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The Relationship Between Pre-Service Teachers' Digital Technology Competencies and Their Attitudes Towards Artificial Intelligence

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Annotation. This quantitative study examines the relationship between pre-service teachers' digital technology competencies and their attitudes toward artificial intelligence (AI). Data were collected from 260 participants using relevant scales. Results indicate a significant positive relationship between digital competencies and AI attitudes, highlighting the importance of digital training in teacher education.

Keywords: *digital technology competence, artificial intelligence, attitude, pre-service teachers.*

Introduction

The 21st century has been a period of fundamental changes in education systems because of the rapid development of information and communication technologies. This digital transformation process has reshaped educational institutions not only in

terms of tools but also in pedagogical, administrative, and structural aspects. Digital technology competence, which is one of the key aspects of digitalization, refers to individuals' ability to use technology in a conscious, ethical, and effective manner, which also supports cognitive competencies including access to information, problem solving, and analytical thinking, and stands out as an important element that increases success and effectiveness in education (İmamoğlu et al., 2024; Karakuş & Ocak, 2019), as well as in broader school processes such as decision-making, leadership, and school culture (Aksakal et al., 2024; Uyak et al., 2024; Küçükkara et al., 2024).

The integration of teachers into the process plays a vital role in the success of digital transformation in education. Specifically, the interests, attitudes, and proficiency of the pre-service teachers in digital technologies are key determinants of the quality of future classroom practices (Tutar et al., 2024; Yurtsever, 2024). In fact, higher education institutions are now working to enhance the digital literacy and the self-efficacy of both the instructors and the pre-service teachers through integrating digital pedagogical content into the curriculum (Gömükpınar, 2022).

In this regard, it is important to examine both the digital technology competencies of the pre-service teachers and their attitudes toward AI. As these factors do more than simply influence one another, they affect the quality of the professional practices as well (Coşkun, 2024; Aydın et al., 2025). Research shows that as AI literacy levels increase, attitudes toward these technologies become more positive. On the other hand, knowledge gaps, lack of hands-on experience, and ethical concerns result in resistance toward AI (Erdoğdu & Çakır, 2024; Sarıkaya & Kavan, 2024).

Digital Technology Competence

Digital technology competence refers to the ability of individuals and institutions to use digital tools effectively, securely, and ethically. This competence goes beyond mere technical skills, and it also includes a critical approach to technology along with awareness of digital ethics and security. The impact of digital competencies on work performance increases efficiency and productivity by ensuring the correct use of digital tools in the workplace. In fact, as individuals' digital competence levels increase, their capacities for problem-solving, accessing information, and analysis also improve. In this sense, digital technology competence facilitates individuals' integration into digital transformation processes and plays a crucial role in achieving organizational goals (İmamoğlu et al., 2024).

Developing digital competencies in education enables individuals to be more effective in lifelong learning processes. Particularly, when the digital literacy and self-efficacy of the pre-service teachers are improved, the application of contemporary teaching methods enhances. The pedagogical use of digital tools is essential for students to become active individuals in the digital world (Karakuş & Ocak, 2019). These competencies involve more than just technical use as they also include social aspects such

as digital ethics, information security, and digital rights and responsibilities. Digital competence scales have become an important tool for assessing the digital skill levels of both institutions and individuals. Conducting validity and reliability analyses of these scales contributes to defining digital transformation strategies, especially at the institutional level. Accordingly, digital technology competence is becoming a necessity for following the dynamics of the digital age (Tutar et al., 2024).

The concept of digital technology competence has become a fundamental necessity in today's rapidly changing information society for enhancing the competitiveness of individuals and institutions and ensuring sustainable digital development. Especially through digital platforms, including Education Information Network (EBA), the digital maturity levels of the educational institutions and their initiatives toward digital transformation are supported in Türkiye. This situation contributes to increasing the ability of both teachers and students to use digital tools effectively. It becomes possible for individuals to improve their digital technology competence as the digital transformation capacity of the educational institutions increases (Yurtsever, 2024).

At the higher education level, digital transformation leads to the restructuring of content design and delivery methods. This process accelerates the transition from the information age to the digital society and necessitates the acquisition of next-generation skills, particularly digital literacy. The digital pedagogical competence of faculty members directly affects learning outcomes. In this context, digital transformation entails not just technical adaptation but also cultural and structural change (Gömükpınar, 2022). Furthermore, digital competencies are just as crucial when it comes to the digital transformation strategies of local governments and public institutions. As these institutions become more competent in the effective use of digital technologies, the ability to provide more accessible and efficient services to citizens is enabled. Elements such as digital security, data protection, and the development of user-friendly interfaces become prominent during this process. Digital competencies enhance problem-solving capacities of the institutions regarding the problems faced during digitalization (Kahraman & Özen, 2025).

Artificial Intelligence Concept and Its Use in Education

Artificial intelligence (AI) technologies have been discussed increasingly in the field of education recently (Abid et al., 2019; Chao et al., 2021; Challen et al., 2019; Chounta et al., 2022; Çolak-Yazıcı, 2023; dos Santos et al., 2019; Eagly & Chaiken, 1993; Galindo-Domínguez, 2024; Han et al., 2020; Jiang et al., 2017; Kim, 2023; Kong, 2021; McCarthy, 2007; McGrath, 2023; Ngo et al., 2021; Pokrivcakova, 2023; Russell & Norvig, 2021) as well as in the field of implementing digital solutions in education (Holmes, Bialik, & Fadel, 2019). With the help of diverse applications such as the design of individualized learning environments, automated assessment systems, and adaptive teaching tools, AI technologies make teaching processes more flexible,

data-driven, and student-centered (Gencer & Gencer, 2024; İşler & Kılıç, 2021). However, applying these technologies in educational settings also results in ethical, social, and psychological concerns. Issues such as data security, algorithmic biases, and the pedagogical implications of human-AI interaction play a definitive role in shaping individual attitudes toward AI (Çetin & Aktaş, 2021; Köksalan et al., 2024).

Artificial intelligence encompasses the development of systems that mimic human abilities, including thinking, learning, and problem-solving. With the use of this technology in the field of education, various areas of application stand out, such as adaptive teaching systems, automated assessment tools, teacher support systems, and especially personalized learning. By analyzing learners' needs, these AI-supported learning systems provide personalized solutions, making learning more effective. In Türkiye, AI-based solutions are also being developed at universities and in educational platforms (İşler & Kılıç, 2021).

In the medical education field at the university level, there are actions regarding the integration of AI-based course content into the education program. The inclusion of courses such as health informatics, AI algorithms, and data analysis in the field of medical education is considered an important development to make future physicians compatible with digital transformation. The research conducted in Türkiye showed that such courses are not widespread, although they are expected to find a greater place in the future (Gencer & Gencer, 2024).

On the other hand, artificial intelligence applications in education not only offer opportunities but also cause certain threats. Especially threats regarding ethical concerns, data privacy, and algorithmic biases need to be addressed carefully. In this context, establishing a legal and pedagogical framework that ensures the correct, safe, and ethical use of these technologies is as crucial as the development of the AI-supported educational technologies (Çetin & Aktaş, 2021).

When studies on artificial intelligence are examined, many examples of the pedagogical use of this technology are presented, especially in mathematics teaching. In this context, AI undertakes critical functions, including tracking students' individual development and providing error-based feedback. This way, it is observed that the instructional process has become more interactive and data-driven for both students and teachers (Duralar, 2020).

The integration of AI technologies into strategic management processes is also effective in shaping education policies. Public institutions and universities, particularly, started the process of integrating data analytics and AI-based decision-making mechanisms into educational processes within the scope of digital transformation. This transformation is considered one of the stepping stones in achieving Türkiye's aim of being an information society (Karahancer, 2024).

Prospective Teachers' Attitudes Towards Technology

Pre-service teachers' attitudes towards technology play a critical role in the digitalization of contemporary education systems. These attitudes are decisive in determining whether pre-service teachers adopt and effectively utilize technology in the teaching process. Research indicates that pre-service teachers with positive attitudes tend to use technological applications in the classroom more frequently and effectively (Kaymak & Titrek, 2021).

It has been found in the studies conducted specifically in the field of pre-service classroom teachers that the attitudes towards education technologies are closely related to pre-service teachers' beliefs in their self-efficacy regarding computers. Nonetheless, it is also stated that these attitudes represent only a limited portion of their self-efficacy beliefs, which suggests that pedagogical and affective competencies also influence the use of technology, in addition to technological skills. The quality of the education provided in the field of technology in the education faculties shapes these attitudes (Polat & Karakuş, 2020).

The attitudes of the pre-service teachers regarding technology reflect their individual tendency as well as their pedagogical proficiency, which determine the extent to which pre-service teachers will integrate technology into educational settings and the strategies they will adopt. In addition to individual differences, variables such as access to technological equipment, frequency of internet use, and experience with digital tools significantly affect pre-service teachers' attitudes. Research shows that increased internet usage is associated with more positive attitudes towards technology (Çetin et al., 2012).

Perceptions of technology integration also shape these attitudes. The perspectives of computer science teachers and pre-service teachers regarding technology integration differ in terms of school policies, administrative support, and existing infrastructure. This underscores the need for systematic support mechanisms to facilitate the adoption of technological innovations in educational environments (Çakır & Yıldırım, 2009).

Significant relationships have been found between pre-service teachers' problem-solving skills, metacognitive awareness levels, and their attitudes towards technology. In these studies, it is presented that individuals with higher self-awareness and better problem-solving skills adopt more flexible and positive attitudes toward digital tools, which suggests that teacher education programs should be structured in a way that they can be comprehensive enough to include both cognitive and affective skills without being restricted to only technological knowledge (Bakioğlu et al., 2015).

Attitudes Towards Artificial Intelligence

Many studies have covered the topic of artificial intelligence (AI) in recent years in the field of education, several of them investigated the teachers' levels of AI competency

and their attitudes toward technology and AI use as well (Aydın et al., 2025; Büyük & Çetingüney, 2025; Coşkun, 2024; Erdoğdu & Çakır, 2024; Sarıkaya & Kavan, 2024).

With digital transformation, knowing about the pre-service teachers' digital technology proficiency and their attitudes toward AI has become a key element that contemporary education systems now require. Digital technology competence refers to the degree to which pre-service teachers can use information and communication technologies effectively, consciously, and ethically in their teaching processes. This competence, however, does not only limit itself to technical knowledge but also covers topics such as pedagogical integration skills and ethical sensitivity. Especially the fact that now AI-based tools are getting integrated into the field of education more than ever, it is highly important to learn more about the pre-service teachers' attitudes toward these technologies (Coşkun, 2024).

It has been stated in several studies that the pre-service teachers' perceptions of AI highly influence their purpose of using technology, their ethical concerns, and their perceptions of their professional competence in general. Consequently, when they have a positive attitude, it is more likely that they'll become more open and feel more productive when using these technologies. On the other hand, for this attitude to improve, it is important to integrate AI-related awareness-raising activities into the curriculum, as well as digital literacy (Büyük & Çetingüney, 2024). It has been found that there is a significant relationship between the pre-service teachers' attitudes toward changes and their concerns related to AI. Those individuals with resistance to technology have higher anxiety levels when it comes to AI. This shows that the psychological readiness of the teachers is also important in teacher education in the process of digital transformation (Sayılı & Akman, 2025).

Research also states that the positive attitudes of the pre-service teachers develops parallelly with their level of digital literacy. It was observed in a study conducted on the Turkish Language pre-service teachers that as these teachers' knowledge about AI increases, their trust in these technologies and the possibility of them using these technologies in education also increases. This shows that the pre-service teachers not only need the information but also need their participation in this digital transformation process to be strengthened (Sarıkaya & Kavan, 2024).

On the other hand, the pre-service teacher's concerns about AI are shaped by ethical concerns and topics such as changes in professional roles. For example, the use of humanoid robots and AI-supported learning systems may trigger anxieties described as "Frankenstein syndrome" in some individuals. These kinds of emotional responses show that in the recognition of technological innovations, it is important to take affective factors into consideration as well as cognitive competence (Köksalan et al., 2024).

Additionally, a key factor in pre-service teachers' digitalization process is their overall attitudes toward technology. More frequent and efficient use of technology in the classroom is linked to positive attitudes (Kaymak & Titrek, 2021). Computer self-efficacy

views, pedagogical and affective competences, access to technology, internet usage frequency, and prior experience with digital tools all have an impact on attitudes on educational technology (Çetin et al., 2012; Polat & Karakuş, 2020). In addition, it has been discovered that more adaptable and constructive approaches to digital tools are correlated with problem-solving abilities and metacognitive awareness, highlighting the necessity of teacher education programs that address cognitive and affective skills in addition to technological knowledge (Bakioğlu et al., 2015).

This literature makes it clear that pre-service teachers' perspectives on digital technology and AI, which are becoming more and more significant in today's world, are gaining scientific attention. Pre-service teachers are the first professional role models that students encounter, and their views on technology and AI may significantly influence students' perceptions and adoption of these innovations. Therefore, examining attitudes towards digital technologies and AI constitutes a crucial research topic.

Accordingly, the following research hypotheses are the focus of this study:

H_1: There is a significant difference in pre-service teachers' digital technology competencies and attitudes towards AI according to their gender.

H_2: There is a significant difference in pre-service teachers' digital technology competencies and AI attitudes according to their mother's education level.

H_3: There is a significant difference in pre-service teachers' digital technology competencies and AI attitudes according to their father's education level.

H_4: There is a significant difference in pre-service teachers' digital technology competencies and AI attitudes according to their departments of education.

H_5: There is a significant correlation between pre-service teachers' digital technology competencies and AI attitudes.

H_6: Pre-service teachers' digital technology competencies significantly predict their AI competency scores.

Methodology & Data Analysis

The purpose of this study was to investigate the connection between pre-service teachers' digital technology competencies and their attitudes towards artificial intelligence (AI) and to determine whether significant differences exist according to various demographic variables, including gender, parental education level, and department of study. The research was designed using a correlational survey model, one of the quantitative research approaches. Additionally, since comparisons were made between groups based on demographic variables, the causal-comparative model was also employed. The study group consisted of 260 pre-service teachers from various fields in

Türkiye during the 2024–2025 academic year. Participants were enrolled in the departments of preschool teaching, classroom teaching, Turkish language education, social studies education, science education, special education, guidance and psychological counseling, English education, and elementary mathematics teaching. The study was approved by the Ethics Committee of Sakarya University (Date: April 3, 2024; Approval No: 30/37). Data were collected using two scales: the Digital Technology Competencies Scale and the Attitudes Towards Artificial Intelligence Scale. The Digital Technology Competencies Scale was developed to measure individuals' competencies in using technology and demonstrated a great level of internal coherence. The data were normally distributed, and the Cronbach's Alpha coefficients were calculated as .946 and .947 for the standardized items, indicating excellent reliability. The Attitudes Towards Artificial Intelligence Scale was used to assess pre-service teachers' attitudes towards AI applications. The Cronbach's Alpha coefficients were .832 and .838 for standardized items, showing high reliability. According to widely accepted criteria, Cronbach's Alpha values above 0.70 indicate acceptable reliability, while values above 0.90 are considered excellent. In this context, both scales demonstrated strong internal consistency, confirming that the items reliably measure the intended constructs. Data were analyzed using SPSS 25.0. First, reliability analyses (Cronbach's Alpha) were conducted to assess the internal consistency of the scales. The results confirmed that both scales are highly reliable and suitable for further statistical analyses.

Findings

In this section, the findings related to preservice teachers' digital technology competencies and attitudes towards artificial intelligence are tabulated and interpreted based on the hypothesis.

Table 1

Independent Samples t-test Results Comparing Prospective Teachers' Digital Technology Competencies and Attitudes Toward AI Scores by Gender

Variable	Gender	n	$\bar{X}$	SD	df	t	p
Digital technology competencies	Women	196	68.64	13.55	258	-0.26	.083
	Men	64	69.13	9.88	146.33		
Attitudes toward artificial intelligence	Women	196	69.19	7.97	258	-2.13	.788
	Men	64	71.59	7.42	114.18		

Based on Table 1, the mean score of female participants is lower than ($\bar{X}$ = 68.64; SD = 13.55), male participants ($\bar{X}$ = 69.13; SD = 9.88; $t_{(258)}$ = -0.26). Since the *p* value

is greater than .05, there was no statistically significant difference between genders in terms of digital technology competencies. Regarding attitudes toward AI, the mean score of female participants is lower ($\bar{X}$ = 69.19; SD = 7.97), male participants ($\bar{X}$ = 71.59; SD = 7.42; $t_{(258)}$ = -2.13) either. Based on these data, it can be concluded that pre-service teachers' opinions do not significantly change based on the gender variable.

Table 2

ANOVA Results Comparing Preservice Teachers' Digital Technology Competencies and Attitudes Toward AI by Mother's Education Level

Variable	Mother's Education Level	N	$\bar{X}$	SD	df	F	p
Digital technology competencies	Primary school	131	67.47	13.28	3, 256	1.18	.317
	Middle school	55	70.13	12.33			
	High school	52	70.90	10.03			
	University	22	68.00	15.62			
Total	—	260	68.76	12.73			
Attitudes toward artificial intelligence	Primary school	131	68.89	8.24	3, 259	1.18	.317
	Middle school	55	70.98	6.63			
	High school	52	70.60	7.97			
	University	22	70.18	8.39			
Total	—	260	69.78	7.90			

Based on the results presented in Table 2, a one-way analysis of variance (ANOVA) was performed to find out whether preservice teachers' digital technology competency scores and attitudes toward AI differed according to their mothers' education levels. When the digital technology competency scores were examined, the mean scores according to the mother's education level were $\bar{X}$ = 67.47 for the primary school group, $\bar{X}$ = 70.13 for the middle school group, $\bar{X}$ = 70.90 for the high school group, and $\bar{X}$ = 68.00 for the university group. However, these differences were not statistically significant, $F_{(3, 256)}$ = 1.18, p = .317. This indicates that preservice teachers' digital technology competency levels did not vary significantly according to their mothers' education levels. Similarly, in terms of attitudes toward AI, the mean scores were $\bar{X}$ = 68.89 for the primary school group, 70.98 for the middle school group, $\bar{X}$ = 70.60 for the high school group, and 70.18 for the university group. Again, there was no discernible statistical difference among these groups, $F_{(3, 259)}$ = 1.18, p = .317. The p-values obtained in both analyses were well above the .05 significance level, demonstrating that the groups' differences were not statistically significant.

Table 3

ANOVA Results Comparing Preservice Teachers' Digital Technology Competencies and Attitudes Toward AI by Father's Education Level

Variable	Father's Education Level	N	$\bar{X}$	SD	df	F	p
Digital technology competencies	Primary school	74	66.07	13.22	3, 256	1.93	.125
	Middle school	52	69.06	11.03			
	High school	95	69.49	12.25			
	University	39	71.69	14.48			
Total	—	260	68.76	12.73			
Attitudes toward artificial intelligence	Primary school	74	68.76	6.95	3, 259	0.89	.446
	Middle school	52	70.67	8.06			
	High school	95	69.65	8.20			
	University	39	70.87	8.62			
Total	—	260	69.78	7.90			

Based on Table 3, a one-way analysis of variance (ANOVA) was performed to understand whether pre-service teachers' digital technology competency and attitudes toward AI scores differed significantly according to their fathers' education levels. Fathers' education levels were categorized into four groups: primary school, middle school, high school, and university. For digital technology competency scores, the mean scores according to fathers' education levels were $\bar{X}$ = 66.07 for primary school, $\bar{X}$ = 69.06 for middle school, $\bar{X}$ = 69.49 for high school, and $\bar{X}$ = 71.69 for university. Although a partial upward trend was observed across groups, the difference was not statistically significant, $F_{(3, 256)} = 1.93$, $p = .125$. This indicates that fathers' education level does not have a determining effect on the digital technology competency levels of preservice teachers. Regarding attitudes toward artificial intelligence, the mean scores were $\bar{X}$ = 68.76 for primary school, $\bar{X}$ = 70.67 for middle school, $\bar{X}$ = 69.65 for high school, and $\bar{X}$ = 70.87 for university. However, these differences were not statistically significant, $F_{(3, 259)} = 0.89$, $p = .446$. The fact that the p-values obtained are above the .05 significance level indicates that the observed group differences may be the result of chance rather than being statistically significant.

Based on the results presented in Table 4, a one-way analysis of variance (ANOVA) was performed to understand whether preservice teachers' digital technology competencies and attitudes toward AI differed based on their academic fields. The analysis included nine departments: Preschool Education, Primary Teaching, Elementary Mathematics, Social Studies, Science, Turkish, Guidance and Psychological Counseling (PDR), English, and Special Education.

Table 4

One-way ANOVA Results of Preservice Teachers' Digital Technology Competencies and Attitudes Toward AI by the Department of Education

Variable	Department of Education	n	$\bar{X}$	SD	df	F	p
Digital technology competencies	Preschool education	29	69.17	16.36	8, 251	1.15	.331
	Primary teaching	39	69.74	8.33			
	Elementary mathematics	34	73.06	14.73			
	Social studies education	24	64.88	15.62			
	Science education	31	68.74	9.92			
	Turkish language education	19	69.05	15.03			
	Guidance and psychological counseling (PDR)	32	67.59	14.69			
	English language education	10	72.40	6.45			
	Special education	42	66.21	9.26			
Total	—	260	68.76	12.73			
Attitudes toward artificial intelligence	Preschool education	29	71.62	7.94	8, 251	2.56	.011
	Primary teaching	39	68.77	7.19			
	Elementary mathematics	34	71.44	8.02			
	Social studies education	24	70.33	9.05			
	Science education	31	69.23	8.21			
	Turkish language education	19	69.05	7.92			
	Guidance and psychological counseling (PDR)	32	67.94	8.15			
	English language education	10	78.20	6.86			
	Special education	42	67.95	6.16			
Total	—	260	69.78	7.90			

In the digital technology competencies dimension, the mean scores differed slightly among departments. The group with the highest mean was Elementary Mathematics Teacher Education ($\bar{X}$ = 73.06), while the lowest mean was observed in Social Studies Teacher Education ($\bar{X}$ = 64.88). However, these differences were not statistically significant, $F_{(8, 251)} = 1.15$, $p = .331$. This indicates that preservice teachers' digital technology competencies do not differ significantly according to their departments. In contrast, the findings regarding the attitudes toward artificial intelligence dimension revealed a statistically significant difference among departments, $F_{(8, 251)} = 2.56$, $p = .011$. Since this p-value is below the .05 significance level, it indicates that the Department of Education has an effect on attitudes toward artificial intelligence. According to the mean scores, the highest attitude levels were found in English Language Teaching ($\bar{X}$ = 78.20), followed by Preschool Education ($\bar{X}$ = 71.62) and Elementary Mathematics Education

($\bar{X}$ = 71.44). The lowest mean scores belonged to the Guidance and Psychological Counseling ($\bar{X}$ = 67.94) and Special Education ($\bar{X}$ = 67.95) departments.

Table 5

Correlation Analysis Between Preservice Teachers' Digital Technology Competencies and Attitudes Toward AI

Variable	1	2
Digital technology competencies	—	.307**
Attitudes toward artificial intelligence	.307**	—

In table 5, the relationship between preservice teachers' digital technology competencies (DTEC) and their attitudes toward artificial intelligence (ATAI) is presented. A Pearson correlation analysis was performed using a statistic programme to determine the direction and strength of the relationship between the two variables. The results indicate a positive and significant relationship between digital technology competencies (DTEC) and attitudes toward artificial intelligence (ATAI), $r = .31$, $p < .01$. *

This correlation coefficient suggests a moderate positive relationship between the two variables. In other words, as preservice teachers' levels of digital technology competence increase, their attitudes toward artificial intelligence also tend to improve. This finding indicates that preservice teachers' technological competence levels are closely related to their attitudes toward contemporary educational technologies, particularly artificial intelligence–based applications. The *p*-value of .000 indicates that this result is highly statistically significant.

Table 6

Regression Analysis Results Between Preservice Teachers' Digital Technology Competencies and Attitudes Toward AI

Model	R	R^2	Adjusted R^2	Std. Error of the Estimate
1	.307	.094	.091	12.14

Based on the regression analysis results presented in Table 6, the multiple correlation coefficient (*R*) of the regression model was found to be .31. This value indicates a positive and moderate relationship between the independent variable (digital technology competencies) and the dependent variable (attitudes toward artificial intelligence). The coefficient of determination (R^2) of the model is .094, meaning that digital technology competencies explain approximately 9.4% of the variance in attitudes toward artificial intelligence. The remaining 90.6% of the variance can be attributed to other factors not included in the model or random variation. The adjusted coefficient of determination

(Adjusted R^2) was calculated as .091. This value corrects R^2 by accounting for the number of independent variables and the sample size. The similarity between R^2 and Adjusted R^2 indicates that the model provides an acceptable fit to the data. Finally, the standard error of the estimate was 12.14, showing the average prediction error of the model in estimating attitudes toward artificial intelligence. A lower standard error value would indicate more accurate model predictions.

Discussion

In this study, the relationship between pre-service teachers' digital technology competencies (DTEC) and their attitudes towards artificial intelligence (AI) was examined, with particular attention to the gender variable. The results showed that male participants had significantly higher attitudes toward AI, although there was no significant gender difference in digital technological competencies. When compared to earlier studies, these findings are both consistent and inconsistent. For example, pre-service preschool teachers' opinions regarding AI and AI literacy were found to be significantly positively correlated by Mart and Kaya (2024). This result suggests that a greater positive opinion about AI is associated with higher technological proficiency and awareness. However, gender disparities were not thoroughly examined in their study. Similar to this, Akman and Akman (2025) discovered that education faculty students' sentiment regarding AI was generally favorable, although they did not find any discernible gender disparities. Contrary to their findings, our study revealed that male participants had more positive sentiments toward AI.

Results from other research are inconsistent. For example, our findings of digital competencies are consistent with those of Köroğlu and Kana (2024), who found no significant gender differences in pre-service teachers' views about digitalization, which aligns with our findings and supports that the access and the use of digital technologies can reduce the gender gaps in society. On the other hand, Sarıkaya and Kavan (2024) discovered that male Turkish Language pre-service teachers' attitudes toward AI change positively based on gender, which supports our study's findings. Additionally, according to Coşkun (2024), pre-service teachers' views about AI are influenced by their digital competencies, and it is crucial to include technical advancements into these attitudes. Similarly, Güler, Uğur. And Güler (2025) discovered that views on the use of AI technologies in educational settings are directly impacted by AI awareness in teacher education.

In our research findings, there is no significant difference between pre-service teachers' gender and their digital technological competence, which might be because of the widespread use of digital tools and the waning impact of conventional gender roles. Conversely, the reason why male pre-service teachers have more positive attitude

toward AI might be related to cognitive inclinations, personal interests in technology, and societal expectations. All things considered, these results add to the body of literature by offering both corroborating and clarifying information.

Additionally, the study verified that opinions toward AI and DTEC are positively and significantly correlated. AI-based educational systems are generally seen more favorable by pre-service teachers who believe they are digitally competent, which shows that both technical and pedagogical perspectives are impacted by the digitalization of modern learning settings. The results are consistent with those of Mart and Kaya (2024), who found that pre-service preschool teachers' attitudes and AI literacy were positively correlated. Additionally, Prakasha and Sanskriti (2025) discovered a positive correlation between faculty members' opinions about AI and their ability to integrate technology. Moroever, Karacaoğlu (2025) research results suggest that teacher competencies in AI usage are multifaceted, covering a wide range of areas including educational technology, personalization, assessment, and collaboration. These competencies are crucial for teachers to enhance their professional development and provide more effective education to students.

Mart and Kaya (2024) observed that self-efficacy ideas about technology exhibited only minimal connections with attitudes, despite the fact that digital competencies play a crucial role. This implies that opinions toward AI are also influenced by other elements, such as individual variations, pedagogical beliefs, and educational background. The moderate correlation found in our research is comparatively substantial when compared to earlier studies, highlighting the significance of digital capabilities in teacher training programs. Technology-focused courses in education faculties seem to alter pre-service teachers' cognitive and affective aspects in addition to their competence development.

Finally, the study looked at whether parental education levels and academic department affected attitudes toward DTEC and AI. Neither the father's nor the mother's level of education was shown to be significantly different. However, opinions toward AI varied greatly by academic department, indicating that personal experiences and educational setting have a bigger influence than family history. This is consistent with Çete's (2023) findings that digital literacy and technology use abilities are not directly impacted by parental education. These results emphasize how crucial it is to incorporate digital pedagogical content into teacher preparation programs in order to improve attitudes and knowledge. Benli et al. (2025) propose that human-centered artificial intelligence design is an approach that ensures technology supports human well-being, dignity, and autonomy. Within this framework, artificial intelligence systems should be viewed not as solutions that eliminate ultimate authority, but as tools that support human judgment. From this perspective, it can be argued that schools should incorporate the perspectives of their employees into technology design processes and build systems around student needs.

Conclusion

In conclusion, the results show that pre-service teachers have complicated and occasionally contradictory opinions about the use of artificial intelligence (AI) in the classroom. There is an acknowledgement of the advantages AI can provide, such as improved efficiency, tailored learning, and less work for teachers, even as many worry about possible hazards, such as decreased human interaction, decreased student effort, and diminished learning retention. Improving AI literacy among educators and students, incorporating AI-related knowledge into the curriculum, creating national initiatives, and putting in place ethical supervision systems are all essential to maximizing these advantages while reducing the risks. Given that these perceptions are likely to shape future educational practices, teacher education programs must prioritize comprehensive and critical training on the pedagogical integration of AI.

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References

Abid, S., Khan, M. A., Shah, S., & Ali, B. (2019). Artificial intelligence: Medical students' attitude in district Peshawar, Pakistan. *Pakistan Journal of Public Health, 9*(1), 19–21. https://doi.org/10.32413/pjph.v9i1.295

Akman, G. İ., & Akman, Y. (2025). Educational beliefs and artificial intelligence: A study on the perceptions of education faculty students. *Journal of Western Anatolia Educational Sciences, 16*(1), 911–928. https://doi.org/10.51460/baebd.1601530

Aksakal, Ş., Emre, İ., & Özbek, M. (2024). Determining classroom teachers' attitudes toward artificial intelligence. *Journal of New Approaches in Education, 7*(1), 1–13.

Aydın, İ. E., Çalışkan, H., & Usta, İ. (2025). Determination of the usage areas of artificial intelligence–supported applications in open and distance learning. *Turkish Journal of Educational Sciences, 23*(1), 666–697. https://doi.org/10.37217/tebd.1576430

Bakioğlu, B., Alkış Küçükaydın, M., & Karamustafaoğlu, O. (2015). Examining the level of metacognitive awareness, problem-solving skills, and technology attitudes of pre-service teachers. *Trakya University Journal of Faculty of Education, 5*(1), 22–33.

Benli, F., Titrek, O., Öner, M., & Benli, A. (2025). Üniversite öğrencilerinin yapay zekâya yönelik tutumlari: Sakarya üniversitesi örneği [University students' attitudes toward artificial intelligence: The case of Sakarya University]. In T. Yılmaz & E. Çetinkaya (Eds.), *Yapay Zeka Çağında Toplum, Yönetim ve Çalışma* [*Society, governance, and work in the age of artificial intelligence*]. Berikan Publishing.

Büyük, U., & Çetingüney, H. (2025). Teachers' self-efficacy beliefs towards the use of artificial intelligence in education: A validity and reliability study. *West Anatolian Journal of Educational Sciences, 16*(1), 1422–1445. https://doi.org/10.51460/baebd.1602705

Coşkun, B. (2024). Prospective teachers' perceptions of artificial intelligence and reflections on the use of artificial intelligence in education. *Cappadocia Journal of Education, 5*(2), 439–456. https://doi.org/10.69643/kaped.1566047

Challen, R., Denny, J., Pitt, M., Gompels, L., Edwards, T., & Tsaneva-Atanasova, K. (2019). Artificial intelligence, bias and clinical safety. *BMJ Quality & Safety, 28*(3), 231–237. https://doi.org/10.1136/bmjqs-2018-008370

Chao, P.-J., Hsu, T.-H., Liu, T.-P., & Cheng, Y.-H. (2021). Knowledge of and competence in artificial intelligence: Perspectives of Vietnamese digitalnative students. *IEEE Access, 9*, 75751–75760. https://doi.org/10.1109/ACCESS.2021.3081749

Chen, L., Chen, P., & Lin, Z. (2020). Artificial intelligence in education: A review. *Ieee Access*, *8*, 75264–75278. https://doi.org/10.1109/ACCESS.2020.2988510

Chounta, I. A., Bardone, E., Raudsep, A., & Pedaste, M. (2022). Exploring teachers' perceptions of artificial intelligence as a tool to support their practice in Estonian K-12 education. *International Journal of Artificial Intelligence in Education*, 32(3), 725–755. http://dx.doi.org/10.1007/s40593021-00243-5

Çolak Yazıcı, S., & Erkoç, M. (2023). Analysis of sciencegroup teachers' use of artificial intelligence in the distance education process. *Dokuz Eylül University Buca Faculty of Education Journal, (58)*, 2682–2704. https://doi.org/10.53444/deubefd.1316144

Çakır, R., & Yıldırım, S. (2009). What do computer teachers think about the factors affecting technology integration in schools? *Ilkögretim Online, 8*(3), 952–964.

Çete, A. E. (2023). Investigation of Turkish teachers' self-efficacy and attitudes towards digital reading in terms of various variables: Bursa province example (Unpublished master's thesis). Bursa Uludağ University.

Çetin, M., & Aktaş, A. (2021). Artificial intelligence and future scenarios in education. *OPUS International Journal of Society Researches, 18*(Special Issue of Educational Sciences), 4225–4268. https://doi.org/10.26466/opus.911444

Çetin, O., Çalışkan, E., & Menzi, N. (2012). The relationship between technological competencies and attitudes of preservice teachers towards technology. *İlköğretim Online, 11*(2), 273–291.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly, 13*(3), 319–340. https://doi.org/10.2307/249008

Dos Santos, D. P., Koenigkam-Santos, M., & Gallas, B. D. (2019). Medical students' attitude towards artificial intelligence: A multicentre survey. *European Radiology, 29*(4), 1640–1646. https://doi.org/10.1007/s00330-018-5601-1

Dörterler, Ö., Polat, Ö., & Yağcı, M. (2024). Examining the relationship between preschool teachers' self-efficacy beliefs and their beliefs about educational technologies. *Iğdır University Journal of Social Sciences, 35*, 197–217. https://doi.org/10.54600/igdirsosbilder.1389015

Duralar, B. (2024). *Artificial intelligence research in mathematics education: A systematic review* [Unpublished master's thesis]. Balıkesir University Institute of Science and Technology.

Eagly, A. H., & Chaiken, S. (1993). *The psychology of attitudes*. Harcourt Brace Jovanovich College Publishers.

Erdoğdu, F., & Çakır, Ö. (2024). Determination of prospective teachers' artificial intelligence literacy and their perceptions about artificial intelligence. *International Journal of Social Sciences in Turkish Cultural Geography, 9*(2), 63–95. https://doi.org/10.55107/turksosbilder.1594635

Fan, K. Y., Hu, R., & Singla, R. (2020). Introductory machine learning for medical students: A pilot. *Medical Education, 54*(11), 1042–1043. https://doi.org/10.1111/medu.14318

Galindo-Domínguez, H., Martínez-Sánchez, F., & López-Meneses, E. (2024). Relationship between teachers' digital competence and attitudes towards artificial intelligence in education. *International Journal of Educational Research, 126*, 102381. http://dx.doi.org/10.1016/j.ijer.2024.102381

Gencer, K., & Gencer, G. (2024). Investigation of the status of artificial intelligence courses in medical education curricula in Turkey. *Journal of Computer Science and Technology, 5*(2), 66–76. https://doi.org/10.54047/bibted.1520315

Gömükpınar, B. (2022). *Digital transformation in higher education institutions in Turkey* [Unpublished master's thesis]. National Thesis Center of YÖK.

Güler, E., Uğur, S., & Güler, C. (2025). Determination of faculty of education lecturers' awareness of generative artificial intelligence and suggestions for its use in teacher training. *Mehmet Akif Ersoy University Journal of Education Faculty, 74*, 618–647. https://doi.org/10.21764/maeuefd.1627851

Han, H.-J., Kim, K.-J., & Kwon, H.-S. (2020). The analysis of elementary school teachers' perception of using artificial intelligence in education. *Journal of Digital Convergence, 18*(7), 47–56. https://doi.org/10.14400/JDC.2020.18.7.047

Holmes, W., Bialik, M., & Fadel, C. (2019). *Artificial intelligence in education: Promises and implications for teaching and learning.* Center for Curriculum Redesign.

İmamoğlu Akman, G. İ., & Akman, Y. (2025). Educational beliefs and artificial intelligence: A study on the perceptions of education faculty students. *Journal of Western Anatolia Educational Sciences, 16*(1), 911–928. https://doi.org/10.51460/baebd.1601530

İmamoğlu, S. Z., Türkcan, H., & Toklucu, H. (2024). Determination of digital competence and psychological empowerment on job performance. *International Review of Economics and Management, 12*(2), 142–159. https://doi.org/10.18825/iremjournal.1588731

İşler, B., & Kılıç, M. (2021). Artificial intelligence usage and development in education. *New Media Electronic Journal, 5*(1), 1–11. https://doi.org/10.17932/IAU.EJNM.25480200.2021/ejnm_v5i1001

Jiang, F., Jiang, Y., Zhi, H., Dong, Y., Li, H., Ma, S., Wang, Y., Dong, Q., Shen, H., & Wang, Y. (2017). Artificial intelligence in healthcare: Past, present and future. *Stroke and Vascular Neurology, 2*(4), 230–243. https://doi.org/10.1136/svn-2017-000101

Kahraman, A., & Özen, Ü. (2025). Evaluation of information technologies and digital competencies in the process of digital transformation of local governments. *EKEV Akademi Dergisi, 101*, 404–427. https://doi.org/10.17753/sosekev.1584989

Karacaoğlu, Ö. C. (2025). Identifying and developing teachers' competencies in artificial intelligence-supported education. *International Journal on Lifelong Education and Leadership*, *11*(2), 53–61. https://doi.org/10.25233/ijlel.1761330

Karahançer, Y. Ö. D., & Yücel, Ş. (2024, July 19–21). Strategic management and artificial intelligence: Content analysis. *Proceedings of Bingöl 2nd International Conference on Social Sciences*, 1–10. Bingöl, Turkey.

Karakuş, G., & Ocak, G. (2019). An investigation of digital literacy selfefficacy skills of preservice teachers in terms of different variables. *Afyon Kocatepe University Journal of Social Sciences, 21*(1), 129–147. https://doi.org/10.32709/akusosbil.466549

Kaymak, E., & Titrek, O. (2021). Examining teachers' selfefficacy levels for adapting to technology. *Sakarya University Faculty of Education Journal (SUJEF), 21*(2), 104–134. https://doi.org/10.53629/sakaefd.910026

Kim, S.W. & Lee, Y. (2024). Investigation into the influence of socio-cultural factors on attitudes toward artificial intelligence. *Educational Information Technology, 29*, 9907–9935. https://doi.org/10.1007/s10639-02312172-y

Kong, S.-C., Cheung, W. M.-Y., & Zhang, G. (2021). Evaluation of an artificial intelligence literacy course for university students with diverse study backgrounds. *Computers and Education: Artificial Intelligence, 2*, 100026. https://doi.org/10.1016/j.caeai.2021.100026

Köksalan, B., Akpınar, B., & Akyıldız, T. Y. (2024). Analysis of teachers' views on the advantages and disadvantages of using humanoid robots in education (Frankenstein syndrome). *Electronic Journal of Social Sciences, 23*(92), 1394–1415. https://doi.org/10.17755/esosder.1483914

Köroğlu, A., & Kana, F. (2025). Turkish teacher candidates' views on the use of artificial intelligence in language teaching. *Journal of Bayburt Faculty of Education, 20*(45), 1–37. https://doi.org/10.35675/befdergi.1560034

Küçükkara, M. F., Ünal, M., & Sezer, T. (2024). Preschooleducation teachers' views on artificial intelligence. *Journal of Basic Education Research, 4*(1), 17–28. https://doi.org/10.55008/te-ad.1431142

Mart, M., & Kaya, G. (2024). Examining the relationship between preschool teacher candidates' attitudes toward artificial intelligence and artificial intelligence literacy. *Edutech Research, 2*(1), 91–109.

McCarthy, J. (2007). *What is artificial intelligence?* University of Nebraska – Lincoln. https://cse.unl.edu/~choueiry/S09-476-876/Documents/whatisai.pdf

McGrath, C., Cerratto Pargman, T., Juth, N., & Palmgren, P. J. (2023). University teachers' perceptions of responsibility and artificial intelligence in higher education — An experimental philosophical study. *Computers and Education: Artificial Intelligence, 4*, 100139. https://doi.org/10.1016/j.caeai.2023.100139

Ngo, B., Nguyen, D., & van Sonnenberg, E. (2021). Artificial intelligence: Has its time come for inclusion in medical school education? Maybe… Maybe not. *MedEdPublish, 10*, Article 3811. https://doi.org/10.15694/mep.2021.000131.2

Pokrivcakova, S. (2023). Pre-service teachers' attitudes towards artificial intelligence and its integration into EFL teaching and learning. *Journal of Language and Cultural Education, 11*(3), 100–114. http://dx.doi.org/10.2478/jolace-2023-0031

Polat, S., & Karakuş, F. (2020). Examination of pre-service teachers' attitudes and self-efficacy perceptions toward computer-assisted education. *Journal of International Education of Cumhuriyet, 9*(2), 579–592. https://doi.org/10.30703/cije.632437

Prakasha, G. S., Sanskriti, R., Ishani, B., & Thirumalesha, S. (2025). University teachers' attitudes toward artificial intelligence and their relationship with technology integration. *Pamukkale University Journal of Faculty of Education, 63*, 294–314. https://doi.org/10.9779/pauefd.1267071

Russell, S., & Norvig, P. (2021). *Artificial intelligence: A modern approach* (4th ed.). Pearson.

Sarıkaya, B., & Kavan, N. (2024). An investigation of Turkish teacher candidates' attitudes towards artificial intelligence. *Electronic Journal of Education Sciences, 13*(26), 191–203. https://doi.org/10.55605/ejedus.1550010

Sayılı, E. B., & Akman, Y. (2025). Investigation of the relationship between teachers' resistance to change perceptions and artificial intelligence anxiety. *Turkish Journal of Educational Sciences, 23*(1), 541–558. https://doi.org/10.37217/tebd.1577046

Tekin, N. (2023). Artificial intelligence in education: A content analysis on trends in research from Türkiye. *Necmettin Erbakan Üniversitesi Ereğli Eğitim Fakültesi Dergisi, 5* (Özel Sayı), 387–411. https://doi.org/10.51119/ereegf.2023.49

Tutar, H., Erdem, A. T., & Şahin, N. (2024). Corporate digital competence scale (CDSS): A scale development study. *Gümüşhane University Journal of Social Sciences, 15*(2), 498–516.

Uyak, S., Güngör Uyak, S., & Others. (2024). Artificial intelligence applications in preschool education institutions: Perspectives of administrators and teachers. *Social Mentality and Researcher Thinkers Journal (SMART Journal), 9*(75), 4625–4636. https://doi.org/10.29228/smryj.72414

Yurtsever, M., & Yurtsever, G. (2024). Digital maturity of schools in Turkey and digital transformation steps. *International Journal of Quest for Excellence in Qualitative Research in Education, 3*(2), 119–132.

Būsimųjų mokytojų skaitmeninių technologijų kompetencijų ryšys su jų nuostatomis į dirbtinį intelektą

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Santrauka

Šiame tyrime nagrinėjamas būsimų mokytojų skaitmeninių technologijų kompetencijų ryšys su jų nuostatomis į dirbtinį intelektą (toliau – DI). 2024–2025 akademiniais metais, taikant kiekybinį metodą ir pasitelkus koreliacinius bei priežastinius lyginamuosius modelius, buvo tiriami 260 būsimų mokytojų, atstovaujančių skirtingoms universiteto katedroms, atsakymai.

Duomenims rinkti naudotasi skaitmeninių technologijų kompetencijų ir nuostatų į DI skalėmis. Gauti rezultatai atskleidė statistiškai reikšmingą teigiamą ryšį tarp skaitmeninių kompetencijų ir nuostatų į DI, o tai leidžia daryti išvadą, kad aukštesnis būsimųjų mokytojų skaitmeninis raštingumas yra sietinas su teigiamomis nuostatomis į DI. Nors skaitmeninių kompetencijų srityje tarp lyčių nebuvo nustatyta statistiškai reikšmingų skirtumų, visgi būsimų mokytojų vyrų nuostatos į DI buvo teigiamesnes. Kita vertus, nebuvo pastebėta statistiškai reikšmingų skirtumų, kuriuos lemtų jų tėvų išsilavinimo lygis. Nors būsimų mokytojų skaitmeninės kompetencijos skirtinguose universiteto fakultetuose labai nesiskyrė, vis dėlto nuostatos į DI buvo skirtingos, aukštesni būsimų mokytojų balai nustatyti Anglų kalbos mokymo, Ikimokyklinio ugdymo ir Pradinio matematikos ugdymo fakultetuose. Taigi, iš tyrimo rezultatų matyti, kad skaitmeninių technologijų kompetencijų stiprinimas yra itin svarbu mokytojų rengimo programose.

Esminiai žodžiai: *skaitmeninių technologijų kompetencija, dirbtinis intelektas, nuostatos, būsimieji mokytojai.*

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