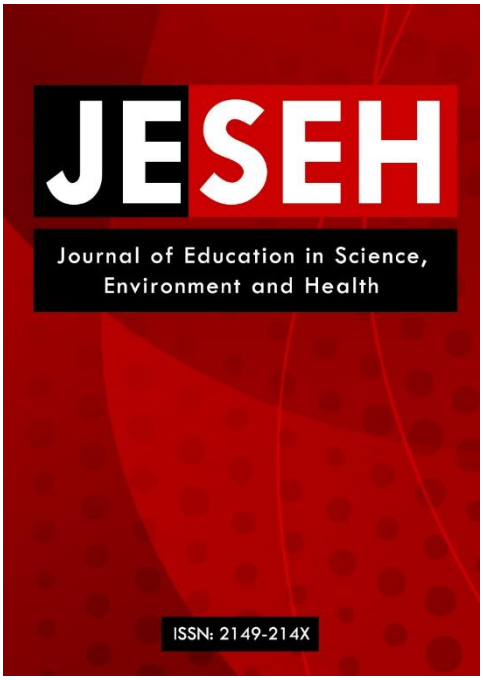

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Abstract

This study aims to investigate the artificial intelligence (AI) literacy levels of pre-service teachers and their views on the use of AI in education. Adopting a mixed-methods approach, the study employed both quantitative and qualitative techniques to ensure comprehensive analysis. The quantitative data were collected using the "Artificial Intelligence Literacy Scale," while qualitative data were gathered through open-ended questions developed by the researchers. The sample consisted of 323 pre-service teachers from different departments and grade levels at Nigde Omer Halisdemir University Faculty of Education. Statistical analyses, including independent samples t-tests and one-way ANOVA, were used to examine differences in AI literacy levels based on variables such as gender, age, grade level, field of study, parental education level, and use of AI technologies. Content analysis was applied to the qualitative data. The findings revealed that pre-service teachers generally possess high levels of AI literacy. Significant differences were observed based on personal factors such as having AI applications, receiving technology-related education, and using AI in academic tasks. However, no significant differences were found for gender, age, or parental education level. Qualitative findings indicated that pre-service teachers mostly use AI tools for academic purposes, recognize their benefits in terms of time-saving and knowledge access, but also express ethical concerns and the need for critical awareness. The study highlights the importance of embedding AI literacy into teacher education programs to prepare future educators for the digital age.

Introduction

Problem Statement

The rapid development of artificial intelligence (AI) technologies has significantly transformed various aspects of modern life, including communication, commerce, healthcare, transportation, and education. From facial recognition software and automated vehicles to voice assistants such as Google Assistant and Siri, AI systems are now embedded in everyday activities (Güzey et al., 2023; İşler & Kılıç, 2021). These technologies not only shape user behavior and decision-making but also influence how people access, process, and apply information in both personal and professional contexts.

Artificial intelligence, in its broadest sense, refers to systems capable of mimicking human cognitive functions such as learning, reasoning, and problem-solving (Russell & Norvig, 2016). Definitions of AI vary according to disciplinary focus. Popov (1990) describes it as the effort to make computers perform tasks that typically require human intelligence. McCarthy (2004), one of the founders of the field, defined AI as the science and engineering of creating intelligent machines. Similarly, Nabiyev (2012) and Alpaydın (2013) emphasize the simulation of human cognitive processes through algorithms and data structures. Despite these definitional nuances, there is a general consensus that AI systems aim to imitate human thinking and adapt through experience (Çelebi & İnal, 2019; Obschanka & Audretsch, 2020).

The growing presence of AI technologies in daily life brings with it the need for individuals to develop a specific form of digital competence known as AI literacy. AI literacy is defined as the ability to understand, evaluate, and use AI systems effectively and ethically (Kong et al., 2022; Wang et al., 2022). It includes awareness of the capabilities and limitations of AI, the ability to use AI tools in real-world contexts, and an understanding of the social, ethical, and pedagogical implications of AI use (Su et al., 2023; González-Calatayud et al., 2021; Elçiçek, 2024). Without sufficient literacy in this area, individuals risk becoming passive consumers of technology rather than active, critical, and ethical users.

The integration of AI into education has become a global trend, supported by research and innovation aimed at improving teaching and learning processes. AI tools have been employed to personalize learning experiences, predict student performance, manage classroom behavior, assess assignments, and facilitate administrative tasks (Holmes et al., 2019; Bajaj & Sharma, 2018). These tools also offer opportunities to support learners with different needs and preferences, thereby promoting inclusive and equitable education systems. As Bajaj and Sharma (2018) note, students' learning styles vary widely—from preference for facts and experiments to theoretical reasoning—and AI can help adapt learning content accordingly.

From a policy and strategic perspective, many countries have begun to institutionalize AI in education. In Turkey, the Ministry of National Education (MoNE) has established a broad framework for AI integration. The International Forum on Artificial Intelligence Applications in Education, organized in 2024, focused on increasing AI literacy, improving teacher training, and establishing ethical and institutional guidelines for AI use (MoNE, 2024). Within the same context, courses such as "AI with Arduino," "Fundamentals of Data Science," and "Machine Learning with Python" have been introduced via the Teacher Informatics Network (ÖBA), reaching nearly 97,000 teachers. Furthermore, MoNE's recently established Department of Artificial Intelligence and Big Data Applications aims to develop AI strategies for education and to design learning materials that strengthen AI literacy (MoNE, 2025). These initiatives reflect a shift toward a teacher-centered digital transformation model supported by AI-based technologies.

Despite these efforts, there remains a lack of empirical studies on AI literacy in the context of pre-service teacher education in Turkey. While technological infrastructure has advanced and policy-level initiatives are growing, it is unclear how well-prepared future teachers are in terms of their understanding of AI tools, ethical considerations, and pedagogical applications. Moreover, as AI literacy is a multifaceted construct shaped by demographic, educational, and experiential factors, it is important to explore how these dimensions influence teacher candidates' competencies and attitudes.

A review of the existing literature reveals that most empirical research on AI literacy has focused on students in engineering, computer science, or informatics programs. For example, Güler and Polatgil (2025) found that university students in technology-related fields had high AI literacy levels, but that factors such as participating in digital projects and using AI tools had a greater impact than demographic characteristics. Mart and Kaya (2024) studied pre-service preschool teachers and reported low levels of knowledge about AI despite positive attitudes. Similarly, Banaz and Demirel (2024) observed that gender, class level, and online behavior were associated with AI attitudes among Turkish teacher candidates. However, none of these studies examined AI literacy in a comprehensive, mixed-method framework that includes both statistical and thematic data analysis across a diverse population of teacher candidates.

In addition, while some studies mention ethical issues, critical thinking, and personalization in education, they often treat these aspects as secondary. Yet, pre-service teachers not only need to use AI for academic tasks such as presentations, research, or lesson planning, but also to critically assess the reliability, bias, and ethical dimensions of the tools they use (Helvacı, 2025; Zhao et al., 2018). This points to a gap in both practice and research—teacher candidates are exposed to AI in daily and academic life but may lack the structured, reflective training needed to use it responsibly.

Therefore, this study aims to fill this gap by exploring both the AI literacy levels of pre-service teachers and their perceptions of AI use in education within a Turkish context. Employing a mixed-methods design, the study investigates how AI literacy varies according to gender, age, grade level, department, parental education, and the use of AI technologies. The study also analyzes open-ended responses to uncover teacher candidates' views on the role, benefits, risks, and limitations of AI in educational settings. By combining quantitative and qualitative insights, this research provides a holistic understanding of AI literacy among future educators. The findings are expected to inform curriculum development, teacher training policies, and the design of educational technologies, ultimately contributing to the creation of a digitally competent and ethically informed teacher profile for the 21st century.

In this direction, the problem of the study was determined as "What is the literacy status of pre-service teachers studying at Nigde Omer Halisdemir University Faculty of Education regarding AI and what are their views on the use of AI in education?". The sub-problems of this study are as follows:

1. How are the AI literacy levels of pre-service teachers in general?
2. Are there differences in pre-service teachers' AI literacy levels according to their gender?
3. Are there differences in pre-service teachers' AI literacy levels according to their ages?

4. Are there differences in pre-service teachers' AI literacy levels according to their grade levels?
5. Are there differences in pre-service teachers' AI literacy levels according to the field of study?
6. Are there differences in the AI literacy levels of pre-service teachers according to their mother's education level?
7. Are there differences in the AI literacy levels of pre-service teachers according to their father's education level?
8. Are there differences in the AI literacy levels of pre-service teachers according to whether they have AI applications on their mobile devices?
9. Are there differences in pre-service teachers' AI literacy levels according to their technology-related education?
10. Are there differences in pre-service teachers' AI literacy levels according to their use of AI in their studies?
11. What are the views of pre-service teachers on the use of AI in education?

Purpose and Importance of the Research

Today, the rapid spread of AI technologies in the field of education makes teachers' knowledge, attitudes and pedagogical approaches towards these technologies important. The effective and meaningful use of AI in education is possible not only through the integration of technological tools, but also through teachers' ability to integrate these technologies with pedagogical goals (Luckin et al., 2016). Determining pre-service teachers' AI literacy levels and their views on this field will contribute to the digital transformation of the education system by increasing the quality of teacher training processes. As a matter of fact, Luckin et al. (2016) state that AI systems in education do not aim to replace teachers, but to transform their roles and make teaching processes more personalised, efficient and inclusive. In addition, a comprehensive systematic review by Zawacki-Richter et al. (2019) revealed that AI applications in higher education are concentrated in four main areas: profiling and prediction, assessment and measurement, adaptive systems and personalisation, and intelligent tutoring systems. However, it is noteworthy that the vast majority of studies are computer and engineering science-based rather than education-based, and pedagogical or ethical dimensions are largely ignored. This situation reveals the need to equip teachers and pre-service teachers with the knowledge and skills to evaluate these technologies from critical, ethical and pedagogical perspectives in order to ensure the meaningful and responsible use of AI in education.

In this context, the main purpose of this study is to determine the AI literacy levels of pre-service teachers from different fields and grade levels and to examine whether these levels show a significant difference according to various demographic and individual factors (gender, age, grade level, parental education level, etc.). In addition, it is aimed to develop a more holistic perspective on the subject by analysing qualitative data on pre-service teachers' views on AI technologies and their interactions with these technologies. Another factor that increases the importance of the research is the findings revealing that the majority of pre-service teachers today benefit from AI technologies in education in various ways. Among these benefits, instrumental uses such as preparing homework, accessing information, producing presentations and planning personal learning processes stand out. However, despite this widespread use, it was also found that a significant number of pre-service teachers experienced various deficiencies in producing creative questions about AI, ethical awareness and critical thinking competences. This situation reveals the need for a structured and conscious education process regarding AI literacy in teacher training programmes (Helvacı, 2025).

In addition, the finding that pre-service teachers' levels of having AI applications on their mobile devices, receiving technology training and actively using these technologies significantly affected their AI literacy is also quite remarkable. These findings show that individual technology experiences and learning processes play an important role in determining the teacher profile of the digital age (Zhao et al., 2018). In conclusion, this study aims to make original contributions to the literature by analysing pre-service teachers' knowledge and skill levels related to AI and providing concrete suggestions on which points should be intervened in the teacher training process. In this respect, the study will make a meaningful contribution to the discussions on digital pedagogical competence and AI literacy at both national and international levels.

Method

Research Design

In this study, a mixed method research design was used to examine the AI literacy status of pre-service teachers and their views on the use of AI in education. As the research model, triangulation design was preferred. Mixed

research involves the collection, analysis and interpretation of quantitative and qualitative research data within the scope of one or more studies (Leech & Onwuegbuzie, 2009). With the joint use of qualitative and quantitative research methods, the need for mixed method research design has increased in order to overcome the shortcomings of a single method and to conduct more qualified research (Greene, 2015).

In this study, triangulation research design, which is one of the mixed research methods, was used. With the triangulation method (Tunalı et al., 2016), which aims to check whether the resulting data are compatible with each other by applying both quantitative and qualitative research methods to the same hypothesis independently of each other, the presence of a significant relationship between the demographic characteristics of pre-service teachers and their AI literacy status was examined.

Participants

The study group of the research consists of a total of 323 pre-service teachers studying at Niğde Ömer Halisdemir University Faculty of Education in the 2024-2025 academic year. Convenience sampling method was used as the sampling method. Convenience sampling method is defined as collecting data from a sample that the researcher can easily access (Büyüköztürk, 2024, p.9). In this method, the researcher starts collecting data from the most accessible participants and forms the sample until he/she reaches a group of the size he/she needs and conducts a study on an event or sample that will provide the most savings (Cohen & Manion, 1998; Ravid, 1994). Applying a questionnaire to the captive audience is an example of this method (Balcı, 2022, p.108). This sampling approach offers the researcher the opportunity to collect data from the immediate environment (Aziz, 1990, p.48).

Table 1. Demographic characteristics of pre-service teachers in the sample

Variables	Feature	f	%
Gender	Woman	251	77,7
	Male	72	22,3
Age	17-19	56	17,4
	20-22	232	72,3
	23+	33	10,3
Class Level	1st Grade	37	11,5
	2nd Grade	71	22,0
	3rd Grade	160	49,5
	4th Grade	55	17,0
Programme Type	Mathematics and Science Education	121	37,5
	Educational Sciences	67	20,7
	Turkish and Social Studies Education	91	28,2
	Fine Arts Education	13	4,0
	Elementary Education	31	9,6
Mother Education Status	Primary School	138	42,7
	Middle School	82	25,4
	High School	72	22,3
	Undergraduate and Graduate	30	9,3
Father's Education Status	Primary School	76	23,5
	Middle School	88	27,2
	High School	89	27,6
	Undergraduate and Graduate	70	21,7
Do you have AI applications on your mobile devices?	Yes	273	84,5
	No	49	15,2
Have you received training on technology?	Yes	153	47,4
	No	170	52,6
Do you use AI in your work?	Yes	278	86,1
	No	43	13,3
Total		323	%100

The participants were determined on the basis of volunteerism among the pre-service teachers studying at Nigde Omer Halisdemir University Faculty of Education, to which the researcher had access. In addition, in the selection of the participants, attention was paid to include individuals from different grade levels (1st grade, 2nd grade, 3rd grade, 4th grade) and different departments (Mathematics and Science Education, Educational Sciences, Turkish and Social Sciences Education, Fine Arts Education, Elementary Education). This ensured diversity in the sample.

The demographic characteristics of the participants were collected with a personal information form. In the personal information form, information about the gender, age, grade level, programmes of study, mother's education level, father's education level, having AI applications on their mobile devices, receiving training on technology and using AI in their studies were collected. The frequencies and percentages of the demographic characteristics of the pre-service teachers participating in the study are given in Table 1.

As seen in Table 1, 77.7% (f = 251) of the 323 pre-service teachers constituting the research group were female and 22.3% (f = 72) were male. When the age distribution of the participants was analysed, it was determined that 72.3% (f = 232) were between the ages of 20-22, 17.4% (f = 56) were between the ages of 17-19, and 10.3% (f = 33) were 23 years and older. In the distribution according to grade levels, 49.5% (f = 160) of the participants were third grade students, 22% (f = 71) were second grade students, 17% (f = 55) were fourth grade students and 11.5% (f = 37) were first grade students.

Regarding the type of programme in which the pre-service teachers were enrolled, 37.5% (f = 121) were enrolled in Mathematics and Science, 28.2% (f = 91) in Turkish and Social Sciences Education, 20.7% (f = 67) in Educational Sciences, 9.6% (f = 31) in Elementary Education and 4% (f = 13) in Fine Arts Education. In the distribution of the participants' mothers' education level, 42.7% (f = 138) were primary school graduates, 25.4% (f = 82) were secondary school graduates, 22.3% (f = 72) were high school graduates and 9.3% (f = 30) were undergraduate and above.

The educational level of the fathers was 27.6% (f = 89) high school, 27.2% (f = 88) secondary school, 23.5% (f = 76) primary school and 21.7% (f = 70) bachelor's degree and above. Most of the participants (84.8%; f = 273) stated that they have AI applications on their mobile devices, and 86.6% (f = 278) stated that they use these applications in academic or personal studies. This shows that AI technologies have become widespread and actively used in pre-service teachers' educational environments. However, 47.4% (f = 153) of the pre-service teachers stated that they received a training on technology, while 52.6% (f = 170) stated that they did not receive such a training. The findings reveal that the sample group is mostly young, female, third-year students and highly exposed to technological tools and especially AI applications.

Data Collection Tools

Three different data collection tools were used in the study:

Personal Information Form

It was created by the researchers in order to determine the demographic characteristics of the pre-service teachers participating in the study. This form includes the gender, age, grade level, programme of study, mother's education level, father's education level, having AI applications on mobile devices, receiving training on technology and using AI in studies.

Artificial Intelligence Literacy Scale

"Artificial Intelligence Literacy Scale" developed by Wang et al. (2022) and adapted into Turkish by Çelebi et al. (2023) was used to measure the AI literacy status of the pre-service teachers participating in the study. The scale has 4 sub-dimensions and 12 items. The sub-dimensions are categorised as "Awareness, Use, Evaluation and Ethics" and there are three items in each sub-dimension. The scale items are prepared in the form of a 7-point Likert scale ranging from the most negative to the most positive and have the response options "Strongly Agree, Agree, Partially Agree, Undecided, Partially Disagree, Disagree, Strongly Disagree". Therefore, the lowest score that can be obtained from the scale is 12 and the highest score that can be obtained is 84.

In this scale, there are also 3 reverse coded items, one each in the sub-dimensions of "Awareness, Use and Ethics". In order to use the scale in the research, the adapters of the scale were asked for their permission via e-mail. The adapters of the scale reported via e-mail that they would be pleased to use the scale in the research and that they gave their permission. The reliability study of the scale was conducted by the scale adapters and the internal consistency coefficient of the scale (α) was found to be 0.85 (Çelebi, 2023). In this study, the internal consistency

coefficient (α) was calculated as 0.831. It was concluded that this scale, which was adapted into Turkish, is a reliable and valid tool to measure the AI literacy status of adults who are not specialised in AI.

Open-ended Questions

In order to determine the views of the pre-service teachers participating in the study on the use of AI in education, 6 open-ended questions were directed to the participants with a questionnaire form. The questions were developed by the researchers. The open-ended questions prepared to be applied to the pre-service teachers participating in the research are as follows;

1. What are the activities you have carried out in your daily life with AI technology?
2. According to you, in which areas are AI technologies used? Can you give an example?
3. According to you, how can AI applications or products be used to increase work efficiency?
4. What kind of solutions do you think AI offers us in our daily lives?
5. In your opinion, what are the factors that we should pay attention to when using AI?
6. Can you create at least 3 question sentences to be asked in an AI application?

Data Collection Process

In the research process, qualitative and quantitative data were collected simultaneously from the pre-service teachers participating in the research on the basis of volunteerism. The necessary informed consent text was presented to the pre-service teachers participating in the research. In the scale kit, firstly, within the scope of informed consent, the purpose of the research, that the data will be used only within the scope of this research, that the information will not be shared with third parties, how the questionnaire form should be filled in and information about the researchers were given. Then, personal information form, open-ended questions and scale items were included. In order to conduct the research, the approval of the ethics committee was obtained from Nigde Omer Halisdemir University Ethics Committee dated 25.06.2025 and numbered 2025/11-25. Qualitative data were obtained with the personal information form and open-ended questions prepared by the researchers. Quantitative data were obtained with the "Artificial Intelligence Literacy Scale" developed by Wang et al. (2022) and adapted into Turkish by Çelebi et al. (2023).

Data Analysis

SPSS programme was used to analyse the data in the study. Arithmetic averages, frequencies and percentages were determined for analyses. In order to test the hypotheses to be used in data analysis, the distribution of the data obtained should be examined. If the data distribution shows "normal probability distribution" or "normal distribution", parametric tests are used; nonparametric tests are used for data that do not show normal distribution (Bayrakcı, 2018). In order to test whether the data collected from the pre-service teachers participating in the study showed normal distribution, normality analysis and Kolmogorov-Smirnov and Shapiro-Wilk skewness values were examined. Since the sample group was sufficient in number, Kolmogorov-Smirnov values were taken into consideration in the study. The descriptive analyses of the Artificial Intelligence Literacy scale are given in Table 2.

Table 2. Descriptive analysis of the scale

Scale	$\overline{X}$	sd	Hydrangea	Skewness	Kurtosis	Kolmogrov-Simirnov Statistics	P
Artificial Intelligence Literacy	5.248	.949	5.250	-.577	.876	.087	.000

When Table 2 is analysed, it is seen that the mean score is 5.25 and the median value is 5.25. These values indicate that the participants' AI literacy levels are generally high. The standard deviation value of the scale is .95, indicating that the scores exhibit a balanced distribution around the mean. The skewness value of the distribution was calculated as -.577 and kurtosis value as .876. Both values are in the range of ±1 and it can be said that the data show an approximately normal distribution. As a result of the analysis, Kolmogorov-Smirnov was found as .087 and the skewness coefficient value as -.577. The fact that the skewness coefficient value is between "+1 and -1" values shows that the data obtained have a normal distribution (Çokluk et al., 2010).

However, the p value (.000) obtained as a result of the Kolmogorov-Smirnov test was statistically significant, which revealed that the distribution deviated from normal. However, when the sample size is taken into consideration, it is known that this test is very sensitive and can give significant results even in small deviations. Therefore, considering that the skewness and kurtosis values were within acceptable limits, it was accepted that the data were approximately normally distributed and parametric tests were used in the comparisons. The data obtained from open-ended questions were analysed by content analysis method, codes, categories and themes were determined and frequencies and percentages were given in the form of tables.

Results

The data obtained in this part of the study were analysed within the framework of 11 (eleven) sub-problems. The findings and interpretations are given in an order appropriate to the order of the sub-problems.

Findings Related to the First Sub-Problem

The first sub-problem of the study was expressed as "How are the AI literacy levels of pre-service teachers in general?". For this purpose, the scores of pre-service teachers from the artificial intelligence literacy scale were calculated and the distribution of the scores is shown in Table 3. In the table, the column titled "possible scores" includes the lowest and highest values that can be obtained from the scale.

Table 3. Distribution of pre-service teachers' scores on artificial intelligence literacy

Scale	n	$\overline{X}$	Mod	Median	sd	Lowest to highest scores	Possible scores
Artificial Intelligence Literacy	323	62.962	66.000	63.000	11.362	27.00-84.00	12.00 - 84.00

When Table 3 is analysed, it is seen that pre-service teachers' artificial intelligence literacy levels are generally high. The mean of the participants' scores in this area ($\overline{X}$) is 62.96. The mode value is 66.00 and the median value is 63.00, and the fact that these values are close to the mean shows that the score distribution is symmetrical and extreme outliers are limited. In addition, the standard deviation (sd = 11.36) reveals that the scores of the individuals are homogeneously distributed around the mean. The realised score range varies between 27.00 and 84.00, and these values indicate a medium-high level of concentration within the possible score limits of the scale (12.00-84.00). The findings obtained show that pre-service teachers have sufficient knowledge and awareness in terms of AI literacy.

Findings Related to the Second Sub-Problem

The second sub-problem of the study was expressed as "Are there differences in the AI literacy levels of pre-service teachers according to their gender?". For this purpose, arithmetic averages of pre-service teachers' scores from the AI literacy scale were calculated and comparisons were made according to gender variable with t-test. The results obtained are given in Table 4.

Table 4. t-test analysis results of pre-service teachers' artificial intelligence literacy levels according to their gender

Scale	Gender	n	$\overline{X}$	sd	df	t	p
Artificial Intelligence Literacy	Woman	251	5.290	.845	321	1.480	.140
	Male	72	5.103	1.241			

When Table 4 is analysed, the mean score $\overline{X}$ =5.29, standard deviation sd = 0.85 for female participants (n = 251) and the mean score $\overline{X}$ =5.10, standard deviation sd = 1.24 for male participants (n = 72). The t(321)=1.480, p=.140 value obtained as a result of the analysis shows that there is no statistically significant difference between the groups since it is above the significance level of .05. This result reveals that pre-service teachers' AI literacy levels do not show a significant difference according to gender and that this skill is at similar levels regardless of gender.

Findings Related to the Third Sub-Problem

The third sub-problem of the study was expressed as "Are there differences in the AI literacy levels of pre-service teachers according to their ages?". In the analysis of this sub-problem, arithmetic averages of the scores obtained from the scales were calculated and comparisons were made according to the age variable with one-way analysis of variance (ANOVA). The mean score and standard deviation values obtained from the scale according to the age variable of the participants are given in Table 5 and the results of the variance analysis are given in Table 6.

Table 5. Distribution of pre-service teachers' artificial intelligence literacy level scores according to age groups

Scale	Age Groups	n	$\overline{X}$	sd
Artificial Intelligence Literacy	17-19	56	5.257	.767
	20-22	232	5.250	.949
	23 and above	33	5.174	1.202

According to the findings in Table 5, the mean score of AI literacy of the participants in the 17-19 age group (n = 56) was calculated as $\overline{X}$ = 5.26, sd = 0.77; the mean score of the 20-22 age group (n = 232) was calculated as $\overline{X}$ = 5.22, sd = 0.95; and the mean score of the 23 and over age group (n = 33) was calculated as $\overline{X}$ = 5.17, sd = 1.20. These values obtained reveal that there is a general similarity between age groups in terms of AI literacy levels. However, it is seen that the standard deviation values increase with age; this situation shows that there are greater differences in the AI literacy levels of individuals in older age groups and a more heterogeneous distribution is exhibited. The results of one-way analysis of variance (ANOVA) performed to determine whether these observational differences are statistically significant are presented in Table 6.

Table 6. Results of analysis of variance according to the age groups of pre-service teachers' scores of artificial intelligence literacy levels

Scale	Source of variance	Sum of squares	df	Mean squares	F	p
Artificial Intelligence Literacy	Between groups	0.179	2	.089	.099	.906
	Within groups	287.134	318	0.903		

When Table 6 is analysed, no significant difference was found between age groups in terms of AI literacy levels, F(2, 318) = 0.10, p = .906. The total value of squares between groups (SD = 0.179) is quite low compared to the total value of squares within groups (SD = 287.134). This result shows that the small mean differences observed between the age groups are not statistically significant and are most likely due to random differences. Therefore, it can be said that the age variable does not have a significant effect on the AI literacy levels of pre-service teachers.

Findings Related to the Fourth Sub-Problem

The fourth sub-problem of the study was expressed as "Are there differences in the AI literacy levels of pre-service teachers according to their grade levels?". In the analysis of this sub-problem; arithmetic averages of the scores obtained from the scales were calculated and comparisons were made according to the class level variable with one-way analysis of variance (ANOVA). The mean score and standard deviation values obtained from the scale according to the grade level variable of the participants are given in Table 7 and the results of the variance analysis are given in Table 8.

Table 7. Distribution of pre-service teachers' artificial intelligence literacy level scores according to their grades

Scale	Classroom	n	$\overline{X}$	sd
Artificial Intelligence Literacy	1st grade	37	5.385	.943
	2nd grade	71	5.118	.737
	3rd grade	160	5.305	.992
	4th grade	55	5.159	1.062
	Total	323	5.248	.949

When Table 7 is analysed, it is seen that the scores of pre-service teachers' AI literacy levels are similar according to their grade levels. The average score of 1st grade students ($\overline{X}$ = 5.39, sd = 0.94) is the highest, followed by 3rd grade students ($\overline{X}$ = 5.30, sd = 0.99) and 4th grade students ($\overline{X}$ = 5.16, sd = 1.06). The lowest average score belongs to 2nd grade students ($\overline{X}$ = 5.12, sd = 0.74). Across all grades, the average score of the participants

regarding AI literacy was calculated as $\overline{X}$ = 5.25 (sd = 0.95). These findings show that pre-service teachers have a similar level of AI literacy regardless of their grade level.

Table 8. Results of analysis of variance according to the grades of pre-service teachers' scores of artificial intelligence literacy levels

Scale	Source of variance	Sum of squares	df	Mean squares	F	p
Artificial Intelligence Literacy	Between groups	2.854	3	.951	1.055	.368
	Within groups	287.542	319	.901		

According to the results of one-way analysis of variance (ANOVA) presented in Table 8, there was no statistically significant difference between pre-service teachers' AI literacy levels and their grade levels, F(3, 319) = 1.06, p = .368 (p>.05). This finding shows that pre-service teachers' AI literacy levels do not change according to the grade level they study.

Findings Related to the Fifth Sub-Problem

The fifth sub-problem of the study was expressed as "Are there differences in the AI literacy levels of pre-service teachers according to the field of study?". In the analysis of this sub-problem; arithmetic averages of the scores obtained from the scales were calculated and comparisons were made according to the field of study variable with one-way analysis of variance (ANOVA). The mean score and standard deviation values obtained from the scale according to the field of study variable of the participants are given in Table 9 and the results of the variance analysis are given in Table 10.

Table 9. Distribution of pre-service teachers' artificial intelligence literacy level scores according to the fields of study

Scale	Field of Study	n	$\overline{X}$	sd
Artificial Intelligence Literacy	Mathematics and Science Education	121	5.157	.820
	Educational Sciences	67	5.546	.937
	Turkish and Social Sciences Education	91	5.241	1.108
	Fine Arts Education	13	5.025	1.047
	Elementary Education	31	5.077	1.802
	Total	323	5.248	.949

When Table 9 is analysed, it is seen that the mean scores of pre-service teachers' AI literacy levels differ according to the fields of study. While the mean score of AI literacy of pre-service teachers studying in the field of Mathematics and Science Education ($\overline{X}$ = 5.16, sd = 0.82), it is observed that this mean is higher in Educational Sciences ($\overline{X}$ = = 5.55, sd = 0.94). The mean scores obtained in Turkish and Social Studies Education ($\overline{X}$ = 5.24, sd = 1.11), Fine Arts Education ($\overline{X}$ = 5.03, sd = 1.05) and Elementary Education ($\overline{X}$ = 5.08, sd = 1.80) are similar to the other fields. The general average is at the level of ($\overline{X}$ = 5.25, sd = 0.95) for all groups. These findings indicate that the AI literacy levels of pre-service teachers may vary according to the field of study.

Table 10. Results of analysis of variance according to the fields of study of pre-service teachers' scores of artificial intelligence literacy levels

Scale	Source of variance	Sum of squares	df	Mean squares	F	p	Significant Difference
Artificial Intelligence Literacy	Between groups	8.495	4	2.124	2.396	.049*	Could not be determined.
	Within groups	281.901	318	.886			

*p<.05 level

The findings in Table 10 showed that there was a statistically significant difference between the groups, F(4, 318) = 2.396, p = .049. The sum of squares between groups was calculated as 8.495 and the sum of squares within groups was calculated as 281.901. This result indicates that there are significant differences in AI literacy scores according to the fields of study. However, according to the results of the Tukey HSD post hoc test, no significant differences were found in pairwise comparisons between groups (p > .05). In line with these findings, the fact that

significant differences were not found in the post hoc tests although the analysis of variance was significant may be due to the uneven distribution of sample sizes (e.g., Mathematics and Science Education n = 121 while Fine Arts Education n = 13) and the high standard deviation values observed in some groups (e.g., Elementary Education sd = 1.802). In addition, the fact that the ANOVA results were at the borderline significance level (p = .049) and the calculated effect size was small (η^2 = .029) may have made it difficult to statistically determine the differences between the groups.

Findings Related to the Sixth Sub-Problem

The sixth sub-problem of the study was expressed as "Are there differences in the AI literacy levels of pre-service teachers according to their mother's education status?". In the analysis of this sub-problem; arithmetic averages of the scores obtained from the scales were calculated and comparisons were made according to the mother's education status variable with one-way analysis of variance (ANOVA). The mean score and standard deviation values obtained from the scale according to the participants' mother's education status variable are given in Table 11, and the results of the variance analysis are given in Table 12.

Table 11. Distribution of pre-service teachers' artificial intelligence literacy level scores according to mother's education level

Scale	Mother's education status	n	$\overline{X}$	sd
Artificial Intelligence Literacy	Primary School	138	5.248	.881
	Middle School	82	5.236	.882
	High School	72	5.244	1.069
	Undergraduate and Graduate	30	5.322	1.158
	Total	322	5.251	.949

The distribution of the scores of pre-service teachers' AI literacy levels according to their mothers' education level is presented in Table 11. When descriptive statistics are analysed, small differences are observed between the AI literacy levels of pre-service teachers according to their mother's education level. The average AI literacy levels of individuals whose mothers have undergraduate and graduate education levels have the highest value ($\overline{X}$ = 5.32, sd = 1.16). This is followed by individuals with high school ($\overline{X}$ = 5.29, sd = 1.07), primary school ($\overline{X}$ = 5.25, sd = 0.88) and secondary school ($\overline{X}$ = 5.24, sd = 0.88) level mothers, respectively. Although there was no significant difference between the groups in terms of mean scores, it was observed that the level of AI literacy increased as the level of education increased, albeit in a limited way. This shows that the development of AI literacy may depend not only on familial/environmental factors but also on the individual's own education process, level of interaction with technology and professional interest. One-way analysis of variance (ANOVA) was performed to determine whether the AI literacy levels of pre-service teachers showed a significant difference according to their mothers' education level. The results of the analysis are given in Table 12.

Table 12. Results of analysis of variance according to the mother's education level of pre-service teachers' artificial intelligence literacy levels

Scale	Source of variance	Sum of squares	df	Mean squares	F	p
Artificial Intelligence Literacy	Between groups	.173	3	.058	.063	.979
	Within groups	289.528	318	0.910		

According to the ANOVA result, no statistically significant difference was found between the groups: F(3, 318) = 0.063, p = .979. This finding reveals that AI literacy scores are similar according to the mother's education level. In other words, pre-service teachers' AI literacy levels seem to have developed independently of their mothers' education level. This result indicates that participants' AI awareness is shaped by individual factors, teaching process and personal interest in technology rather than familial socio-cultural background. In addition, the fact that pre-service teachers receive education in similar university environments and are in widespread contact with technology in today's digital age can be considered among the factors explaining this similarity.

Findings Related to the Seventh Sub-Problem

The seventh sub-problem of the study was expressed as "Are there differences in the AI literacy levels of pre-service teachers according to their father's education level?". In the analysis of this sub-problem; arithmetic averages of the scores obtained from the scales were calculated and comparisons were made according to the

father's education status variable with one-way analysis of variance (ANOVA). The mean score and standard deviation values obtained from the scale according to the participants' father's education status variable are given in Table 13, and the results of the variance analysis are given in Table 14.

Table 13. Distribution of pre-service teachers' artificial intelligence literacy level scores according to father's education level

Scale	Father's Education Status	n	$\overline{X}$	sd
Artificial Intelligence Literacy	Primary School	76	5.153	.962
	Middle School	88	5.366	.853
	High School	89	5.284	.955
	Undergraduate and Graduate	70	5.158	1.039
	Total	323	5.248	.949

When Table 13 was analysed, it was seen that the general average was ($\overline{X}$ = 5.25, sd = 0.95). The mean scores of the groups according to the father's education level are as follows: primary school ($\overline{X}$ = 5.15, sd = 0.96), secondary school ($\overline{X}$ = 5.37, sd = 0.85), high school ($\overline{X}$ = 5.28, sd = 0.96) and undergraduate/graduate ($\overline{X}$ = 5.16, sd = 1.04). Descriptive findings show that there is no consistent increasing or decreasing trend between father's education level and AI literacy.

Table 14. Results of analysis of variance according to the father's education status of pre-service teachers' artificial intelligence literacy level scores

Scale	Source of variance	Sum of squares	df	Mean squares	F	p
Artificial Intelligence Literacy	Between groups	2.596	3	.865	.959	.412
	Within groups	287.799	319	.902		

The results of the one-way analysis of variance (ANOVA) conducted to test the effect of father's education status on the AI literacy scores of pre-service teachers are given in Table 14. According to the results of the analyses, there is no statistically significant difference between the groups; F(3, 319) = 0.96, p = .412. This finding supports that pre-service teachers' AI literacy levels are independent of their father's education level.

Findings Related to the Eighth Sub-Problem

The eighth sub-problem of the research was expressed as "Are there differences in the AI literacy levels of pre-service teachers according to the status of having AI applications on their mobile devices?". For this purpose, arithmetic averages of pre-service teachers' scores from the AI literacy scale were calculated and comparisons were made according to the variable of having AI applications with t-test. The findings obtained are given in Table 15.

Table 15. t-test analysis results according to the preservice teachers' having artificial intelligence applications on their mobile devices in artificial intelligence literacy levels

Scale	Having Artificial Intelligence Applications	n	$\overline{X}$	sd	df	t	p
Artificial Intelligence Literacy	Yes	273	5.290	.942	320	1.992	.047*
	No	49	4.998	.961			

**p<.05 level*

When Table 15 is analysed, it is seen that the AI literacy levels of pre-service teachers differ significantly according to their having artificial intelligence applications on their mobile devices. The mean scores ($\overline{X}$ = 5.29, sd = 0.94, n = 273) of pre-service teachers who have AI applications on their mobile devices are higher than the mean scores ($\overline{X}$ = 4.99, sd = 0.96, n = 49) of pre-service teachers who do not have AI applications. As a result of the t-test for independent samples, this difference was found to be statistically significant, t(320) = 1.99, p = .047. This finding shows that having AI applications on their mobile devices may have an increasing effect on pre-service teachers' AI literacy levels.

Findings Related to the Ninth Sub-Problem

The ninth sub-problem of the study was expressed as "Are there any differences in the AI literacy levels of pre-service teachers according to the status of receiving education related to technology?". For this purpose, the arithmetic averages of the scores of pre-service teachers from the AI literacy scale were calculated and comparisons were made according to the variable of receiving education about technology with t-test. The results obtained are given in Table 16.

Table 16. t-test analysis results according to the preservice teachers' artificial intelligence literacy levels according to the status of receiving technology-related education

Scale	Receiving Technology Training	n	$\overline{X}$	sd	df	t	p
Artificial Intelligence Literacy	Yes	153	5.397	.981	321	2.689	.008*
	No	170	5.115	.902			

** p<.05 level*

When Table 16 is analysed, it is seen that the mean scores of pre-service teachers who have received technology education ($\overline{X}$ = 5.40, sd = 0.98, n = 153) are higher than pre-service teachers who have not received technology education ($\overline{X}$ = 5.12, sd = 0.90, n = 170). As a result of the independent samples t-test analysis, it was determined that this difference was statistically significant, t(321) = 2.69, p = .008. This finding shows that receiving education related to technology significantly affects pre-service teachers' AI literacy levels.

Findings Related to the Tenth Sub-Problem

The tenth sub-problem of the research was expressed as "Are there differences in the AI literacy levels of pre-service teachers according to their use of AI in their studies?". For this purpose, arithmetic averages of the scores of pre-service teachers from the AI literacy scale were calculated and comparisons were made according to the variable of using AI in studies with t-test. The results obtained are given in Table 17.

Table 17. t-test analysis results of pre-service teachers' artificial intelligence literacy levels according to their use of artificial intelligence in their studies

Scale	Using Artificial Intelligence in Studies	n	$\overline{X}$	sd	df	t	p
Artificial Intelligence Literacy	Yes	278	5.289	.953	319	2.252	.025*
	No	43	4.941	.856			

**p<.05 level*

According to the independent sample t-test results presented in Table 17, pre-service teachers' AI literacy levels differ significantly according to their use of AI in their studies. The mean AI literacy score of pre-service teachers who used AI ($\overline{X}$ = 5.29, sd = 0.95, n = 278) was higher than those who did not use AI ($\overline{X}$ = 4.94, sd = 0.86, n = 43). This difference is statistically significant, t(319) = 2.25, p = .025. This finding shows that pre-service teachers' active use of AI technologies in their studies can be effective in increasing their AI literacy levels.

Findings Related to the Eleventh Sub-Problem

The eleventh sub-problem of the study was: "What are the opinions of pre-service teachers regarding the use of artificial intelligence in education?" The open-ended responses were analyzed using content analysis and organized under seven main themes. The results are presented in tables and discussed accordingly. Based on the analysis, seven themes were identified: (1) Daily Use of AI, (2) Areas Where AI Is Used, (3) Contribution of AI to Work Efficiency, (4) AI Solutions in Daily Life, (5) Considerations in Using AI, (6) Questions Generated for AI Applications, and (7) AI Applications and Categories. The frequency and percentage distributions of pre-service teachers' responses are presented in the tables below.

Daily Use of AI

Table 18. Findings regarding the purposes of pre-service teachers for using artificial intelligence technology in daily life

Codes	Categories	f*	%
Educational Use	Homework, presentation preparation, research, project / thesis writing, academic text support, slide preparation, getting ideas	297	92.0
Obtaining Information and Asking Questions	Obtaining information on topics of interest, posing questions, quick access to information, consultation	149	46.1
Visual and Design Production	Logo design, image/video creation, photo editing, cartoon, banner, animation	39	12.1
Personal Assistant and Daily Planning	Daily planning, setting alarms, creating a study programme, navigation, time management	19	5.9
Entertainment and Social Use	Chatting, fortune-telling, storytelling, humour, solitude relief	16	5.0
Participants who stated that they do not use	Pre-service teachers who stated that they never or rarely use artificial intelligence technologies	20	6.2

** Participants reported use under more than one category; therefore, the total number of frequencies (f) may exceed the number of participants. Percentages were calculated over the general total.*

As presented in Table 18, the majority of participants (f = 297, 92%) reported using artificial intelligence primarily for educational purposes. This includes preparing assignments, presentations, academic texts, and research. For example, S1 stated, "*I use AI for my homework,*" while S30 remarked, "*I use it for writing reports and doing assignments.*" This reflects a strong tendency to utilize AI as a practical academic support tool. Additionally, 149 participants (46.1%) indicated using AI to obtain information or ask questions. S2 explained, "*I ask about things I don't know and get information for my homework,*" and S302 added, "*If I can't find an answer on Google, I ask AI.*" A smaller group (f = 39, 12.1%) used AI for visual and design purposes, such as creating logos or images. S65 shared, "*I design logos and create images,*" while S68 noted, "*I design cartoons.*" Some participants (f = 19, 5.9%) utilized AI for personal planning, such as setting reminders and organizing their day. S62 explained, "*Siri helps me organize my life.*" Entertainment and social interaction were cited by 16 participants (5%), who reported using AI for chatting or fun purposes. For instance, S138 said, "*I chat with AI when I'm alone,*" and S59 mentioned, "*I had my fortune read.*" Finally, 20 participants (6.2%) stated that they do not use AI at all or only use it rarely. As S45 noted, "*I don't use AI.*"

Areas Where AI Is Used

Table 19. Areas of use of artificial intelligence technologies according to the views of pre-service teachers

Codes	f	%*
Education	265	82.0
Health	95	29.4
Trade and business life	83	25.7
Scientific research / academia	71	22.0
Engineering and software	63	19.5
Daily life	51	15.8
Art, design and media	47	14.6
Defence industry and security	32	9.9
Agriculture, transport and automotive	27	8.4
Banking and finance	18	5.6
Law	11	3.4
Games and entertainment	21	6.5
Religious services	3	0.9
I don't know / undecided	5	1.5

** Since the participants indicated more than one usage area, the total percentage exceeds 100%.*

In Table 19, education was identified as the most prominent area where AI is used, cited by 265 participants (82%). Participants emphasized AI's use in preparing lessons, conducting research, and academic planning. S1 said, *"It should be especially used in education and research,"* while S14 commented, *"I use it for homework, organizing, and doing research."* Health was mentioned by 95 participants (29.4%) as a significant domain, with

S183 stating, *"Surgeries can be performed with AI."* Commerce and business life followed with 83 responses (25.7%). S63 noted, *"AI is used in customer service and solves problems instantly through chat."* Scientific research and academia were mentioned by 71 participants (22%). S56 gave the example: *"It is used for writing articles and planning in academia."* Other areas included engineering and software (f = 63, 19.5%), daily life (f = 51, 15.8%), media and art (f = 47, 14.6%), defense (f = 32, 9.9%), agriculture and transportation (f = 27, 8.4%), banking (f = 18, 5.6%), law (f = 11, 3.4%), and entertainment (f = 21, 6.5%). A small group (f = 5, 1.5%) indicated uncertainty with statements such as *"I don't know."*

Contribution of AI to Work Efficiency

Table 20. Frequency and percentage distributions of themes related to artificial intelligence and work efficiency

Codes	f	%*
Time Saving and Speed	80	24,8
Idea and Knowledge Acquisition	60	18,6
Workload Reduction / Automation	45	13,9
Planning, Organisation and Decision Making	35	10,8
Educational and Creative Use	30	9,3
Critical Views / Ethical Concerns	10	3,1
Vague / No Opinion Responses	20	6,2
Other / General Expressions	43	13,3

** Since the participants indicated more than one usage area, the total percentage exceeds 100%.*

According to Table 20, the most cited benefit of AI in improving work efficiency was time saving and speed (f = 80, 24.8%). Participants appreciated the way AI accelerates tasks and processes. For example, S63 stated, *"Pages of work can be done in seconds. It definitely saves time."* Next, 60 participants (18.6%) highlighted idea generation and access to knowledge. S5 noted, *"It can help generate new ideas at work,"* and S50 added, *"We can ask AI to provide ideas."* Workload reduction through automation was emphasized by 45 participants (13.9%). S26 shared, *"AI tools can replace manual labor,"* while S53 explained, *"It helps complete tasks that would take a long time otherwise."* Thirty-five participants (10.8%) appreciated AI's role in planning and organization. S18 said, *"It supports strategy planning and product creation,"* and S289 added, *"AI helps to proceed in a structured way."* AI's educational and creative applications were cited by 30 participants (9.3%), with S281 commenting, *"I use it for drawing graphs and preparing presentations,"* and S304 noting, *"It supports creative thinking."* Critical perspectives were voiced by 10 participants (3.1%). S60 stated, *"AI limits human creativity,"* and S93 warned, *"It reduces employment opportunities."* Vague or unclear responses (f = 20, 6.2%) and general expressions (f = 43, 13.3%) were also observed, such as S123's remark: *"It can be used in any subject."*

AI Solutions in Daily Life

Table 21. Thematic distribution of preservice teachers' responses to the question "what kind of solutions does artificial intelligence offer in our daily life?"

Codes	Categories	f	%*
Time Saving and Fast Access	Saving time, speeding up work, shortening processes, fast information	158	55,2
Access to Information and Learning Support	Access to information, homework help, ease of research, course support	136	47,6
Convenience and Practicality	Ease of daily tasks, simplification of work	122	42,7
Problem Solving and Guidance	Sample solutions, guidance, counselling	91	31,8
Creativity and Different Perspective	Generating new ideas, broadening perspective	79	27,6
Personalisation and Digital Assistance	Individual suggestions, assistant role, habit analysis	44	15,4
Critical/Conscious Use and Ethical Concerns	Suspicion of accuracy, ethical rules, careful handling	13	4,5
Other (Unspecified / Irrelevant / Blank)	Expressions left blank or not understood	37	11,5

** Since the participants indicated more than one usage area, the total percentage exceeds 100%.*

As shown in Table 21, the leading perceived benefit of AI in daily life was time saving and fast access to results, cited by 158 participants (55.2%). S104 said, *"It helps us reach results faster."* Learning support and information access followed (f = 136, 47.6%). S14 stated, *"It helps with homework and offers various ideas."* Ease and practicality were noted by 122 participants (42.7%), with S310 stating, *"It simplifies many of our daily tasks."* Problem solving and guidance were emphasized by 91 participants (31.8%). Participants highlighted AI's potential for counseling and support. Creativity and broadening perspectives were cited by 79 participants (27.6%), with general remarks such as, *"It offers different viewpoints."* Personalization and digital assistance were referenced by 44 participants (15.4%). S62 said, *"It suggested a skincare routine based on my habits."* Critical awareness was present among 13 participants (4.5%). S60 commented, *"It offers practical solutions, but its accuracy is debatable."* Finally, 37 responses (11.5%) were either blank or lacked clear relevance.

Considerations in Using AI

Table 22. Thematic distribution of factors to be considered in the use of artificial intelligence

Codes	Categories	f	%
Ethics and Safety	Personal data privacy	68	21.9
	Compliance with ethical principles	44	14.1
Accuracy and Reliability	Risk of misinformation	53	17.0
	Source confirmation	36	11.6
Use in Education	Risk of laziness	32	10.3
	Loss of authenticity	22	7.1
Technological Limitations	Algorithmic errors	18	5.8
Social Impacts	Weakening of human relations	12	3.9
Practicalities of Use	Asking clear questions	9	2.9

Table 22 presents factors participants consider important in AI usage. Ethical concerns and safety were cited most frequently (f = 112, 36%), especially regarding personal data privacy (f = 68) and adherence to ethical principles (f = 44). S41 emphasized, *"Protecting our private information should be a priority."* Accuracy and reliability concerns followed (f = 89, 29%), including the risk of misinformation (f = 53) and the need for source verification (f = 36). S96 said, *"We should compare AI-generated information with other sources."* In educational use, 32 participants (10.3%) warned about laziness, while 22 (7.1%) feared the loss of authenticity. S275 noted, *"Using AI constantly might reduce our thinking ability."* Technological limitations (f = 32, 10.3%), social impacts (f = 21, 6.8%), and practical tips such as asking clear questions (f = 9, 2.9%) were also highlighted. S210 stated, *"We need to ask well-formulated questions to get accurate results."*

Questions Generated for AI Applications

Table 23. Question sentences on artificial intelligence application: codes, frequencies and sample participant responses

Codes	f	%
Information, Counselling and Guidance	85	28
Education and Student Support Practices	50	17
Artificial Intelligence Technology, Ethics and Future Questions	40	13
Questions on Everyday Life	30	10
Creativity, Entertainment and Artistic Demands	25	8
Respondents who did not answer / left blank	93	29

According to Table 23, 85 participants (28%) generated questions related to professional guidance. S10 asked, *"What trainings should I take to become a good psychological counsellor?"* Fifty participants (17%) focused on educational support. S14 asked, *"Can you create an activity to help me learn this topic?"* Forty participants (13%) explored ethical or future-oriented questions. S13 posed, *"Can AI surpass human creativity?"* and *"How can it make ethical decisions without consciousness?"* Thirty participants (10%) submitted practical everyday life questions. S12 inquired, *"What's the weather tomorrow and how should I dress?"* Creative and entertainment-focused questions came from 25 participants (8%). S11 asked, *"Can you write a detective story for me?"* However, 93 participants (29%) did not respond or provided irrelevant content, indicating variability in creativity and AI engagement.

AI Applications and Categories

According to Table 24, the most preferred AI application by pre-service teachers was ChatGPT with a usage rate of 27.2% (n = 272), followed by Google Assistant with 20.6% (n = 206) and Siri with 11.2% (n = 112). This shows that pre-service teachers are more likely to use language-based AI systems for functions such as text generation, information access and academic support. Less well-known applications that require technical knowledge (e.g. Claude, Scite.ai, DALL-E, Synthesia) were used by only 1 to 6 people.

Table 24. Artificial intelligence applications used by pre-service teachers

AI Applications	n	AI Applications	n
Siri	112	Bing Chat	11
Google Assistant	206	DALL-E	6
Microsoft Cortana	15	Synthesia	2
ChatGPT	272	Google Notebook LM	19
Socrates	4	ImageBind	3
MathGPTPro	4	Gemini	23
Pictory	2	Microsoft Bing	1
Google Bard	17	Copilot	3
Alexa	5	Canva	2
Claude	2	Microsoft Bing-ai	2
Scite.ai	2	Klling.ai	1
My AI	1	Gamma	2
OpenAI	1	Grok	5
Deepseek	6	Deeply	1

When the AI applications used by pre-service teachers are analysed by categorising them according to their functions, Table 25 emerges. Table 25 shows the categories to which the AI applications used by pre-service teachers belong, the definitions of these categories and sample applications belonging to each category.

Table 25. Categories of artificial intelligence applications used by pre-service teachers

Category	Description	Sample Applications
Language and Text Based Assistants	AI applications for text generation, question answering, translation and knowledge-based textual support.	ChatGPT, Claude, Google Bard, Groq, Kimi.ai
Voice Digital Assistants	Digital assistants, usually built into mobile devices, with which users interact with voice commands.	Siri, Google Assistant, Microsoft Cortana, Alexa
Visual and Video Production Tools	Creative production-oriented AI tools used to create visual or video content.	DALL-E, Synthesia, ImageBind, Canva
Education-Oriented AI Tools	Special purpose applications developed for the production of educational content or to support learning processes.	Socrates, MathGPTPro, Google Notebook LM
AI Assisted Search and Browsers	Search engine-based platforms and browsers that provide AI support to information screening and production processes.	Bing Chat, Copilot, Microsoft Bing, BingXov
Other	Other applications that do not fall directly into the above categories and are intended for limited or specific use.	Scite, My AI

Accordingly, the applications were categorised under the headings of “Language and Text Based Assistants”, “Voice Digital Assistants”, “Visual and Video Production Tools”, “Education Oriented AI Tools”, “AI Supported Search and Browsers” and “Other”. According to the frequency of use, the most preferred category was language and text-based assistants with a rate of 44.9%. This category includes applications such as ChatGPT, Claude, Bard that serve users’ needs for text generation, answering questions and accessing information. Voice-based digital

assistants (e.g. Siri, Google Assistant) ranked second with 33.6%, indicating that AI integrated into mobile devices in daily life are intensively used by pre-service teachers. AI supported search and browsers (e.g. Bing Chat, Copilot) were used by 7.3%, education-oriented AI tools (e.g. Socrat, MathGPTPro) by 5.2%, visual and video production tools (e.g. DALL-E, Synthesia) by 4.3% and other tools (e.g. Scite, My AI) by 4.7%. These findings reveal that pre-service teachers mostly access AI technologies through language-based and general ease-of-use tools, whereas they tend to use tools for visual production and specialised areas in a more limited way.

Conclusion and Discussion

The aim of this study is to determine the AI literacy levels of pre-service teachers and to examine whether these levels differ in line with various demographic and individual variables. According to the findings obtained, it was determined that pre-service teachers generally have high levels of AI literacy. This situation shows that individuals raised in the digital age are more familiar with technological tools and their awareness of AI technologies has increased (Kaya & Başarmak, 2023; Topal & Tekin, 2021).

According to the results of the study, demographic variables such as gender, age, grade level, and parental education level do not make a significant difference on AI literacy. This finding shows that male and female students have similar AI literacy levels in terms of AI literacy. Especially today, university education and easily accessible digital content may have minimised such differences between people. When similar studies in the literature are examined; in the study conducted with pre-school pre-service teachers, no significant differences were found between males and females within the scope of AI literacy (Mart & Kaya, 2024). However, in the study examining the AI literacy levels of students, the gender variable created a significant difference in AI literacy level (Elçiçek, 2024). In a similar study, a significant difference was found between male and female pre-service teachers in terms of AI literacy (Banaz & Demirel, 2024). In a study conducted by Asio (2024), it was concluded that the gender variable did not have a significant effect on AI literacy. According to the findings, the reason why different results were obtained in the AI literacy levels of the gender variable may be due to the different samples used in each study (Güler & Polatgil, 2025).

On the other hand, significant differences were observed in the AI literacy levels of pre-service teachers according to their fields of study. It was observed that pre-service teachers in the field of Educational Sciences had higher scores in this field. This result can be explained by the intensity of technology-supported contents included in the curricula and the differences in digital competencies specific to the field (Kuşçu et al., 2014). However, in the post-hoc analyses, it was not statistically determined which groups these differences were between. This may be associated with the unbalanced distribution of the sample size between the groups.

Another important finding obtained within the scope of the research is that the pre-service teachers' having AI applications on their mobile devices and receiving technology-related training significantly affect their AI literacy levels. These findings support that technology literacy gained through direct experience and education improves individuals' attitudes and skills towards AI (Zawacki-Richter et al., 2019). In a study in the literature, significant differences were observed between individuals' ability to use information technologies and AI literacy levels; it is seen that as the level of individuals' ability to use information technologies increases, their AI literacy levels increase (Güler & Polatgil, 2025). Likewise, the use of AI in studies also shows a positive relationship with individuals' AI literacy levels. This shows that constructivist learning approaches to technology use support the development of higher-level cognitive skills in individuals (Mishra & Koehler, 2006).

The results of content analysis of qualitative data also coincide with quantitative findings. Pre-service teachers stated that they actively used AI technologies especially in educational activities (homework preparation, presentation creation, information acquisition). This finding shows that the potential of integrating AI into the learning process is recognised and a highly instrumental approach to these technologies is developed (Luckin et al., 2016). In addition, pre-service teachers also drew attention to the functions of AI such as time saving, quick access to information and guidance, and emphasised the facilitating effect of AI technologies on the learning process.

However, some of the pre-service teachers also expressed concerns about the use of AI such as ethics, security and authenticity. This finding points to the importance of individuals developing not only technical competence but also ethical sensitivity. In particular, the need for conscious use of information accuracy, resource utilisation and data security should be evaluated in the context of digital citizenship and critical technology literacy (Ribble, 2015). AI literacy is a holistic concept that includes ethical and social elements as well as technical knowledge

(Türel et al., 2024). Studies have shown that both theoretical and practical trainings are necessary for higher education students to acquire this skill (Černý 2024).

Finally, it is seen that some of the pre-service teachers are inadequate in producing creative and intellectual questions about AI. This situation shows that pre-service teachers should not only develop their skills in using AI tools, but also their capacities to effectively direct, question and use these tools for creative purposes.

Recommendations

In faculties of education, course contents should be developed in which pre-service teachers can evaluate AI technologies not only as users but also as producers and critical individuals, and AI literacy should be handled with an interdisciplinary approach. In curricula, issues such as ethics, data security and authenticity with AI should be emphasised more and applied courses and scenario-based activities should be used in this direction. Project-based learning and problem-solving oriented pedagogical approaches should be encouraged to support pre-service teachers' ability to produce more creative and critical questions with AI applications.

Scientific Ethics Declaration

* The authors declare that the scientific ethical and legal responsibility of this article published in JESEH journal belongs to the authors.

* This study was approved by the Ethics Committee of Nigde Omer Halisdemir University at its meeting dated 25 June 2025, with decision number 2025/11-25.

Conflict of Interest

* The authors declare that they have no conflicts of interest

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