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ARTIFICIAL INTELLIGENCE IN EDUCATION: ATTITUDES AND PERCEPTIONS OF PRE-SERVICE TEACHERS

Abstract. Teachers who intend to use artificial intelligence (AI) in their classrooms are expected to possess the necessary competencies and provide appropriate support to their students. Therefore, identifying pre-service teachers' attitudes and perspectives toward AI is essential for training teachers who can effectively utilize modern technologies. The aim of this study is to determine pre-service teachers' attitudes toward AI, analyze them across various variables, and reveal the importance of AI use in education from the perspective of the sample. The study was conducted in two sequential phases using a descriptive survey model. In the first phase, the General Attitude Towards Artificial Intelligence Scale was administered to 658 pre-service teachers. In the second phase, a group of 90 pre-service teachers selected from the initial sample received a structured AI training program focused on AI literacy, the integration of AI into educational settings, instructional design with AI, and sample classroom applications. Following the training program, the AI Integration Reflection Form, consisting of four open-ended questions, was administered to these 90 participants. While the quantitative data collected from the scale were analyzed using statistical methods, the responses to the AI Integration Reflection Form were analyzed through content analysis. The findings indicated that pre-service teachers had high levels of positive attitudes and low levels of negative attitudes toward AI. In terms of gender, male participants demonstrated more positive attitudes than female participants. The analysis of the open-ended responses revealed that pre-service teachers mainly emphasized the benefits of AI integration in education. Additionally, it was found that although many participants had prior experience with AI, they were positively influenced by the training and believed it would contribute to improving their performance. Furthermore, pre-service teachers reported that they did not perceive AI as a threat in learning environments and believed that it operated with minimal errors.

Keywords: artificial intelligence; AI training; attitude; reflections on AI use; pre-service teachers

1. INTRODUCTION

Artificial intelligence (AI) is defined as systems possessing human-like abilities such as memory, perception, and language comprehension [1], [2]. This technology stands out as a field of computer science aimed at developing systems capable of mimicking human cognitive functions, such as learning, reasoning, and self-correction [3]. AI technology promises significant advancements in various fields, including the labor market, education, healthcare, and national security [4]. Particularly, it increasingly influences our lives by performing cognitive tasks such as problem-solving and learning [5]. As a result, it is emphasized that AI can enhance efficiency, provide new opportunities, reduce human errors, take responsibility for solving complex problems, and perform monotonous tasks [6]. These benefits are expected to save individuals more time for learning, experimenting, and exploring, which can increase both creativity and quality of life [7].

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AI technology holds significant potential for developing personalized educational content and materials, such as text, visuals, and videos. AI technologies assist teachers by analyzing data, providing insights, and identifying trends [8]. Current research shows that AI technologies are widely adopted in various forms in educational institutions, and their usage areas are rapidly expanding [9]. The integration of AI in education aims to enhance the learning process by making it more personalized, adaptive, and effective [10]. Leveraging AI, educational systems can provide learning resources tailored to students' unique characteristics, such as learning needs, preferences, and individual learning speeds [11], [12]. Moreover, AI is an effective tool that allows students to create their own learning materials, providing a more engaging and enjoyable learning experience. This personalized approach is expected to improve comprehension and higher-order thinking skills while increasing students' satisfaction with the course [13]. Supported by an AI-integrated environment, students can feel empowered to generate knowledge independently [14].

Considering these numerous advantages of AI, it is expected that attitudes toward AI would be positive. Positive perceptions of AI and widespread acceptance enhance the effectiveness of strategic resource use, positively impacting employee productivity and organizational performance [15]. However, despite positive attitudes toward AI, there are also concerns about its widespread use [16]. Although AI brings convenience to human life, studies focusing on attitudes toward this technology highlight various risks and challenges. These include potential impacts on privacy, concerns about increasing social inequality [17], ethical, socio-political, and economic risks [18], violations of trust, unethical use, and a lack of transparency and accountability [19].

The emergence of AI has led to diverse attitudes among teachers and pre-service teachers toward its use in educational settings [20]. Although studies examining teachers' attitudes and perceptions of AI are still limited [21], [22], the role of AI in education and its significance for teachers remain uncertain, causing varying levels of concern among teachers [23], [24]. In general, while the potential benefits of artificial intelligence (AI) in education are numerous, addressing teachers' attitudes and concerns and promoting an open, collaborative dialogue process are of great importance for the responsible and effective integration of AI into education [25]. Studies on AI attitudes should not be perceived solely as an exploration of technology adoption but also as a valuable source of information regarding what needs to be done to further develop AI in the future [26]. The present study makes a contribution to the literature by covering both the attitudinal and pedagogical dimensions of integrating AI in teacher education. This research provides pre-service teachers with structured training that emphasizes the pedagogical use of AI in educational settings. The training program involves examples of incorporating AI in the planning of lessons, the design of instructional materials, the student assessments, and the development of AI-supported learning activities. By emphasizing the pedagogical potential of AI in addition to its role in technical assistance, the work seeks to foster future teachers' insights into how to incorporate AI meaningfully and responsibly in the teaching and learning process. In this context, the study may offer contribution to the growing body of research on AI in education by bridging the gap between technological competence and pedagogical practice.

The research goal. Given the critical role AI is expected to play in education, it is essential to measure the attitudes of teachers and pre-service teachers in a way that accurately reflects the broader population. Accordingly, this study aims to determine the general attitudes and views of pre-service teachers toward AI and explore their relationship with various variables. The research questions of the study are as follows:

1. What is the general level of pre-service teachers' attitudes (positive-negative attitudes) toward artificial intelligence?

2. Do pre-service teachers' overall attitudes toward artificial intelligence (positive–negative attitudes) differ statistically according to gender and grade level?
3. What are pre-service teachers' views regarding the purposes, benefits, drawbacks/risks, and possible precautions related to the use of artificial intelligence applications?

2. RESEARCH METHODS

This study employed a mixed-method descriptive design that integrates quantitative and qualitative data to provide a rich description of pre-service teachers' attitudes and views toward artificial intelligence (AI). At the quantitative phase, descriptive surveys among 658 pre-service teachers determined their overall attitudes towards AI as well as explored possible differences based on the demographic variables. At the qualitative phase, a purposively sampled subgroup of 90 respondents took a structured AI course as well as completed a reflection form that had been developed to explore their perceptions, experiences, as well as recommendations about the integration of AI in education. The research design applies the principles of mixed-method descriptive research that attempt to describe phenomena in depth with the numerical measures as well as the expressed experiences of the respondents without examining cause-and-effect relationship [27], [28]. Integrating quantitative breadth as well as depth based on the qualitative components, the study offers a richer contextualized explanation of pre-service teachers' attitudes as well as perceptions regarding AI.

2.1. Sample

The sample of the study consists of 658 pre-service teachers: 491 (74.6%) females and 167 (25.4%) males. Among the sample, 138 (21%) were enrolled in their first-year, 208 (31.6%) second-year, 83 (12.6%) third-year, 229 (34.8%) fourth-year students. The convenience sampling was used. This approach allows researchers to collect data from groups of people who are more economical to reach in terms of accessibility and time [29]. The participants voluntarily took part in the study.

2.2. Data collection tools

Data were collected through the general attitudes toward artificial intelligence scale (GAAIS) and AI Integration Reflection Form.

The General Attitudes towards Artificial Intelligence Scale (GAAIS): The scale was developed by [30] to assess individuals' general attitudes toward artificial intelligence. The Turkish adaptation of the scale was conducted by [7]. The scale consists of two sub dimensions: Positive GAAIS with 12 items (e.g., "I would like to use Artificial Intelligence in my own job", I am interested in using artificially intelligent systems in my daily life") and Negative GAAIS with 8 items (e.g., "I think artificially intelligent systems make many errors", "I shiver with discomfort when I think about future uses of Artificial Intelligence"). It is structured as a 5-point Likert-type scale. The Cronbach's alpha internal consistency coefficients for the original subscales were 0.88 and 0.83, respectively. For the Turkish version, the coefficients were 0.82 and 0.84, respectively. Based on the sample data in this study, the Cronbach's alpha coefficients were found to be 0.91 and 0.88, respectively.

AI Integration Reflection Form: This form was developed by the researchers to deeply examine pre-service teachers' knowledge and views of AI usage. It consists of four questions:

1) For what purposes do you use AI applications in your classes or educational activities?
2) What do you think are the benefits of using AI applications for educational purposes?

3) What do you think are the drawbacks/risks of using AI applications for educational purposes?
4) What precautions can be taken to eliminate the potential risks of using AI applications?

2.3. Research process

The research consists of two sequential phases. In the first phase, the GAAIS was administered to 658 pre-service teachers. This phase aimed to determine the general attitudes of pre-service teachers toward AI. In the second phase, 90 pre-service teachers, selected from the initial sample, participated in a 6 hour training session (2 hours per week for 3 weeks) on the use of AI in learning environments. The training included an introduction to AI, AI literacy, AI integration into education, instructional design with AI, and a sample AI application (Fig.1). AI literacy refers to the pre-service teachers' awareness, understanding, and skills in using artificial intelligence tools for pedagogic purposes, as emphasized in the training program. Experience in AI refers to the participants' previous understanding or habitual exposure to the AI applications in their personal or academic work. The vision for integration into pedagogy was explored during the training duration and in the reflective journaling, pointing towards the pedagogical integration of AI into course planning, instructional design, assessments, and educational activities. These operational definitions were utilized to ensure conceptual clarity and consistency across the data collection tools. At the end of this phase, the AI Integration Reflection Form was administered to the participating pre-service teachers to determine their views on AI use.

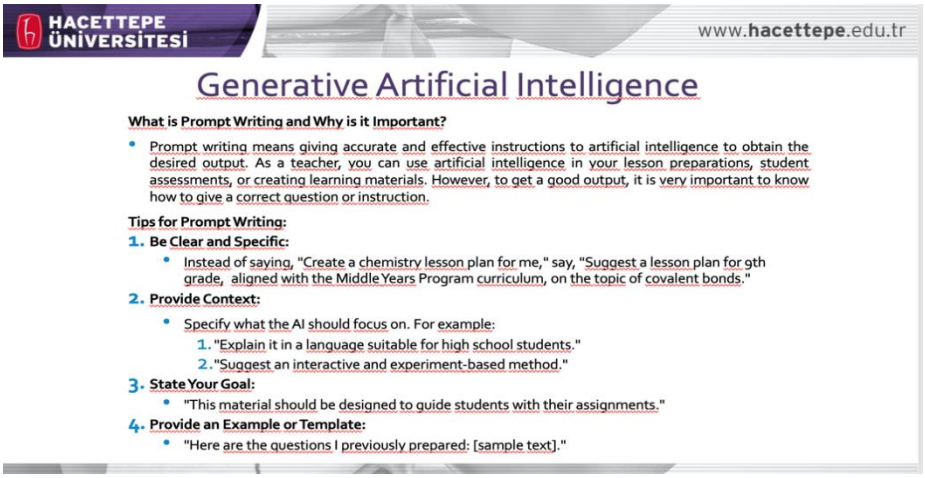

Figure 1. Sample slide from the presentation used in structured AI training program (Originally prepared in Turkish)

2.4. Data Analysis

Two separate analysis procedures were followed in this study: 1. Quantitative data analysis – determining pre-service teachers' general attitudes towards AI, 2. Qualitative data analysis – evaluating the use of AI in education.

Analysis of Quantitative Data: Quantitative data obtained from GAAIS were analyzed using SPSS23 software. Descriptive statistics were calculated, and the normality assumption was tested. GAAIS scores were examined based on gender and grade level. Due to significant differences in the distribution of gender and grade-level groups, non-parametric tests were used. Specifically, the Mann-Whitney U test was employed for gender, while the Kruskal-Wallis test, a non-parametric alternative to ANOVA, was used for grade level.

Analysis of Qualitative Data: Data obtained from the AI Integration Reflection Form were analyzed using content analysis. Initially, responses were organized according to the questions in the form. After carefully reading the responses, coding process was initiated. The data were analyzed line by line using the open coding technique and meaningful sections were coded. These open codes were then grouped based on their frequency and content, transforming them into categories. Finally, the categories were categorized into themes that demonstrated conceptual unity.

3. THE RESULTS

3.1. Quantitative findings

The primary aim of this study is to determine the GAAIS levels of pre-service teachers. Descriptive statistics were used for this purpose. Data on positive and negative GAAIS scores were analyzed using descriptive statistics, including minimum and maximum values, mean scores, standard deviation, skewness, and kurtosis values. The findings obtained from these analyses are presented in Table 1.

Table 1

Descriptive statistics for GAAIS

Variables	Mean	SD	Median	Min.	Max.	Skewness	Kurtosis
Positive GAAIS	3.83	.73	3.83	1.00	5.00	-.673	.928
Negative GAAIS	3.06	.88	3.13	1.00	5.00	-.333	-.328

Table 1 shows that pre-service teachers' scores in the positive attitude sub-dimension of the GAAIS are at a high level (M: 3.83), while their scores in the negative attitude sub-dimension are at a moderate level (M: 3.06). Overall, it was determined that pre-service teachers have a high level of general attitudes toward artificial intelligence.

When the positive attitude sub-dimension of GAAIS is examined, it can be interpreted that pre-service teachers perceive AI as beneficial in many areas, providing economic opportunities and being exciting. In contrast, an analysis of their scores in the negative attitude sub-dimension of GAAIS reveals that pre-service teachers consider AI as malevolent or harmful and express concerns about its widespread use in the future. Another objective of this study is to determine whether pre-service teachers' general attitudes toward artificial intelligence differ by gender. For this purpose, the gender distribution of the sample was first examined. The sample consisted of 491 (74.6%) females and 167 (25.4%) males. Due to the significant difference in the number of participants in each gender group, non-parametric tests were used for data analysis. The differences in GAAIS scores by gender were analyzed using the Mann-Whitney U test. The results of this analysis are presented in Table 2.

Table 2

Mann-Whitney U-test results for the GAAIS

Observed variables		Mean rank	Sum of ranks	U	p
Positive GAAIS	Female	312.60	153488.50	32702.500	.000*
	Male	379.18	63322.50		
Negative GAAIS	Female	335.10	164534.00	38249.000	.195
	Male	313.04	52277.00		

*p<0.05

As shown in Table 2, the results of the Mann-Whitney U test comparing the GAAIS scores of male and female pre-service teachers indicate that the positive attitude levels of females toward artificial intelligence are lower than those of males. This difference is statistically significant (p <.05). Accordingly, it can be concluded that male pre-service teachers are more interested in using artificial intelligence systems compared to their female counterparts. Similarly, male pre-service teachers express a greater willingness to use artificial intelligence in their teaching careers than females.

When analyzing the negative attitude sub-dimension of GAAIS according to gender, it was found that females scored higher than males. However, the difference between the mean scores of male and female pre-service teachers was not statistically significant. Nevertheless, when considering the scale items, it can be inferred that females perceive artificial intelligence as more dangerous and believe that the increasing use of artificial intelligence may one day harm humans. This finding suggests that females approach artificial intelligence with greater caution.

To investigate whether the overall artificial intelligence attitude scores of pre-service teachers vary according to their year of study, an ANOVA analysis was initially considered. However, upon examining the sample distribution, it was found that 138 participants (21%) were in their first year, 208 (31.6%) were in their second year, 83 (12.6%) were in their third year, and 229 (34.8%) were in their fourth year. Due to the considerable difference in the number of participants across the year levels, a non-parametric Kruskal-Wallis test was employed to analyze the differences in GAAIS scores according to the year of study. The results of this analysis are presented in Table 3.

Table 3

Kruskal-Wallis-test results for the GAAIS

Observed variables		Mean	Mean rank	Chi-Square	p
Positive GAAIS	1st grade	3.84	310.07	3.522	.318
	2nd grade	3.78	330.87		
	3rd grade	3.83	343.43		
	4th grade	3.85	334.83		
Negative GAAIS	1st grade	2.90	295.36	11.809	.008*
	2nd grade	3.07	321.22		
	3rd grade	3.17	355.25		
	4th grade	3.12	343.21		

*p<0.05

When examining Table 3, a statistically significant difference is observed in the negative attitude sub-dimension of GAAIS according to the year of study variable (p < .05). Among pre-service teachers, the highest mean score in this dimension is observed among third-year students (M:3.17), while the lowest mean score is found among first-year students (M:2.90). This significant difference in this sub-dimension is particularly evident between first-year and third-year pre-service teachers.

3.2. Qualitative findings

Qualitative findings are presented below, grouped under headings according to the questions in the AI Integration Reflection Form. In this study, pre-service teachers are referred to as PT.

3.2.1. Findings regarding the purposes of using artificial intelligence applications

Pre-service teachers were asked for what purposes they used artificial intelligence applications in their lessons or educational activities, and their responses were coded as shown in Table 4.

Table 4

Categories and codes for the theme of purposes of using artificial intelligence

Category	Code
Assignment assistance	Finding academic sources Instructional material design Designing presentation slides Designing lesson plan
Individual learning	Studying Language learning

The purposes of using artificial intelligence applications by pre-service teachers were categorized under "Assignment assistance" and "Individual learning." The Assignment assistance category consists of four codes: Finding academic sources, instructional material design, designing presentation slides, and lesson plan.

PT6 expressed that they used artificial intelligence applications for finding academic sources as follows: "*I use my artificial intelligence applications while searching for research relevant to my assignments. I then review the studies I find and incorporate them into my assignment*". PT19's statement regarding using artificial intelligence for instructional material design is as follows: "*As a pre-service primary school teacher, I need to prepare more diverse and lasting games and lesson materials because the age group I am interested in is at a more concrete stage*". The responses of pre-service teachers regarding the codes of designing presentation slides and designing lesson plan are as follows: "*I use it for preparing presentations and for suggesting different methods and applications in class*" [PT16], "*I am required to prepare a lesson plan every week by the teacher at the school where I go for teaching practice. Therefore, I use ChatGPT to get ideas while preparing the lesson plan*" [PT30].

The Individual learning category consists of two codes: Studying and language learning. The excerpts related to these codes are as follows: "*Sometimes I use it to look at points I get stuck on about a topic, sometimes to understand the topic bette*r" [PT46], "*I use it especially to learn the English and German meanings of some words and sometimes to improve my English by having daily conversations translated*." [PT86].

3.2.2. Findings regarding the benefits of artificial intelligence applications

Pre-service teachers were asked about the potential benefits of using artificial intelligence applications for educational purposes, and the resulting categories and codes are presented in Table 5.

Table 5

Categories and codes for the theme of benefits of artificial intelligence

Category	Code
Time and effort savings	Quick access to information Reduction of workload
Support for creativity	Providing a variety of ideas Generating solutions
Enrichment of educational content	Visual-graphic production Diversification of activities

The views of pre-service teachers regarding the benefits of artificial intelligence (AI) applications are categorized into three main categories: time and effort savings, support for

creativity, and enrichment of educational content. Under the category of time and effort savings, there are codes labeled as quick access to information and reduction of workload. The following excerpts from the AI Integration Reflection Form illustrate the code of quick access to information: *"...it allows me to complete a task that would take days in just a few hours*" [PT1]. Another pre-service teacher's statements regarding quick access to information are as follows: "*It provides immediate access to the information they want to learn and prevents wasting time on misleading, advertisement-filled, clickbait websites*" [PT53]. Most pre-service teachers stated that they quickly access the information they seek through AI applications and achieve their goals in a short time. Examples of excerpts related to the code of workload reduction are as follows: "*It can lighten teachers' workload by facilitating lesson planning and grading processes*" [PT9], "*It saves me from the extra burden by generating summaries from lecture notes*" [PT78]. Analyzing the sample excerpts reveals that pre-service teachers perceive the ability to quickly access information and have certain tasks performed by AI as beneficial aspects of AI applications.

The category of support for creativity consists of codes labeled as providing a variety of ideas and generating solutions. Examples of excerpts for the code of providing a variety of ideas are as follows: "*It offers different ideas, perspectives, and viewpoints. It provides suggestions I would never have thought of or associated with the topic, which broadens my mind*" [PT25]. The excerpts for the code of generating solutions are as follows: "*Sometimes we can think too simplistically in education. Even when preparing a lesson plan, we may not know where to start. It is useful because it guides us when we cannot develop ideas*" [PT8].

The category of enrichment of educational content is composed of two codes: visual-graphic production and diversification of activities. The following excerpts from the AI Integration Reflection Form illustrate the code of visual-graphic production: "*It is incredibly helpful in preparing suitable visual materials. If you have a very specific visual in mind that you want to use while teaching a topic, finding it online can be very difficult. However, with the advancement of image-generating AIs, the difficulty of this process is now dependent on the power of our words*" [PT55]. Most pre-service teachers stated that AI applications contribute to the diversification of activities by suggesting different strategies, techniques, and methods and by enabling the use of various simulations, videos, and games. One of the pre-service teacher expressed this view as follows: "*I also have the opportunity to demonstrate experiments that are not suitable to be performed in the classroom or lack the necessary materials.*." [PT16].

3.2.3. Findings regarding the drawbacks/risks of artificial intelligence applications

Pre-service teachers were asked what the risks of using artificial intelligence applications for educational purposes could be, and the resulting categories and codes are given in Table 6.

Table 6

Categories and codes for the theme of risks of artificial intelligence

Category	Code
Effects on cognitive and academic development	Deterioration in creativity and thinking skills
	Weakening of problem-solving and learning skills
Social and psychological effects	Technology addiction
	Loss of motivation and interest
Misinformation and trust issues	The risk of misleading information
	Data privacy issues
Risks for the teaching profession and educational process	Weakening of the teacher's role
	Declining quality of the educational process

The views of pre-service teachers regarding the drawbacks of artificial intelligence (AI) applications are categorized into four main categories: effects on cognitive and academic development, social and psychological effects, misinformation and trust issues, and risks for the teaching profession and educational process.

The category of effects on cognitive and academic development consists of two codes: deterioration in creativity and thinking skills and weakening of problem-solving and learning skills. Pre-service teachers expressed their views regarding the code of deterioration in creativity and thinking skills as follows: "*Since using AI is an easier option, developing oneself seems difficult for people. This leads to less thinking and less effort*" [PT6]. Another one stated: "*Directly receiving what AI offers may also lead to the decline of creativity. It may distance individuals from thinking and make thinking seem like a waste of time*" [PT82]. Regarding the code of weakening problem-solving and learning skills, a sample excerpt obtained from pre-service teachers is as follows: *"…when students use it, they may sometimes take shortcuts, directly using AI without employing their own problem-solving skills. As a result, their problem-solving abilities may deteriorate*" [PT13]. Another one expressed that AI applications may negatively affect individuals' desire and ability to learn due to promoting laziness: "*The rapid and ready availability of answers can lead to laziness. Whether it is homework or research, students or teachers may rely on ready-made solutions and not develop their learning skills*" [PT37].

The category of social and psychological effects consists of two codes: technology addiction and loss of motivation and interest. Pre-service teachers' views on the code of technology addiction are as follows: "*…instead of asking the teacher or a friend when you do not understand something, asking AI, having it complete assignments, or solve questions for you increases screen time and creates addiction*" [PT16]. An excerpt representing the code of loss of motivation and interest is: "*Since AI does everything for us, we may lose our desire to learn and research. Our motivation for learning may disappear because there is already something doing it for us, just a keyboard away*" [PT90]. Examining pre-service teachers' views reveals that when discussing the social and psychological effects of using AI for educational purposes, many of them emphasized the risk of disconnecting from real life and weakening human relationships due to technology addiction.

The category of misinformation and trust issues consists of two codes: the risk of misleading information and data privacy issues. Pre-service teachers expressed their concerns regarding the possibility of AI providing misleading information without clear sources as follows: "*Errors in AI algorithms may lead to presenting inaccurate information to learners*" [PT26], "*If wrong questions are asked, wrong answers will be received. This leads to incorrect learning*" [PT39]. Regarding the code of data security and privacy issues, pre-service teachers stated: "*It may store and use the data we share without our knowledge or share it with others*" [PT4], "*…if students' personal information is not sufficiently protected, data breaches may occur. Therefore, files containing students' personal information should not be shared, or those sections should be deleted*" [PT10].

The category of risks for the teaching profession and educational process is divided into two codes: weakening of the teacher's role and declining quality of the educational process. The views regarding the weakening of the teacher's role due to the frequent use of AI applications in learning environments are as follows: "*As long as questions related to teaching are answered by AI, the perception that teachers are unnecessary may emerge*" [PT37], "*…globally, there may be a risk of individuals with weak social skills preferring to learn from AI-supported robot teachers*" [PT57], "*The value of educators may decrease due to AI*" [PT83]. Pre-service teachers expressed views coded as declining quality of the educational process as follows: "*…For this reason, I believe teachers should use these applications consciously, effectively, and occasionally. Otherwise, educational processes*

disconnected from reality and lacking real-life experiences may be planned" [PT20], "*With the disappearance of effort and the increase in plagiarism, education becomes simplified for both learners and teachers*" [PT35]. Although pre-service teachers emphasized that excessive use of AI may decrease the quality of education, they also highlighted that when used in a controlled manner, AI can be an effective tool to support learning.

3.2.4. Findings regarding precautions against potential risks

Pre-service teachers were asked about their opinions on precautions that could be taken against the possible harms of artificial intelligence and their answers are given in Table 7.

Table 7

Categories and codes for the theme of precautions against potential risks of using AI

Category	Code
Conscious use and setting boundaries	Using AI as a tool Critical and selective use

The views on precautions against the potential risks of using artificial intelligence (AI) applications are categorized under the theme of conscious use and setting boundaries. This category includes the codes of using AI as a tool and critical and selective use. The views of pre-service teachers who believe that using AI as a tool at certain stages of education can eliminate potential risks are as follows: "*Seeing AI only as a tool and not leaving all educational tasks to it will be effective in eliminating its harmful aspects*" [PT7], "*...ensuring that AI serves a purpose and is seen only as a supportive tool for education may eliminate the problems*" [PT40]. Some pre-service teachers believe that risks can be eliminated by verifying the information provided by AI and questioning its accuracy. Sample excerpts reflecting a critical and selective perspective are as follows: "*Shaping the information accessed through AI by passing it through a mental filter will help reach accurate information and eliminate potential risks*" [PT19], "*It is necessary to consider the possibility that the data provided by AI may be incorrect and to go to primary sources to verify it*" [PT56]. Pre-service teachers believe that the likelihood of resolving problems arising from the use of AI will increase with conscious use and the establishment of certain boundaries.

4. DISCUSSION AND CONCLUSIONS

As a result of the data obtained, it was determined that the attitudes of pre-service teachers toward artificial intelligence are at a high level. Within the scope of the GAAIS, it was found that the level of positive attitudes of pre-service teachers toward artificial intelligence is high, while the level of negative attitudes is moderate. These findings suggest that pre-service teachers tend to be interested in using artificial intelligence systems in daily life, perceive artificial intelligence as offering economic opportunities, and show an inclination to use this technology in their future professional lives. However, it is also observed that there are some concerns regarding the widespread use of artificial intelligence; issues such as unethical use and the potential harm to people are emphasized.

One of the quantitative findings of the research is that there is a significant difference by gender in the positive attitude sub-dimension of the GAAIS. Male pre-service teachers have higher levels of positive attitudes compared to females. This may indicate that male pre-service teachers have a somewhat more positive perspective toward using artificial intelligence applications. When the literature is examined, similar findings are encountered regarding the variable of gender and attitudes towards artificial intelligence. For example, in the study by [26], it was found that there is consistency between gender and attitudes towards

artificial intelligence, and in the study by [31], it was stated that artificial intelligence literacy shows significant differences by gender. On the other hand, the study by [25] draws attention to the fact that gender does not have a significant effect on attitudes towards artificial intelligence.

According to grade level, significant differences were observed in the negative attitude sub-dimension of the GAAIS. First-year pre-service teachers approach artificial intelligence applications more distantly, and the average scores of individuals in this group are lower compared to other grade levels. In contrast, third-year students have the highest average scores; this indicates that this group has a more positive attitude towards artificial intelligence applications. This difference could be related to the longer and more frequent exposure of upper-grade pre-service teachers to artificial intelligence applications during their coursework. Similarly, the literature emphasizes that individuals' attitudes towards artificial intelligence are related to their level of personal interest, knowledge, and proficiency in using technology (e.g., computers) [7], [32]. While Özülüş et al., [33] state that artificial intelligence literacy differs significantly according to grade level, [34] reveal that age has a positive effect on favorable attitudes towards artificial intelligence. Therefore, the fact that pre-service teachers in upper grades have more knowledge about technology and artificial intelligence than first-year students explains the significant difference in attitudes.

According to the qualitative findings of the study, pre-service teachers use artificial intelligence for purposes such as conducting literature reviews, designing instructional materials, preparing presentations, and planning lessons. In addition, it was also determined that it is used for individual learning efforts, such as content review and language learning. Pre-service teachers stated that artificial intelligence applications provide quick access to information and reduce workload, thus offering benefits in terms of saving time and effort. Moreover, they expressed that artificial intelligence supports creativity by offering idea diversity and contributing to solution generation. In the context of educational use, its support in producing visuals and graphics, its ability to diversify activities, and thus enrich educational content, are among the highlighted advantages. Artificial intelligence encourages creativity by offering personalized development suggestions and providing focused feedback [35].

According to pre-service teachers' opinions, artificial intelligence applications also have drawbacks. They stated that artificial intelligence may lead to a decline in creative and critical thinking skills and a weakening of problem-solving abilities. In line with their views, participants' reflections suggest that the use of artificial intelligence could have potential negative effects on individuals' cognitive and academic development. Additionally, social and psychological effects such as technology addiction and loss of motivation are also noteworthy. It is critically important to balance technological innovations with teacher expertise and to create supportive and well-equipped learning environments to maximize the impact of artificial intelligence in education [36]. Pre-service teachers' views on artificial intelligence vary; some express concerns regarding excessive dependence, ethical issues, and job security [37]. Teachers see artificial intelligence as a valuable learning opportunity; however, their knowledge and awareness regarding its contribution to instructional processes are limited [38]. Considering today's high interest in digital tools, it is recommended that these tools be taken into account during lesson planning, and that artificial intelligence tools be utilized in the preparation of instructional materials [30]. In this context, it may be beneficial for university programs to consider including a course on artificial intelligence in their curricula and to address existing deficiencies more systematically.

The risk of misleading information caused by artificial intelligence applications, along with issues of data security and privacy, increases the negative attitudes of pre-service teachers towards artificial intelligence. In this regard, pre-service teachers stated that artificial

intelligence raises ethical concerns, causes anxiety about the future, and involves potential threats. Additionally, risks that artificial intelligence applications may pose to the teaching profession and educational processes were also emphasized. Pre-service teachers expressed concerns that these applications may weaken the role of teachers and ultimately lead to a decline in the quality of the educational process. The role of artificial intelligence in education, its areas of application, and its significance for teachers still remain unclear. This uncertainty leads to various levels of concern among teachers [24]. Many individuals are worried that artificial intelligence technology may increase automation and lead to unemployment in various occupational groups [39].

Although this study provides valuable insights into the attitudes and perceptions of pre-service teachers towards artificial intelligence, some limitations should be known. First, this research included pre-service teachers from a single university, so generalizability to broader groups is limited. Second, the qualitative phase involved only 90 participants who voluntarily attended a short-term (6-hour) training program on artificial intelligence; therefore, their perceptions, experiences and reflections may be deprived of the richness of diversity among pre-service teachers. Third, the study had self-reported data, the validity of which can be impaired with social desirability bias. The future research could comprise respondents from different universities and faculties, extend the duration of the training, and conduct longitudinal studies or experimental studies to examine the evolution of attitudes and perceptions towards artificial intelligence over time.

In conclusion, this study revealed that the overall attitudes of pre-service teachers toward artificial intelligence were generally positive. Pre-service teachers see artificial intelligence as a useful tool in educational processes such as lesson planning, creating/designing presentations, and designing instructional materials. However, it was also stated that artificial intelligence may have negative effects on thinking skills, creativity, and problem-solving abilities. Concerns regarding ethics, data security, and the risk of misleading information are noteworthy. In addition to the benefits provided by artificial intelligence, it was noted that it may pose a risk of unemployment for the teaching profession, and this issue should be carefully considered in future educational and workforce planning. Taking preventive and adaptive measures across professional groups may therefore be important. It should also be acknowledged that the positive attitudes and views expressed by pre-service teachers were shaped within the context of the short-term training provided in this study. All qualitative findings therefore reflect their impressions and interpretations based on their reflective responses, rather than measured behavioral change. The study was designed with the belief that such insights could contribute to the improvement of educational programs and teacher preparation processes. For future research, it is recommended to conduct experimental studies involving pre-test and post-test measurements to examine the potential impact of similar AI training programs more systematically.

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ШТУЧНИЙ ІНТЕЛЕКТ В ОСВІТІ: СТАВЛЕННЯ ТА УЯВЛЕННЯ МАЙБУТНІХ УЧИТЕЛІВ

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Анотація. Учителі, які планують використовувати штучний інтелект (ШІ) у своїй професійній діяльності, повинні володіти необхідними компетентностями та забезпечувати відповідну підтримку учням. Тому виявлення ставлення та поглядів майбутніх учителів до ШІ є важливою умовою для підготовки педагогів, здатних ефективно використовувати сучасні технології. Метою даного дослідження є визначення ставлення майбутніх учителів до ШІ, його аналіз за різними змінними та виявлення значущості використання ШІ в освіті з точки зору вибірки дослідження. Дослідження проведено у два послідовні етапи з використанням описового опитувального методу. На першому етапі 658 майбутніх учителів пройшли опитування за Шкалою загального ставлення до штучного інтелекту. На другому етапі для 90 учасників із початкової вибірки було реалізовано структуровану програму навчання, що охоплювала питання ШІ-грамотності, інтеграції ШІ в освітній процес, проєктування навчання із використанням ШІ та приклади застосування у класі. Після програми ці учасники заповнили Рефлексійну форму щодо інтеграції ШІ, яка містила чотири відкриті запитання. Кількісні дані, зібрані за шкалою, були проаналізовані статистичними методами, тоді як відповіді на відкриті запитання – методом контент-аналізу. Результати показали, що майбутні вчителі мають високий рівень позитивного ставлення та низький рівень негативного ставлення до ШІ. У контексті гендерного фактора чоловіки продемонстрували більш позитивне ставлення, ніж жінки. Контент-аналіз відкритих відповідей виявив, що респонденти переважно акцентували увагу на перевагах інтеграції ШІ в освіті. Крім того, хоча багато учасників вже мали досвід використання ШІ, навчання позитивно вплинуло на них і, на їхню думку, сприятиме підвищенню професійної ефективності. Водночас, майбутні вчителі зазначили, що не сприймають ШІ як загрозу в навчальному середовищі та вважають його інструментом із мінімальним рівнем помилок.

Ключові слова: штучний інтелект; навчання ШІ; ставлення; рефлексія щодо використання ШІ; майбутні вчителі

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