9781071802773
84. Zhao, P., Zhang, H., Qinhan, Y., Wang, Z., Geng, Y., Fu, F. F., et al. (2025). Using AI chatbots to facilitate mathematics pre-service teachers' noticing skills. *Frontiers in Education, 10,*1605921. https://doi.org/10.3389/feduc.2025.1605921