

PRE-SERVICE TEACHERS' PERSPECTIVES ON GENERATIVE ARTIFICIAL INTELLIGENCE IN EDUCATION

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Abstract

The widespread adoption of generative artificial intelligence (AI) technologies is reshaping educational processes and prompting new discussions regarding the future roles of teachers. While AI-powered applications offer significant opportunities for enhancing teaching, learning, and assessment practices, they also raise concerns related to ethics, reliability, and professional transformation. Understanding pre-service teachers' perceptions and experiences regarding AI is therefore critical for informing the future development of teacher education programs. This study aims to examine pre-service teachers' sources of information about artificial intelligence, their experiences with AI use, their perspectives on the integration of AI into education, and their expectations regarding the future of the teaching profession. The study was designed within a qualitative research framework. The participants consisted of 355 pre-service teachers enrolled in different teacher education programs. Data were collected through an open-ended questionnaire designed to explore participants' sources of knowledge about AI, patterns of AI use, perceptions of its educational applications, perceived advantages and disadvantages, and views on its potential impact on the teaching profession. The data were analyzed using content analysis. The findings revealed that pre-service teachers predominantly perceive artificial intelligence as a technology that facilitates rapid access to information, supports learning, and enhances instructional processes. A substantial proportion of participants reported actively using AI tools, with ChatGPT emerging as the most frequently utilized application. Participants indicated that AI has considerable potential to contribute to personalized learning, content development, instructional material preparation, and problem-solving processes. However, concerns were also expressed regarding misinformation, ethical challenges, technological dependency, and the potential weakening of critical thinking skills. Furthermore, pre-service teachers generally believed that AI would not completely replace teachers in the future; rather, it would function as a powerful supportive tool within educational environments.

Keywords: Artificial intelligence, pre-service teachers, educational technologies, AI literacy, teacher education, ChatGPT.

1. Introduction

Artificial intelligence (AI) has emerged as one of the most transformative technological developments of recent years, generating significant changes across diverse fields, including education, healthcare, engineering, and the social sciences. The rapid advancement of generative AI systems has fundamentally altered processes related to information access, content creation, problem-solving, and decision-making (Dwivedi et al., 2023). Applications powered by large language models, such as ChatGPT, Gemini, Claude, and Copilot, enable individuals not only to consume information but also to actively participate in knowledge production (Kasneci et al., 2023). While these developments create new opportunities for education, they also raise important questions regarding the quality of teaching and learning processes, educational experiences, and the evolving role of teachers.

The integration of AI technologies into educational settings has become increasingly widespread. These technologies can facilitate personalized learning experiences, analyze student performance, support instructional processes, and assist in the development of educational materials (Holmes et al., 2019). In particular, the emergence of generative AI tools has enabled teachers to perform various professional tasks—including lesson planning, assessment development, content generation, and feedback provision—more efficiently and within shorter time frames (Zawacki-Richter et al., 2019).

Recent studies indicate that awareness and use of AI technologies have increased across different age groups. In a study conducted with primary school students in rural areas, the majority of participants reported being familiar with the concept of artificial intelligence and indicated that they had primarily encountered AI through mobile phones, television, and family members. The study further revealed that students commonly associated AI with metaphors such as “robot,” “phone,” “friend,” and “human,” and generally held positive perceptions toward AI technologies (Bayer Kurt et al., 2026). Similarly, research involving pre-service teachers suggests that AI is often perceived as a technology that provides rapid access to information, supports learning, and facilitates instructional processes. However, concerns related to misinformation, ethical issues, and technological dependency have also been frequently reported among pre-service teachers (Yıldız Albayrak & Bal İncebacak, 2025). Collectively, these findings indicate that although perceptions of AI may vary according to age and educational background, both students and pre-service teachers tend to recognize its opportunities while simultaneously acknowledging its potential risks.

Despite its educational potential, the use of AI in education also introduces several challenges, including ethical concerns, data privacy and security issues, academic integrity violations, algorithmic bias, and the possible erosion of critical thinking skills (UNESCO, 2026). As educational systems continue to undergo digital transformation, the knowledge, competencies, and attitudes of both practicing and future teachers toward AI have become increasingly important. The effective integration of AI technologies into educational processes depends not only on technological infrastructure but also on teachers’ ability to use these technologies critically, ethically, and pedagogically.

Recent scholarship further emphasizes the need for institutional support mechanisms to promote responsible and effective use of generative AI in educational contexts. Rather than replacing human-centered teaching, generative AI should be employed to enhance educational practices by

fostering creativity, critical engagement, and ethical learning within higher education environments (Soleimani et al., 2025). Consequently, understanding how pre-service teachers perceive AI, the purposes for which they use it, and the roles they envision for AI in their future teaching practices is of critical importance for the redesign and improvement of teacher education programs.

Given the growing influence of generative AI on educational systems worldwide, examining pre-service teachers' perspectives can provide valuable insights into how future educators are preparing to engage with emerging technologies. Such insights may contribute to the development of AI literacy initiatives, pedagogical frameworks, and teacher preparation programs that support the responsible integration of AI into educational practice.

Recent years have witnessed a substantial increase in research examining teachers' and pre-service teachers' perceptions, attitudes, and experiences regarding generative artificial intelligence (AI) tools. For instance, Kasneci et al. (2023) discussed both the opportunities and risks associated with the use of large language models in education, while Chan and Hu (2023) demonstrated that university students' perceptions of generative AI are shaped by a combination of academic support expectations and ethical concerns. Similarly, Tlili et al. (2023) evaluated the potential educational applications and limitations of ChatGPT. Soleimani et al. (2025) reported that educators' views of generative AI often fluctuate between perceived opportunities and professional concerns, whereas Chiu (2024) explored future research directions regarding AI integration in higher education. Collectively, these studies indicate that educational stakeholders are increasingly engaging with AI technologies. However, they also highlight the need for more in-depth investigations into how pre-service teachers conceptualize AI and the roles they envision for these technologies within future teaching and learning environments.

Although the existing literature has primarily focused on attitudes toward AI, technology acceptance, and intentions to use AI tools, considerably less attention has been devoted to understanding how pre-service teachers construct meaning around AI, the sources from which they acquire AI-related knowledge, how they evaluate their experiences with AI applications, and their expectations regarding the role of AI in education. This gap has become particularly significant following the rapid diffusion of generative AI technologies, which have fundamentally transformed educational practices and professional expectations. A comprehensive examination of pre-service teachers' perceptions and experiences with generative AI is therefore essential for advancing the teacher education literature and informing the preparation of future educators.

Against this background, the present study aims to explore pre-service teachers' perceptions of artificial intelligence, their experiences with AI use, their views on AI-supported educational tools, and their expectations regarding the future role of teachers in AI-enhanced educational environments. It is anticipated that the findings will contribute to the development of AI literacy within teacher education programs and provide evidence-based implications for policies and practices related to the effective integration of AI in education.

2. Method

2.1. Research Design

This study was conducted within the framework of a qualitative research approach to gain an in-depth understanding of pre-service teachers' perceptions of artificial intelligence (AI), their experiences with AI use, and their views regarding the integration of AI into educational settings. Qualitative research seeks to explore and interpret the meanings individuals assign to particular phenomena, as well as their experiences and perspectives within their natural contexts (Creswell &

Poth, 2018). Given the exploratory nature of the study and its focus on participants' subjective interpretations, a basic qualitative research design was adopted.

Basic qualitative research is widely employed in educational research because it aims to understand how individuals make sense of their experiences, beliefs, and perceptions concerning a particular phenomenon (Merriam & Tisdell, 2016). Unlike phenomenology, which focuses on the essence of a lived experience, or grounded theory, which seeks to develop a substantive theory, basic qualitative research emphasizes the interpretation of participants' perspectives and meanings related to a specific topic. Accordingly, this design was considered appropriate for investigating how pre-service teachers conceptualize artificial intelligence, the purposes for which they use AI technologies, and their views regarding the role of AI in teaching and learning processes.

Through the analysis of participants' written responses, the study sought to identify recurring patterns, themes, and categories reflecting pre-service teachers' understandings and experiences of AI in educational contexts. This approach enabled a comprehensive examination of both the opportunities and concerns associated with AI use from the perspective of future educators.

2.2. Participants

The participants of this study consisted of 355 pre-service teachers enrolled in the Faculty of Education at a public university in Türkiye. Participants were recruited from various teacher education programs and voluntarily agreed to participate in the study. The diversity of participants from different disciplinary backgrounds enabled the collection of a broad range of perspectives regarding artificial intelligence and its educational applications.

The study group was determined using convenience sampling, a type of purposive sampling. Convenience sampling is frequently employed in qualitative research when participants are readily accessible to the researcher and capable of providing rich information regarding the phenomenon under investigation (Patton, 2015). This sampling strategy allowed the researchers to efficiently access a large number of pre-service teachers and gather comprehensive data concerning their perceptions, experiences, and views related to artificial intelligence in educational contexts.

Demographic information regarding the participants, including gender, department, and year of study, is presented in Table 1.

Table 1.

Descriptive Characteristics of the Participants

Variable	Category	f	%
Gender	Female	252	71.0
	Male	103	29.0
Year Level	First Year	27	7.6
	Second Year	153	43.1
	Third Year	122	34.4
	Fourth Year	46	13.0
	Fifth Year and Above	7	2.0
	Total	355	100.0
Program Area	Primary Education (Primary School Teaching, Preschool Education)	85	23.9
	Foreign Language Education (English, German, French Language Teaching)	86	24.2
	Educational Sciences (Guidance and Psychological Counseling)	45	12.7

	Mathematics and Science Education (Mathematics, Science, Physics, Biology Teaching)	72	20.3
	Turkish and Social Sciences Education (Turkish Language and Social Studies Teaching)	27	7.6
	Fine Arts Education (Art and Music Education)	28	7.9
	Special Education	11	3.1
	Computer Education and Instructional Technology (CEIT)	1	0.3
	Total	355	100.0
AI Usage Status	Yes	214	60.3
AI Platform Used	No	75	21.1
	Not Sure	66	18.6
	Total	355	100.0
	ChatGPT	127	35.8
Variable	Bing AI / Microsoft Copilot	16	4.5
	Google Bard / Gemini	13	3.7
	Canva AI Features	7	2.0
	Google Assistant	6	1.7
	Snapchat AI	6	1.7
	Gamma	3	0.8
	Other (ElevenLabs, Monica, Nova, DeepL, InVideo, Remini, etc.)	14	3.9
	Category	f	%

The study group consisted of 355 pre-service teachers enrolled in a faculty of education. Of the participants, 252 (71.0%) were female and 103 (29.0%) were male. In terms of year level, 153 participants (43.1%) were second-year students, 122 (34.4%) were third-year students, 46 (13.0%) were fourth-year students, 27 (7.6%) were first-year students, and 7 (2.0%) were enrolled in their fifth year or beyond.

An examination of participants' academic program areas revealed that the highest proportions were enrolled in Foreign Language Education (24.2%) and Primary Education (23.9%), followed by Mathematics and Science Education (20.3%) and Educational Sciences (12.7%). Approximately two-thirds of the participants were studying in Primary Education, Foreign Language Education, or Mathematics and Science Education programs. This distribution indicates that the study captured perspectives from a diverse range of disciplines within teacher education.

Regarding AI use, 214 participants (60.3%) reported actively using AI-based applications, whereas 75 (21.1%) indicated that they did not use such technologies. In addition, 66 participants (18.6%) reported being uncertain about whether the applications they used involved artificial intelligence. This finding may suggest varying levels of AI literacy and awareness among pre-service teachers.

With respect to AI platform preferences, ChatGPT emerged as the most frequently used generative AI tool among participants. Other platforms, including Google Gemini, Microsoft Copilot, Canva AI, and several AI-powered applications such as ElevenLabs, DeepL, and InVideo, were also reported. These findings suggest that pre-service teachers are engaging with a variety of AI technologies rather than relying on a single platform, reflecting the growing presence of generative AI tools in both academic and everyday contexts.

2.3. Data Collection Instrument

The data were collected using the *Artificial Intelligence in Education Opinion Form*, which was developed by the researchers. During the development process, the relevant literature on artificial intelligence in education, generative AI applications, AI literacy, and teacher education was reviewed to establish the conceptual framework of the instrument (Kasneci et al., 2023; Tlili et al., 2023; UNESCO, 2026). Following the literature review, a draft version of the form was prepared and submitted to two experts in educational technology and teacher education for evaluation. Based on their feedback, revisions were made to improve the content validity, clarity, and relevance of the questions.

The opinion form consisted of two sections. The first section included questions designed to collect demographic information about the participants, such as gender, year level, academic program, and AI usage status. The second section comprised open-ended questions aimed at exploring participants' sources of knowledge regarding artificial intelligence, their experiences with AI use, the AI tools they utilized, their views on the use of AI in education, their evaluations of the advantages and disadvantages of AI technologies, and their expectations concerning the future impact of AI on the teaching profession.

The use of open-ended questions enabled participants to express their thoughts, experiences, and perspectives without being constrained by predetermined response categories, thereby facilitating the collection of rich and detailed qualitative data (Patton, 2015; Creswell & Poth, 2018). This approach was considered particularly appropriate given the exploratory nature of the study and its focus on understanding how pre-service teachers perceive and make sense of artificial intelligence within educational contexts.

Data were collected online during the 2025–2026 academic year. Prior to participation, the purpose of the study was explained to all participants, and they were informed that participation was entirely voluntary. Participants were also assured that the data would be used solely for scientific research purposes and that their responses would remain confidential. Informed consent was obtained from all participants before the commencement of data collection.

2.4. Data Analysis

The data obtained in this study were analyzed using the directed content analysis approach proposed by Hsieh and Shannon (2005). Directed content analysis is a qualitative analytical strategy that utilizes existing theoretical and empirical knowledge to guide data interpretation and to validate, extend, or refine existing conceptual frameworks. Accordingly, the analysis process was informed by contemporary literature on artificial intelligence in education, AI literacy, and the use of generative AI technologies (Kasneci et al., 2023; Tlili et al., 2023; UNESCO, 2026).

In the first stage of the analysis, all responses to the open-ended questions were transferred to a digital environment and read repeatedly by the researchers to achieve data familiarization (Creswell & Poth, 2018). Subsequently, participants' responses were segmented into meaningful units and coded in accordance with the purpose of the study. Content analysis facilitates the systematic organization of large amounts of qualitative data into meaningful categories and themes through a coding process (Miles et al., 2020). During coding, particular attention was given to participants' sources of AI-related knowledge, experiences with AI use, educational applications of AI, perceived advantages, perceived risks and limitations, and expectations regarding the future of the teaching profession.

In the second stage, conceptually similar codes were grouped into subcategories, which were then organized into broader categories and overarching themes. Through this iterative process,

participants' views on artificial intelligence were found to cluster around six major themes: (a) sources of AI-related knowledge and experience, (b) purposes and experiences of AI use, (c) educational applications of AI, (d) perceived advantages, (e) perceived risks and limitations, and (f) expectations regarding the future of the teaching profession.

Throughout the analysis, attention was given not only to frequently occurring views but also to divergent and noteworthy perspectives expressed by participants. This approach enabled a more comprehensive understanding of the diversity of pre-service teachers' perceptions of artificial intelligence. Following the initial thematic organization, all coded data were reviewed again, and the relationships among themes and categories were examined and refined through an iterative process.

To enhance the credibility and dependability of the findings, the coding process was independently conducted by two researchers experienced in qualitative research. The resulting coding schemes were compared and discussed until consensus was reached on category definitions and theme structures. Disagreements were resolved through discussion and re-examination of the original data. In addition, the analytical process was documented in detail to ensure transparency and methodological rigor.

The findings are presented with direct quotations from participants to provide rich descriptions and to allow readers to evaluate the relationship between the data and the interpretations presented (Patton, 2015). To protect participant confidentiality, each participant was assigned an identification code (e.g., PST1, PST2, PST3).

2.5. Trustworthiness and Ethical Considerations

In qualitative research, trustworthiness is commonly evaluated through the criteria of credibility, transferability, dependability, and confirmability rather than the traditional concepts of validity and reliability (Lincoln & Guba, 1985). Several strategies were employed in the present study to enhance the rigor and trustworthiness of the findings.

- To ensure credibility, the data collection instrument was reviewed by two experts in educational technology and teacher education during the development process. Their feedback contributed to improving the clarity, relevance, and content validity of the questions. Furthermore, throughout the analysis process, the researchers independently examined the data and conducted the coding procedures separately. The coding results were subsequently compared, areas of agreement and disagreement were identified, and discrepancies were resolved through discussion until consensus was achieved.
- To enhance dependability, all stages of the research process, including data collection procedures, coding decisions, category development, and analytical processes, were documented in detail. The emerging codes, categories, and themes were reviewed iteratively throughout the analysis, and an audit trail was maintained to ensure methodological consistency and transparency.
- To strengthen confirmability, the findings were supported with direct quotations from participants whenever appropriate. In addition, the resulting themes and categories were reviewed by field experts, and necessary revisions were made based on their feedback. These procedures helped ensure that the findings reflected participants' perspectives rather than researchers' assumptions or biases.
- To promote transferability, detailed descriptions of the study context, participant characteristics, data collection procedures, and analytical processes were provided. Such thick description enables readers and future researchers to determine the extent to which the

findings may be applicable to similar educational contexts (Lincoln & Guba, 1985; Shenton, 2004).

Regarding ethical considerations, the study adhered to the principles of voluntary participation, confidentiality, and anonymity throughout the research process. Participants were informed about the purpose of the study and their right to withdraw at any stage without penalty. No identifying information was disclosed, and all data were used exclusively for scientific research purposes.

3. Findings

Based on the findings obtained from this study, the Artificial Intelligence Perception–Use–Future Expectation Model (AI-PUF Model) was developed to explain pre-service teachers' views of artificial intelligence (Figure 1). The model illustrates that pre-service teachers' understandings of AI are not formed through a simple linear process; rather, they emerge through a multidimensional and dynamic interaction among knowledge sources, perceptions, usage experiences, and future expectations.

The AI-PUF Model was constructed inductively from the themes and categories identified during the content analysis process. The model demonstrates how pre-service teachers' encounters with AI-related information shape their initial perceptions, how these perceptions influence patterns of AI use, and how accumulated experiences subsequently affect their expectations regarding the future role of AI in education and the teaching profession. At the same time, the model suggests that these dimensions are interconnected and mutually influential rather than sequential and independent.

As illustrated in Figure 1, the model consists of four interrelated components: (a) information sources, (b) perceptions of artificial intelligence, (c) AI use and educational applications, and (d) future expectations regarding the teaching profession and educational processes. These components collectively represent the ways in which pre-service teachers make sense of artificial intelligence and position it within their current and future professional practices.

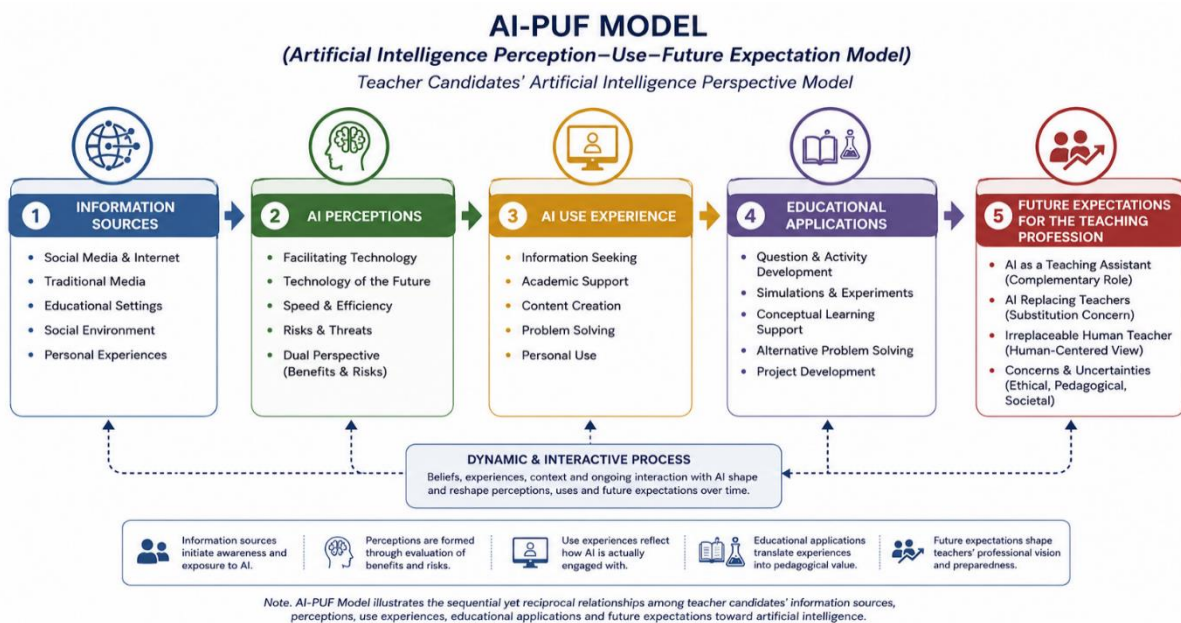


Figure 1. Artificial Intelligence Perception–Use–Future Expectation Model (AI-PUF Model)

The first component of the AI-PUF Model consists of sources of AI-related knowledge and experience. The findings revealed that pre-service teachers primarily acquired information about

artificial intelligence through social media platforms, online environments, traditional media sources, educational settings, social networks, and personal experiences. These sources constitute participants' initial points of contact with AI technologies and provide the foundation upon which subsequent perceptions and evaluations are formed.

The second component involves perceptions of artificial intelligence. Based on their knowledge and experiences, pre-service teachers developed diverse perceptions of AI. Participants frequently described AI as a technology that facilitates daily life, increases efficiency, and represents the future of technological development. At the same time, AI was also perceived as a source of potential risks and threats. These findings suggest that pre-service teachers do not evaluate AI from exclusively positive or negative perspectives; rather, they tend to adopt a balanced view that simultaneously acknowledges both its opportunities and challenges.

The third component comprises AI use and usage experiences. Participants reported using AI for a variety of purposes, including information seeking, supporting academic work, content creation, problem-solving, and personal needs. As usage experiences increased, participants' evaluations of AI became more concrete and informed, influencing their perspectives on the educational applications of these technologies.

The fourth component, educational applications of AI, reflects participants' views regarding the integration of AI into teaching and learning processes. The findings indicated that pre-service teachers perceived AI as a valuable tool for generating questions and learning activities, designing experiments and simulations, supporting conceptual understanding, developing alternative problem-solving strategies, and facilitating project design. This component illustrates how individual experiences with AI may evolve into pedagogical considerations and educational applications.

The final component concerns future expectations regarding the teaching profession. Most participants viewed AI as a supportive tool that could assist teachers in instructional processes. However, some participants suggested that AI might reduce certain teacher responsibilities or assume specific instructional functions in the future. Nevertheless, a substantial proportion emphasized that the social, emotional, and mentoring dimensions of teaching could not be fully replicated by artificial intelligence. These findings indicate that pre-service teachers generally perceive AI as a complementary rather than a substitutive technology within educational contexts.

Overall, the AI-PUF Model demonstrates that pre-service teachers' views of artificial intelligence evolve from knowledge sources to perceptions, usage experiences, educational applications, and ultimately future professional expectations. Importantly, the model does not represent a strictly linear progression. Instead, it depicts a dynamic and interactive process in which developments in AI technologies and new user experiences may continuously reshape perceptions, practices, and expectations. In this respect, the AI-PUF Model provides a holistic conceptual framework for understanding how pre-service teachers interpret and position artificial intelligence within their current and future professional lives.

3.1. Pre-Service Teachers' Perceptions of Artificial Intelligence

An examination of pre-service teachers' views regarding the concept of artificial intelligence revealed that participants predominantly perceived AI as a technology that facilitates daily life, provides rapid access to information, and is expected to become increasingly prevalent in the future. At the same time, some participants expressed concerns that AI could encourage dependency, reduce individuals' effort and initiative, and create various risks for society and education. These findings indicate that pre-service teachers' perceptions of AI encompass both optimistic and cautious perspectives.

The content analysis identified five categories reflecting participants' perceptions of artificial intelligence: (a) facilitative and supportive technology, (b) technology of the future, (c) speed and efficiency, (d) risks and threats, and (e) a dual perspective on AI (Figure 2). While the first three categories represent predominantly positive perceptions emphasizing the benefits and potential of AI, the latter two categories highlight concerns regarding the possible negative consequences and limitations of AI technologies.

The category of facilitative and supportive technology included views emphasizing AI's ability to simplify daily tasks, provide assistance in learning processes, and support academic and professional activities. Participants frequently described AI as a tool that helps users access information more easily and perform tasks more efficiently.

The category of technology of the future reflected participants' beliefs that artificial intelligence will play an increasingly important role in society and education. Many participants viewed AI as an inevitable component of future technological developments and anticipated its continued expansion across various aspects of life.

The category of speed and efficiency captured perceptions related to AI's capacity to save time, accelerate information retrieval, and increase productivity. Participants often highlighted the ability of AI systems to generate responses, summarize information, and support task completion within a short period of time.

In contrast, the category of risks and threats encompassed concerns regarding misinformation, overreliance on technology, ethical issues, privacy risks, and the potential negative consequences of excessive AI use. Participants expressed apprehension that uncontrolled use of AI might lead to undesirable educational and social outcomes.

Finally, the category of a dual perspective on AI reflected participants' recognition that artificial intelligence simultaneously offers significant opportunities and potential risks. Rather than adopting exclusively positive or negative positions, many participants evaluated AI through a balanced lens, acknowledging both its benefits and its limitations.

Overall, these findings suggest that pre-service teachers perceive artificial intelligence as a transformative technology with considerable educational potential while remaining aware of the challenges and uncertainties associated with its increasing integration into everyday and professional contexts.

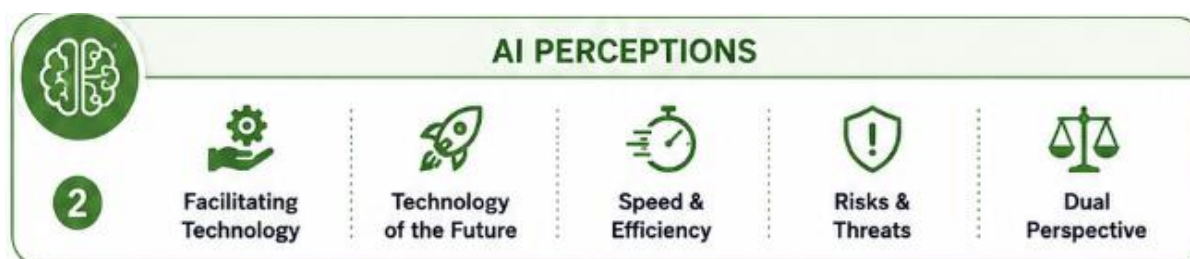


Figure 2. Pre-Service Teachers' Perceptions of Artificial Intelligence

3.1.1. Facilitative and Supportive Technology

A substantial proportion of participants perceived artificial intelligence as a technology that facilitates everyday life, supports learning processes, and assists individuals in a variety of tasks. Participants frequently emphasized the practical benefits of AI and its capacity to provide guidance, information, and support when needed. Representative participant statements are presented below:

PST⁴⁷: "I think it is very helpful and educational."

PST¹²⁸: “Nowadays, it makes our work much easier.”

PST²⁰³: “I see artificial intelligence as a valuable resource that can be used to improve many areas.”

These statements indicate that pre-service teachers primarily view artificial intelligence as a functional and beneficial tool that can support both personal and educational activities.

3.1.2. Technology of the Future

Another prominent category reflected participants’ beliefs that artificial intelligence will occupy a central role in future societies. Participants viewed AI not only as a contemporary technological innovation but also as one of the key technologies shaping the future.

PST⁷⁶: “I see it as our future.”

PST²⁵¹: “I think it is the key to the future.”

PST¹⁴³: “I believe it will possess capabilities that may eventually rival human abilities in an advanced world.”

These responses suggest that pre-service teachers perceive artificial intelligence as a significant driver of future technological and societal transformation.

3.1.3. Speed and Efficiency

Some participants emphasized that the most important characteristic of artificial intelligence is its ability to provide rapid access to information and increase efficiency.

PST¹⁹⁴: “Unlike human intelligence, it provides information much faster.”

PST²⁸⁷: “Its greatest strength, in my opinion, is providing information about things that we may never have thought of.”

These statements demonstrate that participants associate artificial intelligence with enhanced productivity, rapid information retrieval, and efficient knowledge generation.

3.1.4. Risks and Threats

Alongside positive perceptions, some participants highlighted potential risks associated with artificial intelligence at both individual and societal levels. Concerns primarily focused on technological dependency, loss of human control, and possible negative consequences for society.

PST³¹²: “It is very dangerous for the future of humanity.”

PST¹⁷⁶: “Very soon, our society will become dependent on artificial intelligence.”

PST¹⁸⁶: “Artificial intelligence is both humanity’s future and its end.”

These views indicate that concerns regarding the uncontrolled development and use of AI technologies are also present among pre-service teachers.

3.1.5. Dual Perspective on Artificial Intelligence

A number of participants adopted a more balanced perspective by emphasizing both the benefits and the potential drawbacks of artificial intelligence. Rather than viewing AI exclusively as positive or negative, these participants acknowledged its complex and multifaceted nature.

PST⁸⁹: “Although it makes our work easier, I also think it gradually makes us lazier.”

PST²²¹: “I find it both very dangerous and very useful at the same time.”

These statements illustrate that many pre-service teachers approach artificial intelligence through a nuanced lens, recognizing that its opportunities and risks coexist.

Overall, the findings suggest that pre-service teachers’ perceptions of artificial intelligence are predominantly positive. However, these favorable views are accompanied by ethical, social, and individual concerns. The coexistence of optimism and caution indicates that participants perceive

artificial intelligence as a transformative technology whose benefits should be balanced against its potential risks and limitations.

3.2. Sources of AI-Related Knowledge Among Pre-Service Teachers

An examination of pre-service teachers' responses regarding their sources of information about artificial intelligence revealed that participants primarily acquired AI-related knowledge through digital media environments. The analysis identified five categories of information sources: (a) social media and online platforms, (b) traditional media, (c) educational environments, (d) social networks, and (e) personal experiences (Figure 3).

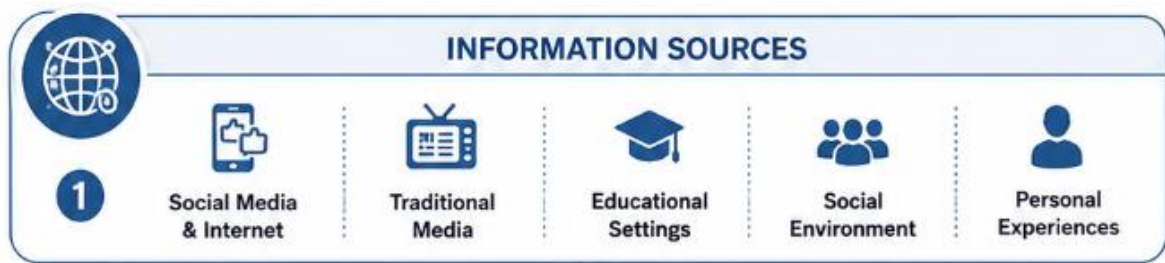


Figure 3. Sources of AI-Related Knowledge Among Pre-Service Teachers

3.2.1. Social Media and Online Platforms

The majority of participants reported obtaining information about artificial intelligence through social media platforms, websites, and various forms of online content. Digital environments appeared to be the most accessible and frequently used sources of AI-related information.

PST³⁴: *"It constantly appears on my social media feeds."*

PST¹¹⁸: *"I follow it through the internet and social media accounts."*

PST²⁰⁷: *"I learned about it through YouTube videos."*

These statements indicate that digital media plays a central role in shaping pre-service teachers' awareness and understanding of artificial intelligence. The widespread availability of AI-related content across online platforms appears to facilitate continuous exposure to emerging technological developments.

3.2.2. Traditional Media

Some participants identified television programs, news broadcasts, documentaries, and other traditional media channels as important sources of information about artificial intelligence.

PST⁷⁵: *"I follow developments through television news."*

PST¹⁴⁶: *"I learned about it from documentaries and news programs."*

These responses suggest that traditional media continues to contribute to public awareness of AI, although its role appears to be less prominent than that of digital media sources.

3.2.3. Educational Environments

A number of participants reported acquiring knowledge about artificial intelligence through university courses, seminars, workshops, and other academic activities.

PST⁹⁶: *"We heard about it in university courses."*

PST¹⁸⁴: *"I first learned about it in detail during a seminar."*

These findings highlight the important role of higher education institutions in promoting AI awareness and supporting the development of AI literacy among future teachers.

3.2.4. Social Networks

Some participants indicated that they became familiar with artificial intelligence through interactions with friends, family members, or other individuals in their social environment.

PST⁵⁹: *“I heard about it from my friends and then started using it.”*

PST²²¹: *“My interest developed through conversations with people around me.”*

These statements demonstrate that interpersonal interactions and social communication contribute to the formation of AI-related awareness and interest.

3.2.5. Personal Experiences

A final category consisted of participants who reported learning about artificial intelligence through direct use and experimentation with AI-powered applications.

PST¹⁴³: *“I learn more as I use it.”*

PST²⁶⁸: *“I became more familiar with artificial intelligence while working with ChatGPT.”*

These responses suggest that experiential learning constitutes an important pathway for developing AI literacy. Direct engagement with AI tools enables users to gain practical knowledge and a deeper understanding of the capabilities and limitations of artificial intelligence technologies.

Overall, the findings indicate that pre-service teachers primarily acquire knowledge about artificial intelligence through digital media and online platforms. However, educational experiences, social interactions, traditional media sources, and direct usage experiences also contribute to their understanding of AI. The diversity of these information sources suggests that pre-service teachers’ perceptions of artificial intelligence are shaped by a combination of formal, informal, and experiential learning opportunities.

3.3. Pre-Service Teachers’ Experiences with Artificial Intelligence Use

An examination of pre-service teachers’ experiences with artificial intelligence revealed that the majority of participants actively used at least one AI-powered application. Participants reported utilizing AI tools primarily for information seeking, assignment preparation, content creation, research activities, and problem-solving. The analysis identified five categories of AI use: (a) information seeking and research, (b) support for academic work, (c) content creation, (d) problem-solving and learning support, and (e) personal use (Figure 4).



Figure 4. Pre-Service Teachers’ Experiences with Artificial Intelligence Use

3.3.1. Information Seeking and Research

A considerable number of participants reported using AI technologies to obtain information quickly and support research activities. AI tools were frequently described as efficient resources for accessing information and exploring unfamiliar topics.

PST⁴¹: *“I use it to quickly obtain information about topics I am curious about.”*

PST¹¹⁷: *“I use it to access different sources while conducting research.”*

PST²²⁸: *“It accelerates my information-gathering process.”*

These statements indicate that pre-service teachers primarily perceive AI as a tool that facilitates access to information and supports research-related activities.

3.3.2. Support for Academic Work

Participants frequently reported using AI tools to assist with assignments, project development, academic writing, and coursework. AI was often viewed as a supportive resource that provides guidance throughout academic tasks.

PST⁹²: *"I use it to get ideas when preparing assignments."*

PST¹⁵⁴: *"It guides me in my projects."*

PST²⁶³: *"I use it to create drafts for my academic work."*

These responses suggest that AI has become integrated into participants' academic practices and is increasingly perceived as a support mechanism for educational tasks.

3.3.3. Content Creation

Some participants reported using generative AI tools to create texts, develop educational activities, and generate creative content.

PST⁸⁷: *"I use it to generate content while preparing presentations."*

PST²⁰¹: *"It provides ideas for instructional activities."*

PST³¹⁷: *"It generates alternative expressions when I am writing."*

These findings demonstrate that generative AI applications play a significant role in supporting pre-service teachers' content development processes and creative production activities.

3.3.4. Problem-Solving and Learning Support

A number of participants stated that they used AI to understand difficult concepts, solve problems, and support their learning processes. AI tools were often described as providing personalized explanations and instructional assistance.

PST¹³⁶: *"I use it to learn solution methods for problems I cannot solve."*

PST²⁴³: *"It explains topics I do not understand in a clearer way."*

PST³⁰¹: *"It provides individualized support during my learning process."*

These statements suggest that pre-service teachers increasingly view AI as an alternative learning support system capable of supplementing traditional educational resources.

3.3.5. Personal Use

Some participants indicated that they use AI not only for academic purposes but also in their daily lives. Reported uses included planning activities, seeking information for personal interests, and engaging in informal conversations.

PST⁶⁴: *"I use it to plan my daily tasks."*

PST¹⁷³: *"I use it to chat about topics I am curious about during my free time."*

These responses demonstrate that AI technologies are becoming embedded in participants' everyday routines and are increasingly perceived as personal as well as educational tools.

An examination of the AI applications used by participants revealed that ChatGPT was by far the most frequently used platform. In addition, participants reported using other AI-powered systems, including Gemini, Microsoft Copilot, and various AI-assisted applications. Overall, the findings indicate that pre-service teachers are moving beyond merely being aware of artificial intelligence and are becoming active users of these technologies. Their experiences suggest that AI is increasingly being integrated into both academic and everyday contexts as a practical and multifunctional resource.

3.4. Pre-Service Teachers' Views on the Educational Applications of Artificial Intelligence

An examination of pre-service teachers' views regarding the use of artificial intelligence in science and mathematics education revealed that participants generally perceived AI as a tool that supports instructional processes, facilitates learning, and enables access to educational experiences that may be difficult to implement in traditional classroom settings. The analysis identified five categories of educational applications: (a) question and activity development, (b) experiments and simulations, (c) support for conceptual learning, (d) problem-solving and alternative solution strategies, and (e) project development (Figure 5).

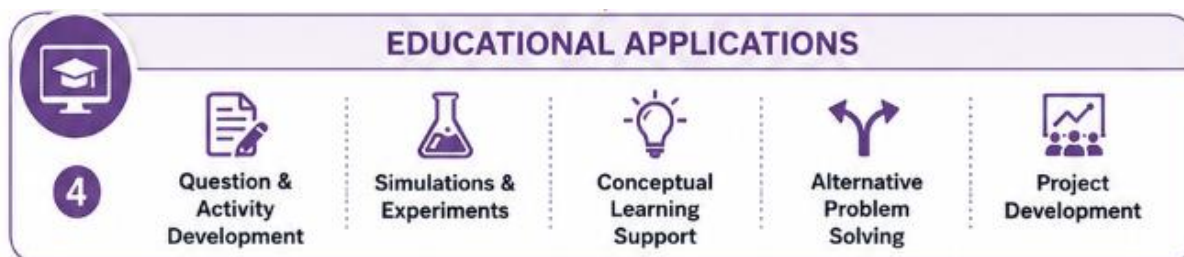


Figure 5. Pre-Service Teachers' Views on the Educational Applications of Artificial Intelligence

3.4.1. Question and Activity Development

A substantial number of participants suggested that artificial intelligence could be used to develop assessment questions, practice exercises, and instructional activities. Participants emphasized AI's potential to support teachers in preparing diverse and engaging learning materials.

Representative participant statements include:

PST¹: *"Question preparation."*

PST¹⁹: *"It can be used to create new problems and questions for teachers."*

PST¹⁸: *"For science, it can be used in experiments, and for mathematics, it can be used to generate activities and different types of questions."*

PST¹⁴: *"Practice exercises."*

These findings indicate that pre-service teachers perceive AI as a valuable resource for instructional material development and assessment design.

3.4.2. Experiments and Simulations

Participants frequently highlighted the potential of AI to support experimental learning through simulations, particularly in situations where conducting real experiments may be costly, impractical, or impossible within classroom settings.

For example:

PST²: *"It can be useful for simulating beneficial but expensive experiments."*

PST²⁵: *"It can be used for experiments that cannot be conducted in classroom environments."*

PST²¹: *"We can ask for examples of experiments on any topic."*

These statements suggest that participants view AI as a technology capable of expanding opportunities for inquiry-based and experiential learning, particularly within science education.

3.4.3. Support for Conceptual Learning

Some participants emphasized the role of AI in explaining abstract concepts, addressing misconceptions, and facilitating deeper conceptual understanding.

PST⁴: *"It can be used to address misconceptions in biology."*

PST²⁰: *“It can be used in science experiments and can also help concretize and illustrate mathematical theories.”*

PST⁵: *“By easily presenting and explaining the theories behind topics and problems, it can assist both teachers and students.”*

These responses indicate that pre-service teachers perceive AI as a tool that can support meaning-making processes and enhance conceptual understanding across different subject areas.

3.4.4. Problem-Solving and Alternative Solution Strategies

Participants also emphasized the potential of AI to support problem-solving by generating alternative approaches and facilitating different ways of thinking.

PST¹¹: *“It can help develop different solution methods.”*

PST²⁴: *“In calculations.”*

These findings suggest that pre-service teachers view AI as a resource that can promote flexible thinking and expose learners to multiple pathways for solving problems.

3.4.5. Project Development

A number of participants indicated that AI could contribute to project design and creative idea generation. In this regard, AI was viewed as a technology that can support innovation and creativity in educational contexts.

PST²³: *“It can be useful for creativity when preparing projects.”*

PST¹⁷: *“For designing experiments and generating problems.”*

These statements demonstrate that participants perceive AI not merely as an information-delivery tool but also as a resource capable of fostering creative thinking and project-based learning.

Overall, the findings reveal that pre-service teachers believe artificial intelligence can make significant contributions to science and mathematics education, particularly in the areas of question development, simulation-based learning, conceptual understanding, problem-solving, and project design. Collectively, these views suggest that participants perceive AI as a pedagogical tool with the potential to enrich instructional practices and expand learning opportunities beyond the limitations of traditional classroom environments.

3.5. Pre-Service Teachers’ Views on the Future Role of Artificial Intelligence in the Teaching Profession

An examination of pre-service teachers’ views regarding the future role of artificial intelligence in education revealed that the majority of participants believe AI will occupy an increasingly important position within educational systems. However, participants expressed differing opinions regarding the extent to which AI may replace teachers in the future. The analysis identified four categories: (a) AI as a supportive instructional assistant, (b) the possibility of replacing teachers, (c) the irreplaceability of teachers, and (d) concerns and uncertainties (Figure 6).



Figure 6. Pre-Service Teachers’ Views on the Future Role of Artificial Intelligence in Education

3.5.1. AI as a Supportive Instructional Assistant

A substantial proportion of participants perceived artificial intelligence as a tool that would support rather than replace teachers. Participants frequently emphasized AI's potential to reduce teachers' workload, facilitate instructional processes, and provide additional support for both teachers and students.

For example:

PST²: *"I think it will play a role similar to a teacher's right hand, helping and facilitating their work."*

PST³: *"It may assume the role of an assistant teacher in the classroom."*

PST¹⁹: *"It will provide students with a new way of acquiring knowledge and will assist teachers."*

PST¹⁴: *"It can reduce teachers' workload and allow them to focus more on guidance."*

These statements indicate that pre-service teachers generally perceive AI as a complementary technology that enhances teachers' effectiveness rather than substituting for their professional roles.

3.5.2. The Possibility of Replacing Teachers

Some participants suggested that, given the rapid development of AI technologies, artificial intelligence could eventually assume functions traditionally performed by teachers.

PST¹: *"It could become an alternative teacher."*

PST¹⁵: *"Soon there may be no need for teachers because students can access any information they need very quickly."*

PST¹⁷: *"Teachers may no longer be necessary."*

PST¹⁸: *"Artificial intelligence may advance so much that students may no longer need teachers."*

These views reflect a belief among some participants that AI could take on a more dominant role within educational systems, particularly in areas related to information delivery and instructional support.

3.5.3. The Irreplaceability of Teachers

In contrast, many participants emphasized that regardless of technological advancements, artificial intelligence would not be able to fully replace teachers.

PST¹¹: *"I think it will make teachers' jobs easier, but it can never replace them."*

PST²⁰: *"I do not think it will ever surpass the role of the teacher."*

PST²⁵: *"As we observed during distance education, no matter how dependent we become on technology, the role of a teacher cannot truly be replaced."*

These responses suggest that participants view teaching as a profession extending beyond information transmission. They emphasized the importance of teachers' social, emotional, motivational, and mentoring functions, which they believe cannot be fully replicated by artificial intelligence.

3.5.4. Concerns and Uncertainties

Some participants expressed concerns regarding the increasing presence of AI in educational contexts. These concerns focused on potential reductions in teachers' influence, excessive reliance on technology, and broader educational implications.

PST⁷: *"I am concerned that teachers' sphere of influence may decrease."*

PST⁹: *"It may make teaching easier, but it could also encourage students to take shortcuts."*

PST²⁴: *"I think it could be frightening."*

These statements indicate that although participants generally recognize the potential benefits of AI, they also hold professional and pedagogical concerns regarding its future integration into education. Overall, the findings suggest that pre-service teachers perceive artificial intelligence as an influential actor in the future of education. However, most participants envision AI as a technology that supports and transforms teaching rather than completely replacing teachers. While acknowledging AI's potential to enhance efficiency and expand learning opportunities, participants continue to attribute unique value to the human, social, emotional, and relational dimensions of teaching. These findings reinforce the view that the future of education is likely to involve collaboration between human teachers and artificial intelligence rather than a complete substitution of one for the other.

4. Discussion

This study examined pre-service teachers' views on artificial intelligence in terms of information sources, perceptions, usage experiences, educational applications, and expectations regarding the future of the teaching profession, and proposed the AI-PUF Model based on the findings obtained. The most significant contribution of the study is that it demonstrates that pre-service teachers' views of artificial intelligence are not merely composed of individual attitudes toward technology; rather, they represent a dynamic structure shaped through information acquisition processes, usage experiences, and pedagogical evaluations.

The findings revealed that pre-service teachers largely perceive artificial intelligence as a useful, supportive, and future-oriented technology. This suggests that the opportunities offered by generative AI tools in educational contexts are rapidly recognized by users. Kasneci et al. (2023) stated that large language models are positively received by educational stakeholders because they can provide personalized support in learning processes, facilitate content creation, and offer instant feedback to students. Similarly, Tlili et al. (2023) emphasized that ChatGPT is perceived as an accessible and flexible support mechanism for learning. Consistent with these studies, the findings of the present research indicate that pre-service teachers primarily view artificial intelligence as a technology that facilitates learning and accelerates access to information.

The findings further indicate that participants generally perceive artificial intelligence as a tool that supports learning, facilitates access to information, and enriches instructional processes. This result is consistent with the study conducted by Bayer Kurt et al. (2026), which found that primary school students in rural areas predominantly perceived artificial intelligence as a helpful, educational, and life-facilitating technology. In that study, students reported that artificial intelligence made daily life easier and contributed to homework completion processes. However, it was also reported that students in higher grade levels developed awareness of potential risks associated with artificial intelligence, such as dependency, laziness, and malicious use. Similarly, the pre-service teachers in the present study drew attention to negative aspects of artificial intelligence, including misinformation, ethical concerns, violations of academic integrity, and technological dependency. When the findings of both studies are considered together, it can be suggested that although positive perceptions of artificial intelligence are widespread, individuals tend to develop more critical and balanced evaluations as their age and experience levels increase.

Likewise, Yıldız Albayrak and Bal İncebacak (2025), in their study examining teachers' views on artificial intelligence, found that participants perceived AI as a technology that supports instructional processes, saves time, and facilitates educational activities. At the same time, they also highlighted risks such as ethical concerns, misinformation, and excessive dependence on

technology. These findings indicate that although positive perceptions of artificial intelligence tend to dominate across different age groups and professional populations, individuals are still capable of approaching the technology from a critical perspective.

However, the findings also revealed that pre-service teachers do not evaluate artificial intelligence in an unconditionally positive manner. A substantial proportion of participants expressed concerns that AI may encourage laziness, foster dependency, and pose various risks for the future of humanity. This finding suggests that perceptions of artificial intelligence are shaped by a tension between technological optimism and technological anxiety. Dwivedi et al. (2023) emphasized that while generative AI tools offer significant opportunities for education, research, and professional life, they also bring risks such as misinformation, ethical concerns, and excessive dependency. Similarly, UNESCO (2023) noted that generative AI systems should be carefully managed with regard to critical thinking, data security, and academic integrity. The dual perspective identified in the present study indicates that pre-service teachers do not perceive artificial intelligence as either entirely positive or entirely negative; rather, they appear to be developing a balanced perspective that acknowledges both its opportunities and risks.

Another noteworthy finding of the study is that pre-service teachers' sources of information about artificial intelligence are largely shaped by social media, the internet, and digital platforms. This finding suggests that AI literacy is developing to a considerable extent through informal learning processes. However, it also raises the possibility that pre-service teachers' knowledge of artificial intelligence may be influenced more by digital media content than by systematic academic learning. Chiu (2024) argues that for artificial intelligence to be successfully integrated into educational systems, pre-service teachers should be prepared not only as users of AI technologies but also as critical evaluators and ethical decision-makers. In this context, the findings highlight the need for structured courses and educational practices aimed at developing AI literacy within teacher education programs.

The findings revealed that pre-service teachers actively use artificial intelligence and that their usage experiences extend across a broad spectrum, ranging from information acquisition to academic production. In particular, intensive use was reported in areas such as assignment preparation, academic writing, content development, and problem-solving. These findings indicate that pre-service teachers are beginning to integrate artificial intelligence into their everyday academic lives rather than viewing it merely as an experimental technology. The systematic review conducted by Zawacki-Richter et al. (2019) demonstrated that AI applications have become increasingly prevalent in higher education, particularly in the areas of learning support, feedback provision, and content development. The present study supports these findings and suggests that generative AI tools are increasingly being positioned as a new cognitive support system within pre-service teachers' individual learning processes.

The findings related to educational applications revealed that pre-service teachers perceive artificial intelligence as a highly functional pedagogical tool. Participants indicated that AI could make significant contributions in areas such as question development, experiment simulations, support for conceptual learning, generation of alternative solution strategies, and project development. This finding suggests that pre-service teachers do not view artificial intelligence merely as a technology that provides information; rather, they perceive it as a pedagogical tool capable of supporting instructional design. Holmes et al. (2019) argued that artificial intelligence can support teachers' pedagogical decision-making processes and enrich learning experiences. Similarly, Kasneci et al. (2023) emphasized that large language models offer substantial opportunities for instructional

material development and personalized learning. The findings of the present study indicate that pre-service teachers likewise recognize this pedagogical potential.

One of the most noteworthy findings of the study emerged from pre-service teachers' views regarding the future role of artificial intelligence in the teaching profession. Although participants acknowledged that AI would play an important role in educational processes, they largely positioned it as a supportive assistant rather than a system that would replace teachers. This finding suggests that pre-service teachers do not view teaching as a profession limited solely to the transmission of knowledge. An examination of participants' responses revealed a prevailing belief that aspects of teaching such as guidance, emotional support, social interaction, and human relationships cannot be fully replicated by artificial intelligence. This finding is consistent with the results reported by Soleimani et al. (2025) in their study examining educators' views on generative artificial intelligence. In that study, educators also perceived AI as a powerful support tool while emphasizing the indispensable nature of human-centered instruction and teacher-student relationships.

One of the important contributions of this study is the proposal of the Artificial Intelligence Perception-Use-Future Expectation Model (AI-PUF Model) to explain pre-service teachers' views on artificial intelligence. While existing studies have generally focused on attitudes toward AI, technology acceptance, or intentions to use AI (Chiu, 2024; Kasneci et al., 2023), the present study demonstrates that pre-service teachers' views of artificial intelligence develop through a multidimensional and process-oriented structure.

The AI-PUF Model suggests that pre-service teachers' views of artificial intelligence begin with information sources, which subsequently shape their perceptions of AI and gradually develop into usage experiences. The findings indicate that AI is perceived not only as a technological tool but also as a learning and teaching support mechanism capable of transforming pedagogical practices. This finding suggests that pre-service teachers view artificial intelligence as a pedagogical partner that can be utilized for question development, supporting conceptual learning, problem-solving, and instructional design processes.

The final stage of the model, professional expectations, reveals that pre-service teachers predominantly position artificial intelligence as a supportive assistant rather than a system that replaces teachers. In this respect, the AI-PUF Model provides a holistic framework explaining how views of artificial intelligence emerge through the interaction of information sources, perceptions, usage experiences, pedagogical applications, and professional identity perceptions. Consequently, the model proposes an approach to AI literacy that encompasses not only technical competencies but also pedagogical and professional dimensions.

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