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Determining the Role of AI Literacy in the AI Readiness of Pre-Service Mathematics Teachers

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Abstract

The purpose of this study is to examine the level of artificial intelligence readiness and artificial intelligence literacy of pre-service mathematics teachers in relation to various variables, and to identify the relationship between these skills. The present study's sample comprised 164 pre-service mathematics teachers. The "Artificial Intelligence Readiness" and "Artificial Intelligence Literacy" scales were utilised as data collection tools. Statistical Package for the Social Sciences (SPSS) software was then deployed in order to facilitate data analysis, with the following analyses being conducted: independent sample t-tests, one-way analysis of variance (ANOVA), correlation analysis and regression analysis. The findings of the study demonstrated that pre-service mathematics teacher candidates exhibited a high level of both artificial intelligence readiness and literacy. Moreover a high level of positive and significant statistical relationship is demonstrated between artificial intelligence literacy and readiness. It was revealed that artificial intelligence literacy is responsible for explaining approximately 55% of the variance in artificial intelligence readiness.

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Introduction

In recent years, there has been a notable advancement in the integration of digital technologies into various facets of human life, profoundly impacting the manner in which we access and communicate information, and even affecting our behavioural tendencies (Chassignol et al., 2018). Digital technologies have facilitated human life and increase productivity by offering enhanced comfort, speed and connection opportunities (Shanmugasundaram & Tamilarasu, 2023). Concurrently, artificial intelligence (AI) technologies, a subset of digital technologies, have proliferated across numerous domains, including business, science, art and education, with the objective of enhancing efficiency (Ng et al., 2021). The integration of AI within the broader domain of education has the potential to significantly enhance learning outcomes (Nalbant, 2021). In this regard, Chen et al. (2020) asserted that the impact of AI on education is significant. Indeed, the impact of AI technologies on education has resulted in the emergence of a globally recognised field known as Artificial Intelligence in Education (AIED) (Ayanwale et al. 2024a).

It can be posited that the integration of AI technologies within educational settings can yield numerous advantages for both teachers and students. Especially in the domain of mathematics education, which is widely regarded as a challenging field, the utilisation of AI technologies is of particular significance (Borah, 2024). The utilisation of AI has the potential to assist students in developing creative, critical, and higher-order thinking skills, in addition to problem-solving abilities, which are pivotal objectives in the mathematics education curriculum (Putri et al., 2024). In a similar vein, Govender (2024) contended that the influence of AI on the pedagogy of mathematics instruction is substantial and it is reasonable to hypothesise that the potential contribution to mathematics education will expand as long as developments in AI technologies continue.

The utilisation of AI in educational settings facilitates individualised learning support that is tailored to the learner's pace and needs. This is achieved by observing the learner's learning process, analysing their performance, and providing immediate feedback (Baidoo-Anu & Ansah, 2023; Hwang et al., 2020). The provision of individualised learning support through AI is an effective method of overcoming the limitations of conventional teaching methods in traditional mathematics education. It provides a form of mathematics teaching that caters to the specific learning needs and pace of each student, thereby ensuring a more personalised and efficacious educational experience (Dabingaya, 2022). AI has the potential to facilitate effective mathematical education through the provision of dynamic and interactive learning environments (Govender, 2024). AI-powered maths learning platforms are constituted of a variety of elements, including game components and interactive simulations. The integration and combination of such features results in the platforms offering a learning environment that is characterised as both enjoyable and engaging with respect to the subject of mathematics (Sreedevi, 2023). The contribution of AI to learning mathematics in a enjoyable and meaningful way increases students' motivation to learn mathematics (Putri et al., 2024; Sreedevi, 2023). The integration of AI within the educational sector has been demonstrated to facilitate a more profound comprehension of mathematical concepts, thereby enhancing students' spatial thinking abilities. This technological advancement has been particularly effective in the domain of mathematics education, where augmented reality applications have been shown to render abstract concepts more comprehensible (Opesemowo & Ndlovu, 2024).

The utilisation of AI in the domain of mathematics education confers numerous advantages for educators. To illustrate this point, it is proposed that teachers employ AI in the assessment of students, thereby allowing them to allocate more of their time and efforts to other aspects of their profession and the creation of valuable educational content (Baidoo-Anu & Ansah, 2023; Govender, 2024). The utilisation of AI in the domain of education is enhance the evaluation process. This enhancement is evidenced through the implementation of applications including image recognition and prediction systems. It has been asserted that evaluations conducted with the assistance of AI are characterised by enhanced accuracy and expedited timeframes (Huang et al., 2021). Furthermore, given that AI is devoid of human-like emotions and feelings, it is anticipated that the evaluations it will make will be more fair and professional (Nalbant, 2021). Furthermore, it is asserted that the system will yield results that are devoid of errors that are commonly made by humans and will function with an minimum error rate (Nalbant, 2021; Sreedevi, 2023). It is an acknowledged fact that AI has the ability to analyse large-scale student populations and to make predictive inferences through machine learning (Zhang & Aslan, 2021). Parallel to this, Chiu et al. (2023) highlighted in their systematic review study that student assessments facilitated by AI are intended for two purposes: automatic grading and predicting student performance. The utilisation of AI in the domain of assessment enables the generation of personalised mathematical questions and exams, tailored to the individual student's level of knowledge and academic progress. These assessments permit the calibration of exam content according to the level of the examinee by employing questions with a commensurate degree of complexity. This methodological approach ensures the evaluation of students' mathematical abilities with a greater degree of precision (Opesemowo & Ndlovu, 2024).

AI has the potential to provide teaching tools that can assist educators in enhancing the efficacy of their pedagogy (Pokrivcakova, 2023). In the field of mathematics education, the utilisation of AI-supported teaching tools has emerged as a significant trend. A comprehensive review of this domain was conducted by Park et al. (2020), which identified several notable tools, including Khan Academy, Squirrel AI, MATHia, Woonjin ThinkBig AI, Dr. MATH, and Botami. The integration of AI within educational settings is quite functional in terms of increasing the teaching power of teachers, developing new teaching strategies, and shaping teaching methods (Hwang vd., 2020; Onesi-Ozigagun et al., 2024). Simultaneously, AI can facilitate the professional development of teachers by analysing their teaching practice and offering customised training modules, workshops and resources to enhance their pedagogical skills and approaches (Opesemowo & Ndlovu, 2024). In summary, the integration of AI within the domain of mathematics education has been shown to facilitate the development of students who possess the capacity to obtain, analyse and apply information in a manner consistent with the demands of the digital age (Putri et al., 2024). In light of the current era, it is imperative that mathematics educators, both novices and those in training, possess a more extensive repertoire of competencies and practical experience in leveraging technological advancements and AI compared to their seasoned counterparts (Wardat et al., 2024).

In order to ensure that students are able to engage with emerging technologies and meet the future requirements of the education system, it is essential to cultivate a readiness for these technologies (Ramazanoğlu & Akın, 2024). Alongside this, the willingness of prospective teachers in STEM fields to utilise AI as an instructional resource is influenced by their level of AI readiness (Ayanwale et al., 2024b). According to Ayanwale et al. (2024b), the concept of AI readiness refers to the degree of preparedness on the part of pre-service teachers, individuals, organisations, and nations to adopt and utilise AI technologies in an effective manner. It has been asserted that educators who possess a high degree of AI readiness are capable of utilising AI to the advantage of their students within the educational environment (Luckin et al., 2022).

The capacity of educators to proactively and productively incorporate AI technologies into their pedagogical practice is not solely contingent on their level of AI readiness. In other words, the degree of AI readiness among teachers alone does not guarantee the efficient and effective use of AI. In view of this, it is imperative that teachers are equipped with the necessary digital competencies to utilise AI technologies in an effective manner within educational settings (Casal-Otero et al., 2023). At this point, the importance of AI literacy becomes evident. AI literacy is defined as the ability to define, use and evaluate AI technologies in accordance with ethical rules (Wang et al., 20222). Chenqi et al. (2023) suggest that the level of artificial intelligence literacy of pre-service teachers will have a direct impact on their future teaching practices. It has further been argued by researchers that prospective teachers' AI literacy will prepare them for the instructional challenges and opportunities they will encounter in the future (Ayanwale, 2024a). Drawing upon extant literature, Younis (2024) enumerated the rationales for why prospective teachers should be AI literate, namely: (i) preparing students for the world of the future, (ii) serving as a paradigm for students on the ethical utilisation of AI technologies, and (iii) enhancing pedagogical methodologies.

In the relevant literature, studies on AI in which pre-service teachers are recruited are generally seen as aiming to determine the candidates' level of awareness (Çam et al., 2021; AlKanaan, 2022); to ascertain their perceptions (Ağmaz & Ergüleç, 2024; Coşkun, 2024); and determining their attitudes (Banaz & Maden, 2024; Galindo-Domínguez et al., 2024; Sarıkaya & Kavan, 2024). In addition to these studies, it is imperative to investigate the AI readiness and AI literacy of pre-service teachers. In order for teacher candidates to benefit from AI technologies in their courses, they must first have AI readiness, and to ensure the effective integration of AI technologies into their course, they must have AI literacy. A comprehensive examination of the extant literature revealed numerous studies investigating the AI readiness of prospective teachers (Alshorman, 2024; Bautista, 2024; Lucas et al., 2025). However, an examination of the existing Turkish literature reveals a paucity of studies investigating the AI readiness of Turkish teacher candidates. In a limited number of studies (Özer-Altinkaya & Yetkin, 2025), the AI readiness of English teacher candidates was examined through the use of reflective opinion forms and semi-structured interviews. Consequently, it can be claimed that there is a significant absence in the literature regarding the evaluation of the AI readiness of Turkish pre-service teachers. On the other hand, it can be argued that there are more studies examining the AI literacy of prospective teachers in both Turkey and the general literature (Ayanwale et al., 2024a; Pei et al., 2025; Yoon & Jang, 2024). Studies on determining the AI literacy levels of Turkish teacher candidates have been carried out for various branches, such as Turkish language teacher candidates (Banaz & Demirel, 2024); social studies teacher candidates (Erdoğdu & Çakır, 2024; Öngören, 2024); pre-school teacher candidates (Mart and Kaya, 2024). In this regard the deficiency in mathematics education is a salient issue. In this respect, the apparent absence of work on AI literacy with teacher candidates in STEM fields, which are closely related to AI technologies, appears to be a significant deficiency. Parallel to this in the systematic literature review conducted by Demircioğlu et al. (2024), it was determined that there was a scarcity of data on AI in mathematics education in the Turkish context in comparison to the global literature.

In consideration of the opportunities presented by AI technologies in the domain of mathematics education, it appears that the utilisation of these technologies is both imperative and inevitable for a meaningful and effective teaching process. In disciplines which demand high conceptual and analytical thinking, such as mathematics education, AI-supported applications offer a range of benefits, including personalised learning opportunities, feedback based on error analysis, and problem-solving skill development. In this regard, the integration of AI technologies into teaching environments for the purpose of providing meaningful and contemporary mathematics education has become imperative, rather than being a matter of choice. However, the effective utilisation of these technologies is contingent upon educators, both current and prospective, possessing adequate AI literacy and being adequately prepared for their integration. The paucity of knowledge, skills and readiness levels of teachers and teacher candidates with regard to artificial intelligence constitutes a significant obstacle to the effective implementation of this integration. This research, conducted in this direction, addressed the current AI readiness levels and AI literacy of pre-service mathematics teachers in a multi-faceted way. It is believed that the study will make significant contributions to teacher candidates in terms of developing awareness of AI in the education process, gaining insight into how they can integrate these technologies into their lessons, and supporting themselves in this direction in their professional development processes. Furthermore, this study has the potential to address a significant gap in the literature by providing a framework for the enhancement of teacher training programs, encompassing both their content and practical implementation. In this context, the following research questions were investigated:

i) What is the level of AI readiness and AI literacy of pre-service mathematics teachers?
ii) Does the AI readiness of pre-service mathematics teachers differ significantly according to gender, year of study, frequency of AI use in daily life, frequency of AI use in educational contexts, willingness to take courses in using AI, regular follow-up of AI developments, and perceived AI attitude?
iii) Does the AI literacy of pre-service mathematics teachers differ significantly according to gender, year of study, frequency of AI use in daily life, frequency of AI use in educational contexts, willingness to take courses in using AI, regular follow-up of AI developments, and perceived AI attitude?
iv) Is there a relationship between AI literacy and AI readiness?
v) What is the role of AI literacy in predicting AI readiness?

Method

Research Design

The objective of the present study was to examine the AI readiness and AI literacy of pre-service mathematics teachers in the context of various variables, and to ascertain the predictive effect of AI literacy on AI readiness. In this specific context, the present research was conducted in accordance with the cross-sectional survey design, which is one of the quantitative research methods. This design facilitates a systematic examination of current perceptions and competencies without any intervention on any variable. The cross-sectional structure of the study enabled the collection of data in a single time period and the performance of both descriptive and relational analyses; in this respect, it demonstrated integrity with the research objectives.

Sample

The present study's sample consists of 164 pre-service teachers enrolled in the undergraduate programme in primary mathematics teaching at the faculty of education of a state university in Turkey. The sample was determined using the convenience sampling method, with consideration given to working conditions and accessibility criteria. The selection of this method was driven by its practicality during the research process, thereby enhancing the efficacy of the data collection procedure. The demographic composition of the sample was as follows: 64% of the participants were female, 36% were male, and the age range of the participants was from 18 to 23 years. Table 1 provides an overview of the demographic characteristics of the participants. As demonstrated in the table, approximately 9% of the sample group included in the study were first-year students; 30.5% were second-year students; 28.7% were third-year students and 31.7% were fourth-year students.

Table 1. Demographic Characteristics of the Participants

Gender	*n*	*%*
Female	105	64.0
Male	59	36.0
Year of Study		
Freshmen	15	9.1
Sophomore	50	30.5
Junior	47	28.7
Senior	52	31.7

Data Collection Tools

The data for the study were collected through the utilisation of various instruments, namely the "personal information collection form", the "AI literacy scale", and the "AI readiness scale". *The personal information collection form* was developed by the researchers for the purpose of collecting demographic information from the participants. The demographic information collected includes gender, year of study, frequency of AI use in daily life (1: Rarely, 2: Sometimes, 3: Frequently), frequency of AI use in educational contexts (1: Rarely, 2: Sometimes, 3: Frequently), willingness to take courses on AI use (I would - I would not), regular follow-up of AI developments (yes-no), and perceived attitudes towards AI technologies (positive-negative).

The AI literacy scale was developed by Wang et. al. (2022) and was adapted to Turkish by Çelebi et al. (2023), who completed its validity-reliability studies. The scale is comprised of 12 items in total, including 4 sub-dimensions, namely awareness, usage, evaluation and ethics. The awareness sub-dimension comprises items designed to assess individuals' fundamental knowledge of AI and smart technologies, their capacity to differentiate between these technologies and others, and their comprehension of the potential functions and benefits of these technologies. Additionally, it encompasses participants' level of cognitive awareness regarding technology (e.g. I can identify the AI technology employed in the applications and products I use). Within the usage sub-dimension, the capacity of individuals to utilise AI-based applications and products effectively in their daily lives or business processes is measured, whilst their propensity to learn such technologies and their aptitude to benefit from these technologies are also evaluated (e.g. I can skilfully use AI applications or products to help me with my daily work). The evaluation sub-dimension is designed to measure the extent to which individuals are able to utilise their critical thinking skills when engaging with AI technologies. The person's ability to compare different AI tools and choose the most appropriate one for their task, to make logical decisions among the solutions offered, and to recognize the limits of the technology were evaluated in this dimension (e.g. I can choose a proper solution from various solutions provided by a smart agent). The ethics sub-dimension is designed to measure the extent to which individuals adhere to ethical principles when using artificial intelligence applications and products. It also examines the extent to which individuals pay attention to privacy and information security issues, and the extent to which they are sensitive to the misuse of these technologies (e.g. I am always alert to the abuse of AI technology). It is worth noting that each sub-dimension of the 7-point Likert-type scale contains an equal number of items. The reliability coefficients of the sub-dimensions of the scale were reported as .72, .74, .76, .72, respectively. Three items on the scale were categorised as reverse items. The factor loadings of the items range from .55 to .79. The Cronbach's Alpha coefficient was calculated as .85 for the overall scale.

The AI readiness scale was developed by Wang et. al. (2023) and was adapted to Turkish by Özüdoğru and Yıldız-Durak (2024), who completed its validity-reliability studies. The scale employed is of the 5-point Likert type, comprising a total of 18 items. The scale is composed of 4 sub-dimensions: cognition (5 items), ability (6 items), vision (3 items) and ethics (4 items). The cognition sub-dimension of the scale is intended to evaluate pre-service teachers' conceptual understanding of teacher roles in the age of artificial intelligence, their ability to effectively balance these roles with artificial intelligence technologies, their knowledge of how artificial intelligence works in education, and their level of awareness of the importance of using these technologies (e.g. I understand the importance of utilizing AI technologies for data collection, analysis, evaluation, and security in education in the era of AI). The sub-dimension of ability is concerned with the competence of pre-service teachers to integrate AI technologies into the teaching process in an effective and pedagogically appropriate manner. This dimension also appraises the capacity of pre-service teachers to integrate AI technologies into classroom routines, to solve teaching-related problems rationally, to design different teaching approaches, to improve the teaching process by using real-time feedback, and to maintain these competences based on collaboration with their colleagues (e.g. I can rationally use AI technologies to solve problems discovered during the teaching process). The "vision" sub-dimension of the scale aims to evaluate the intellectual attitudes of pre-service teachers towards AI technologies. In this context, pre-service teachers' thoughts on the strengths and limitations of AI technologies are measured, along with their individual views and approaches on how these technologies can be developed and applied in the field of education. Their predictions on the opportunities that AI can offer to educational processes and the possible difficulties that can be encountered are also assessed (e.g. I have my own unique thinking and views on how to improve and use AI technologies for education). Finally, at the ethics sub-dimension, the objective was to assess the level of teacher candidates in terms of digital ethics, data security and legal ethics and norms for which they are responsible in the use of AI in education (e.g. I understand the ethical obligations and responsibilities teachers need to assume in the process of using AI technologies). The reliability coefficients of the sub-dimensions of the scale were reported as .90, .93, .81, .88, respectively. The factor loadings of the items range from .75 to .85. The Cronbach's Alpha coefficient was calculated as .96 for the overall scale.

Data Collection Process

The collection of empirical evidence was conducted through face-to-face interaction during designated instructional periods at the faculty of education. The survey was conducted at an opportune point in the course, in a manner that did not disrupt or hinder the participants' lessons. The researchers were responsible for the oversight of the process, and for ensuring that the participants completed the application in a comfortable and free environment. The investigators personally disseminated the survey instruments to the study's participants and were present in the classroom throughout the data collection process to address any queries that might arise. The surveys required an average completion time of 15 minutes. Prior to initiation of the application process, the participants were furnished with comprehensive information regarding the objective of the research, the voluntary nature of their participation, and the confidentiality and anonymity of their responses. It was also asserted that study participants were entitled to withdraw from the study at any time if they did not wish to continue with the practice. Prior to conducting the present research, ethical approval was obtained from the institutions with which the researchers were affiliated. The present research was conducted in accordance with the established ethical standards, ensuring that all procedures followed recognized guidelines for responsible research conduct and maintained the integrity, rights, and welfare of all subjects involved.

Data Analysis

The AI literacy scale is a 7-point Likert-type scale, where items are scored from 1 ("strongly disagree") to 7 ("strongly agree"). The three negative items on the scale are coded as reverse items. The scores that can be obtained from the scale vary between 12 and 84, and are divided into five equal intervals for the purpose of ease of interpretation. Accordingly, scores between 12-26.4 are designated as very low, those between 26.5-40.8 as low, those between 40.9-55.2 as medium, those between 55.3-69.6 as high, and those between 69.7-84 as very high artificial intelligence literacy.

The AI readiness scale is a 5-point Likert-type scale, with items scored from 1 ("strongly disagree") to 5 ("strongly agree"). The scores that can be obtained from the scale vary between 18 and 90 points, and are divided into five equal intervals for the purpose of ease of interpretation. Accordingly, scores ranging from 18 to 32.4 are indicative of very low; scores range of 32.5 to 46.8 indicate low; scores ranging from 46.9 to 61.2 denote medium; scores from 61.3 to 75.6 indicating high; scores within the range of 75.7 to 90 represent very high levels of AI readiness. The specified score ranges were obtained by dividing the difference between the highest and lowest possible scores on the scale by five.

Preliminary to the analysis of the data collected through the scales, missing data were filled in accordance with the average so as to avoid any impact on the results. In addition, the coding of the reverse items in the AI literacy scale was completed. The data were analysed using the SPSS programme. The Kolmogorov-Smirnov test result indicated that the data obtained from the artificial intelligence literacy scale were in accordance with the normal distribution ($p > .05$). In the context of the artificial intelligence readiness scale, the kurtosis and skewness coefficients, when situated within the interval -1 to +1, are indicative of the data approximating a normal distribution. It is therefore concluded that the data adheres to the normal distribution assumption for both scales. The linearity assumption was then evaluated in line with the assumption that the relationship between the dependent and independent variables was linear. It was determined that this assumption was suitable for the analysis. Following the determination of the data's suitability for analysis, a range of analytical methods were employed to address the research questions. These methods included an independent sample t-test, one-way analysis of variance (ANOVA), correlation analysis and regression analysis. Within the scope of the research, a p value of .05 (5%) was deemed as valid.

Results

Findings Regarding AI Readiness and AI Literacy Levels of Pre-Service Mathematics Teachers

The results regarding the AI readiness and AI literacy levels of pre-service mathematics teachers are given in Table 2.

Table 2. Descriptive Statistics on Scale Results

Variables	N	Min.	Max.	$\bar{X}$	*SD*	Skewness	Kurtosis
AI Readiness Scale	164	32	90	63.93	9.19	-.279	.793
Cognitive	164	10	25	18.06	2.72	-.251	.684
Ability	164	8	30	20.95	3.82	-.322	.498
Vision	164	6	30	12.69	4.69	1.412	1.818
Ethics	164	5	20	14.45	2.65	-.314	.427
AI Literacy Scale	164	32	82	59.51	10.27	-.153	-.353
Awareness	164	9	21	15.22	2.77	.206	-.709
Usage	164	5	21	14.43	3.25	-.218	-.126
Evaluation	164	5	21	14.87	3.27	-.434	.269
Ethics	164	5	21	14.97	3.76	-.390	-.447

As can be seen in Table 2, the AI readiness ($\bar{X}$=63.93, SD=9.19) and AI literacy ($\bar{X}$=59.51, SD=10.27) of pre-service mathematics teachers are at a high level.

Findings on Variables Affecting the AI Readiness of Pre-Service Mathematics Teachers

The results obtained from the study, which focused on the impact of gender on the AI readiness of pre-service mathematics teachers, are presented in Table 3.

Table 3. Results of the Independent Samples t-Test on AI Readiness by Gender

Gender	*N*	$\bar{X}$	*S*	*df*	*t*	*p*
Female	105	64.29	9.68	162	.478	.634
Male	59	63.28	8.30			

As can be seen in Table 3, there is no statistically significant difference in the AI readiness of pre-service mathematics teachers according to gender.

The results pertaining to the impact of grade level on AI readiness of primary school mathematics teacher candidates are presented in Table 4.

Table 4. ANOVA Results on AI Readiness by Grade Level

Source of Variance	Sum of Squares	df	Mean Square	F	p	Difference
Between Groups	526.480	3	175.493	2.118	.100	-
Within Groups	13259.782	160	82.874			
Total	13786.262	163				

As illustrated in Table 4, the AI readiness of pre-service mathematics teachers does not demonstrate a statistically significant difference according to grade level.

The results of the study, which relate to the change in AI readiness of pre-service mathematics teachers according to their frequency of using AI in daily life and in educational contexts, are presented in Table 5 and 6.

Table 5. ANOVA Results Regarding Changes in AI Readiness According to Frequency of AI Usage in Daily Life

Source of Variance	Sum of Squares	df	Mean Square	F	p	Difference
Between Groups	1152.946	2	576.473	7.347	.001*	3 > 1
Within Groups	12633.316	161	78.468			2 > 1
Total	13786.262	163				

1: Rarely, 2: Occasionally, 3: Frequently

As illustrated in Table 5, a statistically significant difference is observed in the AI readiness of pre-service mathematics teachers based on their frequency of AI utilisation in daily life [$F(2, 161) = 7.347$, $p < .05$]. The Scheffe test was conducted to ascertain the source of the observed difference, and the results indicated that the AI readiness of pre-service mathematics teachers who indicated frequent ($\bar{X}$=66.34) and occasional ($\bar{X}$=64.34) use of AI in daily life is significantly higher than that of teacher candidates who indicated rare use ($\bar{X}$=59.65).

Table 6. ANOVA Results Regarding Changes in AI Readiness According to Frequency of AI Usage in Educational Context

Source of Variance	Sum of Squares	df	Mean Square	F	p	Difference
Between Groups	715.173	2	357.586	4.404	.014*	3 > 1
Within Groups	13071.090	161	81.187			3 > 2
Total	13786.262	163				

1: Rarely, 2: Occasionally, 3: Frequently

As illustrated in Table 6, a statistically significant difference is observed in the AI readiness of pre-service mathematics teachers based on their frequency of AI utilisation in educational context [F(2, 161) = 4,404, p < .05].]. The Scheffe test was conducted to ascertain the source of the observed difference, and the results indicated that pre-service mathematics teachers who indicated frequent utilisation of AI ($\bar{X}$=71,80) in the educational context exhibited significantly higher levels of AI readiness compared to those who utilised AI on occasionally ($\bar{X}$=63.57) or rarely ($\bar{X}$=61.00).

Additionally, the changes in AI readiness of pre-service mathematics teachers were examined according to three factors. Firstly, the candidates' willingness to take an undergraduate course on using AI. Secondly, their regular follow-up of AI developments. Thirdly, their general perceived attitude towards AI. The results of the analysis are presented in Table 7.

Table 7. Independent Samples t-Test Results by Various Variables

		N	$\bar{X}$	S	df	t	p
Willingness to take an undergraduate course	I would	126	64.8175	9.30325	162	2.271	.024*
	I would not	38	61.0000	8.28871			
Regular follow-up of AI developments	Yes	29	69.5517	9.03796	162	3.770	.000*
	No	135	62.7256	8.80420			
Perceived attitudes towards AI	Positive	125	64.8000	8.90723	162	2.187	.030*
	Negative	39	61.1538	9.66964			

According to Table 7, pre-service mathematics teachers who are willing to take courses on the use of AI ($\bar{X}$=64.81) have statistically significantly higher AI readiness than those who are not willing ($\bar{X}$=61.00) [t(162) = 2.271, p<.05]; those who regularly follow the development of AI technologies ($\bar{X}$=69. 55) have statistically significantly higher AI readiness than those who do not ($\bar{X}$ = 62.72) [t(162) = 3.770 <.01]; and those who have a positive attitude towards AI ($\bar{X}$=64.80) have statistically significantly higher AI readiness than those who have a negative attitude ($\bar{X}$=61.15) [t(162) = 2.187 <.05].

Findings on Variables Affecting the AI Literacy of Pre-Service Mathematics Teachers

The results regarding the effect of gender on the AI literacy of pre-service mathematics teachers are presented in Table 8.

Table 8. Results of the Independent Samples t-Test on AI Literacy by Gender

Gender	N	$\bar{X}$	S	df	t	p
Female	105	59.80	10.76	162	.672	.503
Male	59	59.00	9.38			

Table 8 shows that there is no statistically significant difference in the AI literacy levels of pre-service mathematics teachers by gender.

The results concerning the effect of grade level on AI literacy of primary school mathematics teacher candidates are presented in Table 9. As demonstrated in the table, there is no statistically significant difference in the AI literacy levels of pre-service mathematics teachers according to grade level.

Table 9. ANOVA Results on AI Literacy by Grade Level

Source of Variance	Sum of Squares	df	Mean Square	F	p	Difference
Between Groups	783.308	3	261.103	2.546	.058	-
Within Groups	16411.667	160	102.573			
Total	17194.976	163				

The results of the study, which relate to the change in AI literacy of pre-service mathematics teachers according to their frequency of using AI in daily life and in educational contexts, are presented in Tables 10 and 11.

Table 10. ANOVA Results Regarding Changes in AI Literacy According to Frequency of AI Usage in Daily Life

Source of Variance	Sum of Squares	df	Mean Square	F	p	Difference
Between Groups	2187.934	2	1093.967	11.736	.000*	3 > 1
Within Groups	15007.041	161	93.211			2 > 1
Total	17194.976	163				

1: Rarely, 2: Occasionally, 3: Frequently

As presented in Table 10, a statistically significant difference in the AI literacy of pre-service teachers is observed, based on the frequency of their daily AI usage [$F(2, 161) = 11.736$, $p < .01$]. The Scheffe test was conducted to ascertain the source of the observed difference, and the results indicated that the AI literacy of pre-service mathematics teachers who indicated frequent ($\bar{X}$=63.40) and occasional ($\bar{X}$=60.42) use of AI in daily life is significantly higher than that of teacher candidates who indicated rare use ($\bar{X}$=53.84).

Table 11. ANOVA Results Regarding Changes in AI Literacy According to Frequency of AI Usage in Educational Context

Source of Variance	Sum of Squares	df	Mean Square	F	p	Difference
Between Groups	327.061	2	163.531	1.561	.213	-
Within Groups	16867.914	161	104.770			
Total	17194.976	163				

1: Rarely, 2: Occasionally, 3: Frequently

As demonstrated in Table 11, there appears to be no statistically significant difference in the AI literacy of primary school mathematics teacher candidates in relation to the frequency of AI utilisation within the educational context.

Additionally, the changes in AI literacy of pre-service mathematics teachers were examined according to three factors. Firstly, the candidates' willingness to take an undergraduate course on using AI. Secondly, their regular follow-up of AI developments. Thirdly, their general perceived attitude towards AI. The results of the analysis are presented in Table 12.

Table 12. Independent Samples T-Test Results by Various Variables

		N	$\bar{X}$	S	df	t	p
Willingness to take an undergraduate course	I would	126	60.3016	10.35427	162	1.805	.073
	I would not	38	56.8947	9.65566			
Regular follow-up of AI developments	Yes	29	66.4828	10.78895	162	4.232	.000*
	No	135	58.0148	9.55111			
Perceived attitudes towards AI	Positive	125	60.2000	10.38377	162	1.542	.125
	Negative	39	57.3077	9.70120			

As shown in Table 12, teacher candidates who regularly follow developments in AI technologies ($\bar{X}$=66.48) have statistically significantly higher AI literacy than those who do not ($\bar{X}$=58.01) [$t(162) = 4.232$, $p<.01$].

Findings on the Relationship between AI Readiness and AI Literacy

The findings regarding the relationship between prospective teachers' AI readiness and AI literacy are presented in Table 13. As evident in the table, a strong positive and statistically significant correlation was identified between AI readiness and AI literacy ($r = 0.741$, $p < .01$). Consequently, as teacher candidates' AI literacy increases, their AI readiness also increases.

Table 13. Correlation Between AI Readiness and AI Literacy

		AI Literacy	AI Readiness
AI Literacy	Pearson Correlation	1	.741**
	Sig. (2-tailed)		.000
	N	164	164
AI Readiness	Pearson Correlation	.741**	1
	Sig. (2-tailed)	.000	
	N	164	164

**. Correlation is significant at the 0.01 level (2-tailed).

Findings on the Role of AI Literacy in Predicting AI Readiness

The present investigation employed a regression analysis to establish the extent to which candidates for the role of pre-service mathematics teachers possess of AI literacy can be predicted with accuracy in regard to their level of AI readiness. The results of the analysis are presented in Table 14.

Table 14. Results of Regression Analysis

Variables	B	Std. Error	Beta	t	p
Constant	24.444	2.852		8.569	.000
AI Literacy	.664	.047	.741	14.047	.000

$r = .74$, $r^2 = .549$, $F(1, 162) = 197.326$, $p = .000$

As the regression model presented in Table 14 indicates, AI literacy has been identified as a statistically significant predictor of AI readiness ($t = 14.047$, $p < .01$). As the model indicates, AI literacy is responsible for approximately 55% of AI readiness. The mathematical formula derived from the model is as follows:

$$AI\ Readiness = 0.664\ AI\ Literacy + 24.444$$

Discussion

The aim of this study is to examine the level of AI readiness and AI literacy of pre-service mathematics teachers in terms of various variables, and to identify the relationship between these skills. The analyses conducted for this purpose revealed that teacher candidates have high levels of AI readiness and AI literacy. Erol-Şahin (2024), who examined the perceptions and concerns of future teachers towards AI, stated that future teachers should be prepared for these technologies by expressing the benefits that AI technologies will bring to education and that these developments are the technology of the future. On the other hand, in their study Guan et al (2025) found that K-12 teacher candidates had low AI readiness. The observed inconsistency between the studies may be due to the fact that only pre-service mathematics teachers were sampled in this study. The finding that pre-service mathematics teachers have high AI literacy is consistent with the results of the studies of Zhao et al. (2022) and Banaz & Demirel (2024). The present study revealed that the AI literacy and AI readiness of pre-service mathematics teachers were not significantly affected by gender. In consideration of the present finding, it can be stated that there are studies that both support our study (Mart & Kaya, 2024; Younis, 2024) and those that do not support our study (Banaz & Demirel, 2024; Yoon & Jang, 2024). Therefore, it is reasonable to conclude that the situation may be subject to variation depending on the characteristics of the sample and the research context. In a similar vein, grade level has been found to have no significant impact on AI literacy or AI readiness. In their study, Mart and Kaya (2024) demonstrated that there is no statistically significant relationship between age and AI literacy. On this basis, it can be posited that the two studies reached analogous results.

The frequency with which pre-service mathematics teachers utilise AI in their daily life has a significant impact on AI literacy and AI readiness. The findings of the present study indicate that teacher candidates who frequently utilise AI technologies, and occasionally do so on a daily basis, exhibit significantly higher levels of AI literacy and AI readiness in comparison to those who rarely employ such technologies. This finding is consistent with the results of the study conducted by Ma and Chen (2024). In accordance with the findings of Ma & Chen (2024), a strong and positive correlation exists between high AI usage frequency and the AI literacy scale developed by the researchers, along with all its sub-dimensions. Additionally, while the frequency of AI use by pre-service mathematics teachers in educational contexts has been shown to have a substantial impact on AI readiness, it has been demonstrated that this frequency is not significantly associated with AI literacy. Statements pertaining to the frequent use of AI technologies in educational contexts by teacher candidates were indicative of a significantly elevated level of AI readiness in comparison to those for whom the use of such technologies is occasional or rare. Kalnina et al. (2024) found that 43% of pre-service teachers responded positively to the use of AI for educational purposes. The pre-service teachers' use of AI in the educational context was generally aimed at seeking information, translating texts from foreign languages, and creating texts with correct grammar. In accordance with the results observed in this investigation, it was anticipated that an increased frequency of AI utilisation by teacher candidates in educational context would have a consequential effect on their future readiness to incorporate AI in teaching methodologies.

It is noteworthy that a significant proportion of pre-service mathematics teachers, approximately 77%, expressed a willingness to take courses on the use of AI technologies. In the same vein, Erol-Şahin (2024), in her study with pre-service history teachers, and Mart & Kaya (2024), in their study with pre-service preschool teachers, found that pre-service teachers were willing to do practical activities and take courses on the use of AI technologies. The results of the present study demonstrate that teacher candidates who wish to undertake courses on the utilisation of AI technologies exhibit a greater degree of AI readiness in comparison with those who do not intend to do so. At this point, teacher candidates' desire to take courses on the use of AI may be reflected in their readiness to use AI due to their higher motivation in this regard. Pre-service mathematics teachers who demonstrate a consistent engagement with developments in the field of AI technologies have been found to exhibit higher levels of AI readiness and AI literacy in comparison to those who do not engage with this subject matter. In a similar vein, the research conducted by Banaz & Maden (2024) on Turkish language teacher candidates revealed that those who consistently monitor developments in AI possess a higher level of AI literacy. This finding lends further support to our initial hypothesis. Furthermore, it was determined that the attitudes of pre-service teachers towards AI technologies are a variable that significantly affects AI readiness. In accordance with the assertions of Ayanwale et al. (2024b), prospective teachers must cultivate a positive attitude towards AI in order to derive benefit from AI technologies in the context of their future education. In line with this, the results of our study highlighted that teacher candidates with positive-hopeful attitudes towards AI technologies have higher AI readiness than those with negative attitudes.

One of the most remarkable findings of our study is the identification of a strong positive relationship between AI literacy and AI readiness. It can thus be concluded that as AI literacy increases, AI readiness also increases as well. In a study conducted with medical school students, Laupichler et al. (2022) found that a course aimed at enhancing AI literacy skills exhibited a significant impact on students' AI readiness. In this sense, it can be considered that this finding is parallel to the relevant finding of our study. In last but not least, AI literacy was found to predict approximately 55% of AI readiness. This finding was further substantiated by Cruz et al. (2024). In a study conducted with an audience of healthcare students, Cruz et al. (2024) revealed that both students' knowledge about AI applications in this field and positive attitudes towards AI predicted their AI readiness.

Conclusion and Recommendations

It was concluded that there is a high level of positive significant relationship between primary pre-service mathematics teachers AI readiness and AI literacy. It is recommended that teacher candidates augment their AI literacy through dedicated courses or lessons, initiated during their undergraduate studies, in order to ensure preparedness for AI-assisted pedagogical practices upon the commencement of their professional journeys. Moreover, it has been demonstrated that AI literacy is a contributing factor to AI readiness, predicting about 55% of AI readiness. It is suggested that further research may be conducted in order to ascertain additional factors that can be used to predict AI readiness. Similar analyses can be carried out for other branches other than mathematics. In addition to pre-service teachers, it is possible to conduct similar research with in-service teachers. Moreover, qualitative research methodologies can be employed to elicit more exhaustive information.

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