Buca Eğitim Fakültesi Dergisi,
2025, sayı 66, ss. 4394-4431

Araştırma Makalesi

The Journal of Buca Faculty of Education,
2025, issue 66, pp. 4394-4431

Research Article

Exploring the Relationship Between Teachers' Artificial Intelligence Awareness and Computational Thinking Skills: Differences Across Sociodemographic and Professional Variables*

Öğretmenlerin Yapay Zeka Farkındalığı ile Bilgisayarca Düşünme Becerileri Arasındaki İlişkinin incelenmesi: Sosyodemografik ve Mesleki Değişkenlere Göre Farklılıklar

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Geliş Tarihi: *08.09.2025* ***Kabul Tarihi:*** *16.12.2025*

ABSTRACT

As a requirement of the digital transformation in education, teachers are expected to possess contemporary pedagogical competencies. In this context, demonstrating awareness of artificial intelligence (AI) and computational thinking (CT) skills can help transform teaching processes. This study aimed to determine teachers' level of artificial intelligence awareness and computational thinking skills. We also examined whether AI awareness and CT skills were related and how these variables differed across various sociodemographic and professional variables. This study, conducted in Turkey during the 2024-2025 academic year, used a descriptive correlational survey design and involved 981 teachers (female = 514, male = 467) who volunteered to participate. Data were analysed using descriptive statistics, independent-samples *t*-test, one-way analysis of variance (ANOVA), and Pearson correlation. The analysis indicated that teachers' AI awareness and CT skills were at a moderate level. Additionally, significant differences in teachers' AI awareness and CT skills were observed across sociodemographic and professional variables. A statistically significant, positive correlation was found between AI awareness and CT skills. Based on the results, it is recommended that teachers be given more opportunities to develop their problem-solving skills and to experience AI tools. Furthermore, it is believed that new research with practice-based interventions and qualitative evidence demonstrating teachers' experiences will contribute to the field.

Keywords: Computational thinking, artificial intelligence, digital competence, 21st century skills

ÖZ

Eğitimde dijital dönüşümün bir gereği olarak öğretmenlerden çağdaş pedagojik yeterliklere sahip olması beklenmektedir. Bu bağlamda değerlendirilen yapay zeka (YZ) farkındalığı ve bilgisayarca düşünme (BD) becerilerine yönelik kanıtlar elde etmek öğretim süreçlerini dönüştürmeye katkı sağlayabilir. Bu çalışmanın amacı öğretmenlerin yapay zekâ farkındalığı ve bilgisayarca düşünme beceri düzeylerini tespit etmektir. Ayrıca, YZ farkındalığı ve BD becerilerinin ilişkili olup olmadığını ve bu değişkenlerin çeşitli

* This study is a part of the master’s thesis conducted by the first author under the supervision of the second author.

sosyodemografik ve mesleki değişkenlere göre farklılaşıp farklılaşmadığını ortaya koymaktır. İlişkisel tarama modeliyle Türkiye'de yürütülen bu araştırmaya, 2024-2025 akademik yılında gönüllü katılım esasına dayalı olarak 981 öğretmen (kadın = 514, erkek = 467) katılım sağlamıştır. Verilerin analizinde betimsel istatistikler, bağımsız örneklem *t*-testi, tek yönlü varyans analizi (ANOVA) ve Pearson Korelasyon analizi yapılmıştır. Analiz sonuçları, öğretmenlerin YZ farkındalık düzeylerinin ve BD becerilerinin orta düzeyde olduğunu göstermiştir. Ayrıca, sosyo-demografik değişkenlere göre öğretmenlerin AI farkındalığı ve BD becerilerinde anlamlı farklılıklar bulunmuştur. YZ farkındalığı ile BD becerileri arasında pozitif yönde istatistiki olarak anlamlı ilişki tespit edilmiştir. Sonuçlara dayanarak, öğretmenlerin özellikle problem çözme becerilerini geliştirme ve yapay zekâ araçlarını deneyimleme fırsatlarının artırılması gerektiği önerilmektedir. Ayrıca uygulamaya dayalı müdaheleli yeni araştırmaların ve öğretmenlerin deneyimlerini ortaya koyacak nitel kanıtların alana katkı sağlayacağı düşünülmektedir.

Anahtar Kelimeler: Bilgisayarca düşünme, yapay zeka, dijital yeterlilik, 21. yüzyıl becerileri

INTRODUCTION

Many innovative companies (Google, Microsoft, OpenAI, etc.) are continuing their efforts to develop and disseminate artificial intelligence (AI) tools (facial recognition systems, digital assistants, chatbots, recommendation systems, etc.), which have become one of the most common solutions used to address both individual and organisational problems. The rapid advancement of educational technologies reveals that the field of education will become more susceptible to innovative technologies, indicating that AI could gain a permanent place in education (Renz & Hilbig, 2020). The development and use of these technologies, which have become an integral part of daily life, are vital for every institution, organisation, and government that aims to achieve success (Bughin et al., 2017; Coşkun & Gülleroğlu, 2021; Makridakis, 2017). However, developing these technologies is not enough; training individuals who can understand and use these systems is also necessary.

Today, individuals with analytical and critical thinking skills are needed, not just technical knowledge. Individuals of all ages and professions can use AI technologies more ethically and effectively by developing critical thinking, creativity, collaboration, and technological literacy skills. Thus, they can adapt to the changes brought about by technological advancements in their personal and professional lives and improve society's overall well-being. These skills will also become increasingly important for understanding and developing AI-based programs (Mills et al., 2025). Among these skills, computational thinking can enable individuals to identify problems and generate solutions using computer science-based thinking methods (Korkmaz et al., 2015). CT, the ability to develop systematic and logical approaches to problem-solving and decision-making, is critical for integrating technological tools and applications into learning environments (Yünkül et al., 2017). CT can also be defined as thought processes used to express solutions as computational steps that can be executed by a computer (Mills et al., 2025). The effective use of AI and advanced technologies in education requires teachers to develop CT skills, which are fundamental for instilling in students from primary school through higher education (Lockwood & Mooney, 2017). This skill allows individuals to develop more systematic and creative solutions to their problems.

Considering CT skills in instructional activities is crucial for supporting students' thinking processes. Teachers can play a fundamental role in equipping students with these skills; however, they are expected to possess them first. This allows both groups to effectively manage the digital transformation and adapt to the skills required by this new era (Ansen Gürkan et al., 2025; Dai et al., 2020). Teachers' developmental levels and practical experience with these skills can determine how effectively CT skills are used in classroom activities. Therefore, identifying teachers' competencies in this area is crucial for designing instruction and planning professional development processes. At this point, teachers are expected to support the use of technology and guide students' intellectual development processes. In this context, the limited studies on CT

(Korkmaz et al., 2015) and the increasing importance of AI research, although these studies are primarily confined to higher education institutions (Akdeniz & Özdinç, 2021), highlight the need for more comprehensive research at all levels, from preschool to lifelong learning. Mills et al. (2025) argue that although there is widespread agreement that CT is relevant to the teaching of many disciplines at the abstraction level (e.g., mathematics, media literacy), it still has limited coverage. Therefore, we believe it is important to determine teachers' AI awareness and CT skills, which play a significant role in realising the social and ethical benefits of technological advancement, and to provide evidence on how these skills can be developed.

The positive aspects of these technologies, such as facilitating access to learning opportunities, enriching personal learning experiences, and improving educational methods to achieve the best learning outcomes, accelerate the development and innovation of education (Zhang & Aslan, 2021). However, despite the advantages these systems offer in education, it is also known that they pose certain risks and disadvantages (e.g., ethical violations, prejudice, personal data protection, etc.). In this context, this research is expected to reveal teachers' current status regarding AI awareness and CT skills and contribute to a better understanding of current needs in education by examining these skills in various sociodemographic variables.

The literature demonstrates that studies examining AI and CT variables together and identifying their relationship are limited. Celik (2023) found a positive relationship between CT and AI literacy among university students. Another study (Guggemos, 2024) with high school students found evidence that more intelligent individuals are better at cooperating. The absence of prior research examining the relationship between CT and AI awareness variables among teachers further underscores the value of our study. Wang et al. (2025) suggest that further research is needed to understand how and to what extent AI awareness affects teaching and learning.

The findings are expected to guide teacher education planning, the preparation of in-service training programs, and the development of technology-based education policies, as well as contribute to the development of solution-focused recommendations to identify the needs of teacher groups with diverse characteristics. This study aimed to determine the relationship between teachers' awareness of AI technologies and their CT skills. It also aimed to determine whether these variables differ across various socio-demographic and professional characteristics. In this context, the following research questions (RQs) were addressed:

RQ-1. What are teachers' AI awareness and CT skills?

RQ-2. Do teachers' AI awareness and CT skills differ based on teachers' gender, marital status, graduate status, professional experience, teaching level, type of school, school location, in-service training about educational technology, AI usage, and approval of AI in education?

RQ-3. Is there a statistically significant relationship between teachers' AI awareness and CT skills?

1.1. Generative AI in Education

AI, considered the highest level of potential for an artificial system to achieve previously undefined goals through computational methods (Gignac & Szodorai, 2024), is a multifaceted field that attempts to model the unique capabilities of the human mind in different ways. Walsh (2020) views AI as "Homo digitalis," the next evolutionary stage of Homo sapiens, and argues that this technology could render all known political, economic, social, and cultural values meaningless by the 2060s. It is undeniable that, thanks to this potential, AI will become an indispensable part of life and transform pedagogical approaches.

Over the last 50 years, AI has manifested itself in intelligent instructional systems that can understand teaching methods and techniques, monitor student behaviour, and provide personalised learning environments (Alkhatlan & Kalita, 2019; Rossi & Fedeli, 2012). Today, AI has evolved into a generative structure that will force students, teachers, parents, and educational administrators to redefine their roles. This structure incorporates adaptive learning algorithms, interactive educational environments, and natural language processing technologies. While this broad perspective offers significant benefits, such as transforming, streamlining, and enhancing the quality of educational activities, it also presents opportunities and threats, as with any new technology.

ChatGPT, Gemini, and Copilot, known as generative AI tools, offer advantages such as providing individualised learning opportunities, saving teachers time by facilitating instructional planning, being continuously accessible, and enabling immediate error correction and language development. However, they also have disadvantages, such as using outputs without citing sources, creating an unfair learning environment in student assignments, the risk of generating misinformation, and tendencies to cheat (Fodouop Kouam, 2024; Karaman & Goksu, 2024; Liu et al., 2024; Ofosu-Ampong et al., 2023; Sok & Heng, 2023; Sullivan et al., 2023; Van den Berg & du Plessis, 2023). Therefore, the responsible and ethical use of generative AI tools in education is crucial. The responsible use of these tools is crucial for protecting justice and ethical values in education (Grassini, 2023). This can be achieved primarily through AI awareness.

Tan et al. (2025) conducted a systematic review and highlighted teachers' low AI awareness as a barrier to the implementation of AI. They also stated that teachers' AI awareness would not only enrich the learning experience but also increase teaching efficiency, allowing them to spend more time on student interaction. Wang et al. (2025) stated that teachers need to fully understand the functions and value of AI to use it effectively. They also suggested that AI awareness plays a role in the adoption of generative AI as a learning environment and AI usage behavior (Wang et al., 2025). Research suggests that educators can use AI not only to create personalized content, prepare lesson plans, and evaluate activities, but also to improve engagement, motivation, and academic performance through opportunities such as instant guidance and personalized learning (Karaman & Goksu, 2024; Wardat et al., 2023).

1.2. What is Computational Thinking

Competencies such as critical thinking, creativity, productivity, collaboration, and digital literacy, which are necessary for individuals to succeed in the digitalising world, are considered 21st-century skills. One of these competencies is Computational Thinking (CT). According to Csizmadia et al. (2015), CT is a process that requires understanding the essence of the problem in the problem-solving process, while according to Bundy (2007), it is a skill that improves cognitive abilities and has implications across disciplines. Korkmaz et al. (2015) define CT as the ability of individuals to acquire the knowledge and skills necessary to solve daily life problems using computers. According to ISTE's definition, CT is a thinking approach that uses technology to solve problems (ISTE, 2011; Karaçaltı et al., 2018; Korkmaz et al., 2015). Additionally, according to ISTE (2024), teachers can facilitate learning by integrating CT-based practices—a fundamental skill—into their classes.

The concept of "Computational Thinking" was first used by Papert in the early 1980s using the LOGO programming language to enable children to learn mathematical and computational thinking in innovative and intuitive ways (Pusmaz, 2023). Wing (2006) defines this concept as solving problems, building systems, and interpreting human behaviour by utilising the fundamental principles of computer science. They state that this skill should be acquired by everyone interested in computer science (So et al., 2020; Wing, 2006). They also state that CT is not limited to STEM (Science, Technology, Engineering, Mathematics) fields but can also be effective in other disciplines such as economics, law, and psychology. Furthermore, Palop et al. (2025) point out that IT is not only about mathematics or mathematical thinking and should not be considered as a mere tool for mathematical algorithmic programming. Therefore, computational thinking is important for equipping students with interdisciplinary thinking skills. CT skills enable students to understand and solve complex problems and to adapt more easily to today's technological changes (Tagare, 2024; Zafrullah et al., 2024). By incorporating CT into the learning process, teachers can provide students with deep insights into contemporary science practices and enrich their learning experiences (Hamerski et al., 2022).

A computational thinker can analyse complex problems by leveraging the opportunities offered by technology, develop strategies to solve them, and systematically test these solutions (Crompton & Burke, 2024). In this context, the place of computational thinking in education is increasingly growing and plays a critical role in developing students' analytical thinking skills. This skill strengthens interdisciplinary thinking by bridging disciplines such as mathematics, science, and engineering (Triantafyllou et al., 2024). Considering these definitions, it can be seen that CT skills are a problem-solving approach that involves designing problems suitable for solving with computers or other digital tools (Barr et al., 2011). Therefore, CT encompasses creative thinking, algorithmic thinking, problem solving, critical thinking, communication skills, and collaborative learning (Korkmaz et al., 2015). However, there is also a lack of consensus on the components of CT, thus creating complexity in defining CT (Breslyn & McGinnis, 2019).

CT stands out as a fundamental skill that enhances students' ability to solve complex problems encountered in the digital world. Accordingly, many countries worldwide are restructuring their educational curricula to instill this skill. In European countries, three different approaches are generally adopted regarding the integration of CT into curricula (Palop et al., 2025): (1) including it in all courses, (2) including it as an independent course, or (3) including it as a component of a course (usually mathematics and technology-related courses). Yadav et al. (2016) emphasise that CT skills are not limited to computer science but have the potential to be integrated into various curricula from an early age. Similarly, Falloon (2024) emphasises the importance of acquiring these skills early, stating that this will enable students to become more aware of issues such as the appropriate use of AI applications, engage more consciously with the digital world, and understand how algorithms function. Indeed, recent studies (Lee & Xiong, 2024; Weng et al., 2024; Liao et al., 2024) have demonstrated that integrating AI into learning environments successfully acquires CT skills and improves overall academic performance. Therefore, we believe that teachers' level of AI awareness plays a key role in acquiring CT skills. This study seeks to understand and provide evidence for the relationship between these two skills.

METHOD

2.1. Research Design

This study used a correlational survey design. A correlational survey is a research design used to determine the relationship between two or more variables and to obtain clues about cause and effect (Fraenkel et al., 2012).

2.2. Participants

Participants consisted of teachers working in public or private schools in Türkiye. The participant group was selected through convenience sampling from teachers who volunteered to participate in the study. The participating teachers were diverse in demographic characteristics (age, gender, subject matter, length of service, etc.). Nine hundred eighty-one teachers working in K-12 or preschool settings from different provinces of Türkiye were included in the study. Analysis conducted using the Qualtrics XM Sample Size Calculator yielded an ideal sample size of 384 with a 95% confidence level and a 5% margin of error (Qualtrics, 2025). The number of participants was well above the ideal sample size. Data were collected via an online survey during the 2024-2025 academic year. Participant characteristics are presented in Table 1.

Table 1

Characteristics of participants

Variables	Values	*n*	%
Gender	Female	514	52.4
	Male	467	47.6
Marital status	Married	693	70.6
	Not married	288	29.4
Professional experience	1-5 Years	213	21.7
	6-10 Years	380	38.7
	11-15 Years	94	9.6
	16+ years	294	30.0
Type of school	Public	928	94.6
	Private	53	5.4
Teaching level	Pre-school	79	8.1
	Primary (Grade 1-4)	440	44.9
	Secondary (Grade 5-8)	292	29.8
	High school (Grade 9-12)	170	17.3
School location	Urban	769	78.4
	Rural	212	21.6
Graduate	No	169	17.2
	Yes	812	82.8
In-Service Training	Yes	631	64.3
	No	350	35.7
AI Usage	Yes	286	29.2
	No	695	70.8
AI Should Be Used	Yes	820	83.6
	No	161	16.4

Note. N = 981, Age: $M \pm SD$ (36.78±9.293), In-Service Training: Whether they have received in-service training on educational technologies (AI, digital tools, technology integration, etc.). AI Usage: It is about whether teachers use AI models/tools. AI Should Be Used: It is about whether teachers agree that AI should be used in teaching.

According to Table 1, teachers are diverse in age, gender, marital status, professional experience, graduate status, school location, type of school, and teaching level.

2.3. Data Collection Tools

In this study, we used the Demographic Information Form developed by the researchers to obtain the teachers' demographic characteristics, and the Artificial Intelligence Awareness Level Scale and the Computational Thinking Scale to measure the dependent variables.

2.3.1. Demographic Characteristics Form

This form was prepared to determine the socio-demographic and professional characteristics of the participants, including age, gender, teaching level, and so on, as listed in Table 1. In line with the purpose of the study, the form also included the following questions: "Have you ever received in-service training on educational technologies? (Y/N)?", "Have you experienced AI tools (ChatGPT, Gemini, etc.)? (Y/N)?", and "Do you find using AI tools in education appropriate? (Y/N)?" Participants completed this form online on an entirely voluntary basis, and no personal information was requested. Completing the form takes approximately 5-8 minutes, and it was emphasised that participants' candid responses are crucial to the study's validity and reliability. The form has been adapted for easy completion on mobile devices.

2.3.2. Teachers' Artificial Intelligence Awareness Scale

This scale, developed by Ferikoğlu and Akgün (2022), consists of 51 items. The scale consists of four factors: (1) Practical knowledge, (2) Belief-Attitude, (3) Ability to Associate, and (4) Theoretical knowledge. This Likert-type scale ranges from (1) strongly disagree to (5) strongly agree. The scale explains 70.27% of the total variance. The factor loadings for the scale items range from 0.878 to 0.567. Confirmatory Factor Analysis values are within acceptable limits (RMSEA=0.069; CFI:0.903). The lowest possible score is 51, and the highest is 255. High scores indicate high awareness, while low scores indicate low awareness. In this study, we calculated *Cronbach's Alpha* reliability coefficients for the teachers' scale scores as .95. We also calculated the reliability coefficients for the sub-dimensions as .88, .91, .89, and .86, respectively. These values explain the scale's reliability.

2.3.3. Computational Thinking Scale

This scale, developed by Korkmaz et al. (2017), contains 29 items. The scale consists of five factors: (1) Creativity, (2) Cooperativity, (3) Algorithmic Thinking, (4) Critical Thinking, and (5) Problem Solving. This scale was chosen because it is considered a valid and reliable scale in the literature for similar samples, it measures CT skills holistically, and it possesses strong psychometric properties. This Likert-type scale asked teachers to respond to the statements as follows: (1) never, (2) rarely, (3) sometimes, (4) usually, (5) always, and to mark the option that best suited them for each situation. The scale explains 56.12% of the total variance. The factor loadings for the scale items range from 0.475 to 0.785. Confirmatory Factor Analysis values are within acceptable limits (RMSEA = 0.062, CFI = 0.95). The lowest score teachers can obtain from the scale is 29, and the highest is 145. High scores indicate a high level of CT skill, while low scores indicate a low level of CT skill. In this study, the *Cronbach's Alpha* reliability coefficient for the teachers' scale scores was .88. In addition, the sub-dimension reliability coefficients were .93, .87, .92, .90, and .88, respectively. These values indicate that the scale has high reliability.

2.4. Data Analysis

Univariate and multivariate outlier analysis were conducted first during the data analysis. First, *z*-scores were calculated for the main variables in the data set. As a result of these calculations, 31 outliers were removed from the data set because participants were beyond ±3 of the *z*-score obtained for the main variables (Mertler & Vannatta, 2016). Analyses were conducted to answer the research questions using data from 981 participants.

Normality analysis was conducted to determine whether the data were normally distributed, and skewness and kurtosis values were calculated. The data is normally distributed if the values are between -1.5 and +1.5 (Tabachnick & Fidell, 2013). The results of the normality analysis are presented in Table 2.

Table 2

Normality analysis of the scales

Variables	Items	Skewness	Kurtosis
Practical Knowledge	16	-.418	.829
Belief-Attitude	14	-.094	-.014
Ability to Associate	10	-.230	.725
Theoretical Knowledge	11	.113	-.199
AI-Awareness	51	.165	-.029
Algorithmic Thinking	6	-.446	-.769
Creativity	8	-.869	.738
Problem Solving	6	-.613	-.547
Cooperativity	4	-1.094	1.023
Critical Thinking	5	-.714	.410
CT-Skills	29	-.226	-.107

AI: artificial Intelligence, CT: computational thinking

Table 2 shows that both scales and the sub-dimensions’ skewness and kurtosis values were between -1.5 and +1.5. Based on this result, the data were assumed to have a normal distribution.

In this direction, the independent samples *t*-test was used for paired groups, one-way analysis of variance (ANOVA) was used for comparisons of three or more groups, and the Tukey or Tamhane post hoc analysis methods were used depending on the homogeneous distribution of the data to determine which group the difference was in favour of. Finally, Pearson correlation analysis was performed to determine the relationship between the variables. Cohen's *d* and *eta squared* (η^2) statistics were used in group comparisons to calculate the effect size. Cohen's d was calculated as the ratio of the difference between group means to the pooled standard deviation and was classified according to Cohen's (1988) criteria (d = 0.20 for small, d = 0.50 for medium, and d = 0.80 for large). The effect size for ANOVA results is expressed as η^2 (η^2 = 0.01/small, η^2 = 0.06/medium, η^2 = 0.14/large effect). We performed all analyses using IBM SPSS Version 5 Software.

2.5. Ethics Committee Approval

The Scientific Research and Publication Ethics Committee of Mardin Artuklu University approved this study (Number=133090, 2024/2). All stages of the study were conducted in accordance with the principles of scientific research and publication ethics. Participants' participation was voluntary, and the data obtained were kept confidential. Furthermore, the thesis was uploaded to the scientific plagiarism-detection program used by Mardin Artuklu University and was declared plagiarism-free.

RESULTS

First, we conducted descriptive analyses of teachers' AI awareness and CT skills. Second, we conducted appropriate analyses (ANOVA and *t*-test) to determine whether AI awareness and CT skills differed by socio-demographic variables such as gender, marital status, educational background, professional experience, educational level, school type, school location, and educational background. We also analysed whether AI awareness and CT skills differed based on teachers' in-service training on educational technologies, experience with AI tools, and approval of AI. Finally, we conducted a Pearson correlation analysis to determine whether there was a correlation between teachers' AI awareness and CT skills. The findings are presented below under subheadings.

3.1. Teachers' AI Awareness and CT Skill Level (RQ1)

We descriptively analysed data from 981 teachers who participated in our study. We calculated the teachers' AI awareness and CT skill levels. The minimum, maximum, mean, and standard deviation values for the teachers' scale scores are presented in Table 3.

Table 3

Teachers' AI awareness and CT skills

Variables	*M*	*M* (Likert)	*SD*	Scores
Practical Knowledge	63.12	**3.94**	8.617	16–80
Belief-Attitude	49.62	**3.54**	9.854	14–70
Ability to Associate	35.78	3.58	6.841	10–50
Theoretical Knowledge	41.25	3.75	6.359	11–55
AI-Awareness	189.77	3.72	26.849	51–255
Algorithmic Thinking	22.20	3.70	0.980	6–30
Creativity	34.96	4.37	0.526	8–40
Problem Solving	20.34	3.39	1.132	6–30
Cooperativity	16.88	4.22	0.746	4–20
Critical Thinking	19.95	3.99	0.752	5–25
CT-Skills	114.26	3.94	0.495	29–145

Note. p <.05, AI: artificial Intelligence, CT: computational thinking

Teachers' AI awareness score was calculated as 189.77±26.849. The highest mean score was in the practical knowledge subscale, and the lowest in the belief-attitude subscale. The total score obtained from the scale indicates that the teachers' AI awareness is above average. The same can be said for teachers' CT skills. Among the CT skill subscales, the highest mean score was in the creativity subscale, while the lowest was in the problem-solving subscale. These findings suggest that teachers have above-average competence in both AI awareness and CT skills, but relatively lower levels in the belief-attitude and ability to associate dimensions related to AI, as well as in the algorithmic thinking subscale related to CT skills.

3.2. Teachers' AI Awareness and CT Skills According to Socio-demographics (RQ2)

3.2.1. Gender

The results of the independent groups *t*-test, conducted to determine differences in teachers' AI awareness and CT skills scores by gender, are presented in Table 4.

Table 4

AI awareness and CT skills of teachers according to gender

Variables	Groups	*n*	*M*	*SD*	*t*	*p*	*d*
Practical Knowledge	Female	514	62.03	8.096	-4.195	**.000***	**0.27**
	Male	467	64.32	9.013			
Belief-Attitude	Female	514	48.18	9.494	-4.877	**.000***	**0.31**
	Male	467	51.21	10.006			
Ability to Associate	Female	514	34.68	6.693	-5.338	**.000***	**0.34**
	Male	467	36.99	6.806			
Theoretical Knowledge	Female	514	40.55	6.176	-3.667	**.000***	**0.23**
	Male	467	42.03	6.473			
AI-Awareness	Female	514	185.44	25.278	-5.384	**.000***	**0.35**
	Male	467	194.55	27.730			
Algorithmic Thinking	Female	514	3.54	.988	-5.606	**.000***	**0.35**
	Male	467	3.88	.939			
Creativity	Female	514	4.35	.517	-1.265	.206	0.08
	Male	467	4.39	.535			
Problem Solving	Female	514	3.56	.974	5.043	**.000***	**0.32**
	Male	467	3.20	1.257			
Cooperativity	Female	514	4.23	.722	.485	.628	0.03
	Male	467	4.21	.772			
Critical Thinking	Female	514	3.94	.740	-2.241	**.025***	**0.13**
	Male	467	4.04	.762			
CT-Skills	Female	514	3.93	.481	-.726	.468	0.04
	Male	467	3.95	.511			

Note. p <.05, AI: artificial Intelligence, CT: computational thinking

According to Table 4, male teachers' AI awareness was statistically significantly higher than female teachers' AI awareness, both in total score (t = -5.384; p < 0.05; d = 0.35) and across all sub-dimensions. Cohen's d values indicate a small effect size.

Teachers' CT skills did not differ by gender in total scores. However, male teachers scored higher on the algorithmic thinking subscale (t = -5.606; p < 0.05; d = 0.35), while females scored higher on the problem-solving subscale (t = 5.043; p < 0.05; d = 0.32). Cohen's d values indicate a small effect size. Male teachers scored higher than female teachers on the critical thinking subscale (t = -2.241; p < 0.05; d = 0.13), but the effect size was very small.

3.2.2. Marital Status

Table 5 presents the results of the independent-samples *t*-test conducted to determine whether teachers' AI awareness and CT skills differ by marital status.

Table 5

AI awareness and CT skills by marital status

Variables	**Groups**	**n**	***M***	***SD***	***t***	***p***	***d***
Practical Knowledge	Married	693	63.10	8.739	-.105	.916	0.01
	Not married	288	63.16	8.331			
Belief-Attitude	Married	693	49.40	10.048	-1.069	.285	0.07
	Not married	288	50.14	9.365			
Ability to Associate	Married	693	35.91	6.964	.901	.368	0.06
	Not married	288	35.48	6.538			
Theoretical Knowledge	Married	693	41.36	6.523	.849	.396	0.06
	Not married	288	41.00	5.948			
AI-Awareness	Married	693	189.77	27.590	-.003	.998	0.00
	Not married	288	189.78	25.021			
Algorithmic Thinking	Married	693	3.75	.923	2.024	**.044***	**0.15**
	Not married	288	3.60	1.099			
Creativity	Married	693	4.37	.527	.548	.584	0.04
	Not married	288	4.35	.523			
Problem Solving	Married	693	3.31	1.129	-3.411	**.001***	**0.24**
	Not married	288	3.58	1.120			
Cooperativity	Married	693	4.24	.745	.980	.327	0.07
	Not married	288	4.19	.748			
Critical Thinking	Married	693	3.99	.731	.330	.742	0.03
	Not married	288	3.97	.801			
CT-Skills	Married	693	3.94	.470	-.246	.806	0.02
	Not married	288	3.95	.552			

Note. p <.05, AI: artificial Intelligence, CT: computational thinking

The analysis in Table 5 shows that teachers' AI awareness did not differ by marital status. The same can be said for CT skills. However, married teachers scored significantly higher on algorithmic thinking (d = 0.15, very small effect), and single teachers scored significantly higher on problem-solving (d = 0.24, small effect) among the CT skill scale subscales.

3.2.3. Graduate Status

Table 6 presents the results of the independent-samples *t*-test conducted to determine whether the AI awareness and CT skills of teachers with graduate education differ from those of teachers without graduate education.

Table 6

AI awareness and CT skills according to graduate status

Variables	Graduate	*n*	*M*	*SD*	*t*	*p*	*d*
Practical Knowledge	No	812	62.71	8.670	-3.304	**.001***	**0.28**
	Yes	169	65.10	8.095			
Belief-Attitude	No	812	49.41	9.854	-1.503	.133	0.13
	Yes	169	50.66	9.814			
Ability to Associate	No	812	35.54	6.838	-2.429	**.015***	**0.20**
	Yes	169	36.94	6.757			
Theoretical Knowledge	No	812	40.97	6.263	-3.059	**.002***	**0.26**
	Yes	169	42.61	6.653			
AI-Awareness	No	812	188.62	26.588	-2.957	**.003***	**0.25**
	Yes	169	195.31	27.481			
Algorithmic Thinking	No	812	3.65	1.003	-3.940	**.000***	**0.30**
	Yes	169	3.94	.823			
Creativity	No	812	4.36	.531	-1.116	.265	0.10
	Yes	169	4.41	.497			
Problem Solving	No	812	3.40	1.130	.494	.621	0.04
	Yes	169	3.35	1.143			
Cooperativity	No	812	4.20	.758	-2.385	**.017***	**0.20**
	Yes	169	4.35	.670			
Critical Thinking	No	812	3.97	.771	-1.842	.066	0.13
	Yes	169	4.07	.651			
CT-Skills	No	812	3.92	.501	-2.435	**.015***	**0.22**
	Yes	169	4.03	.458			

Note. p <.05, AI: artificial Intelligence, CT: computational thinking, Graduate: Whether the teacher has a Master's degree/PhD

According to Table 6, AI awareness of teachers with a graduate degree was higher than that of those without (t = -2.957; p < 0.05; d = 0.25). A significant difference was found in all sub-dimensions except the belief-attitude sub-dimension, and the effect size (d = 0.20↔0.28) was small. CT skills of teachers with a graduate degree were also higher (*t = -2.435; p < 0.05; d = 0.22*). Regarding CT skills sub-dimensions, algorithmic thinking and cooperativity levels of teachers with a graduate degree were found to be significantly higher. The highest effect size was observed in the algorithmic thinking sub-dimension (d = 0.30).

3.2.4. Professional Experience

A one-way analysis of variance (ANOVA) was conducted to determine whether teachers' AI awareness and CT skills differed by teaching experience. The results are presented in Table 7.

Table 7

AI awareness and CT skills according to professional experience

Variables	Years	n	*M*	*SD*	*F*	*p*	*η²*
Practical Knowledge	(1) 1-5	213	62.47	8.348	1.419	.236	0.004
	(2) 6-10	380	63.47	9.484			
	(3) 11-15	94	64.34	7.259			
	(4) 16+	294	62.74	7.986			
Belief-Attitude	(1) 1-5	213	50.89	8.655	3.384	**.018***	**0.010**
	(2) 6-10	380	49.64	10.401			
	(3) 11-15	94	47.03	11.360			
	(4) 16+	294	49.50	9.291			
Ability to Associate	(1) 1-5	213	35.24	6.458	1.963	.118	0.006
	(2) 6-10	380	36.29	6.980			
	(3) 11-15	94	34.69	8.432			
	(4) 16+	294	35.85	6.311			
Theoretical Knowledge	(1) 1-5	213	40.50	6.108	1.740	.157	0.005
	(2) 6-10	380	41.71	6.678			
	(3) 11-15	94	41.54	5.692			
	(4) 16+	294	41.12	6.289			
AI-Awareness	(1) 1-5	213	189.11	24.512	.599	.616	0.002
	(2) 6-10	380	191.11	29.241			
	(3) 11-15	94	187.61	27.522			
	(4) 16+	294	189.22	25.008			
Algorithmic Thinking	(1) 1-5	213	3.40	1.056	9.815	**.000***	**0.029**
	(2) 6-10	380	3.79	.917			
	(3) 11-15	94	3.65	1.076			
	(4) 16+	294	3.83	.926			
Creativity	(1) 1-5	213	4.27	.471	5.256	**.001***	**0.016**
	(2) 6-10	380	4.43	.534			
	(3) 11-15	94	4.45	.516			
	(4) 16+	294	4.33	.543			
Problem Solving	(1) 1-5	213	3.53	1.051	8.504	**.000***	**0.025**
	(2) 6-10	380	3.52	1.102			
	(3) 11-15	94	3.35	1.290			
	(4) 16+	294	3.13	1.132			
Cooperativity	(1) 1-5	213	4.03	.804	6.085	**.000***	**0.018**
	(2) 6-10	380	4.28	.676			
	(3) 11-15	94	4.31	.858			
	(4) 16+	294	4.26	.730			
Critical Thinking	(1) 1-5	213	3.88	.695	2.330	.073	0.007
	(2) 6-10	380	4.04	.771			
	(3) 11-15	94	4.06	.833			
	(4) 16+	294	3.98	.735			
CT-Skills	(1) 1-5	213	3.84	.486	7.068	**.000***	**0.021**
	(2) 6-10	380	4.02	.495			
	(3) 11-15	94	3.97	.499			
	(4) 16+	294	3.91	.486			

Note. $p < .05$, AI: artificial Intelligence, CT: computational thinking, Post-hoc: belief-attitude [1>3]; algorithmic thinking [2>1, 4>1]; creativity [2>1, 3>1]; problem solving [1>4, 2>4]; cooperativity [2>1, 3>1, 4>1]; CT-skills [2>1, 2>4].

The ANOVA results indicate that teachers' AI awareness did not differ by professional experience. Only teachers with 1-5 years of experience scored significantly higher on the belief-attitude subscale than teachers with 11-15 years of experience. Teachers' CT skills differed based on professional experience. This difference was observed across all subscales except the critical thinking subscale. According to Table 7, as professional experience increases, cooperativity, algorithmic thinking, and creativity skills also increase. However, the opposite was true for problem-solving. Teachers with 6-15 years of experience had higher total CT skill scores than novice teachers and teachers with 16 or more years of professional experience. However, the effect size was very small.

3.2.5. Teaching Level

Table 8 presents the results of the one-way analysis of variance (ANOVA) conducted to examine differences in teachers' AI awareness and CT skills across teaching levels.

Table 8

AI awareness and CT skills according to teaching level

Variables	Groups	*n*	*M*	*SD*	*F*	*p*	*η²*
Practical Knowledge	(1) Pre-school	79	59.27	8.633	6.258	**.000***	**0.019**
	(2) Primary (Gr.1-4)	440	63.19	8.440			
	(3) Secondary (Gr.5-8)	292	63.49	8.673			
	(4) High school (Gr.9-12)	170	64.08	8.575			
Belief-Attitude	(1) Pre-school	79	48.48	9.465	.527	.664	0.002
	(2) Primary (Gr.1-4)	440	49.62	10.197			
	(3) Secondary (Gr.5-8)	292	50.02	9.875			
	(4) High school (Gr.9-12)	170	49.46	9.097			
Ability to Associate	(1) Pre-school	79	33.92	6.769	3.202	**.023***	**0.010**
	(2) Primary (Gr.1-4)	440	35.53	7.038			
	(3) Secondary (Gr.5-8)	292	36.38	6.760			
	(4) High school (Gr.9-12)	170	36.26	6.341			
Theoretical Knowledge	(1) Pre-school	79	39.59	4.235	2.558	.054	0.008
	(2) Primary (Gr.1-4)	440	41.20	6.280			
	(3) Secondary (Gr.5-8)	292	41.81	6.782			
	(4) High school (Gr.9-12)	170	41.22	6.535			
AI-Awareness	(1) Pre-school	79	181.27	22.118	3.306	**.020***	**0.010**
	(2) Primary (Gr.1-4)	440	189.54	26.949			
	(3) Secondary (Gr.5-8)	292	191.71	28.000			
	(4) High school (Gr.9-12)	170	191.02	25.996			
Algorithmic Thinking	(1) Pre-school	79	3.74	1.008	2.190	.088	0.007
	(2) Primary (Gr.1-4)	440	3.76	.927			
	(3) Secondary (Gr.5-8)	292	3.70	1.050			
	(4) High school (Gr.9-12)	170	3.54	.964			
Creativity	(1) Pre-school	79	4.56	.506	4.115	**.007***	**0.012**
	(2) Primary (Gr.1-4)	440	4.35	.527			
	(3) Secondary (Gr.5-8)	292	4.36	.529			
	(4) High school (Gr.9-12)	170	4.33	.510			
Problem Solving	(1) Pre-school	79	3.60	1.290	1.517	.209	0.005
	(2) Primary (Gr.1-4)	440	3.32	1.143			
	(3) Secondary (Gr.5-8)	292	3.42	1.152			
	(4) High school (Gr.9-12)	170	3.41	.976			
Cooperativity	(1) Pre-school	79	4.34	.714	2.345	.072	0.007
	(2) Primary (Gr.1-4)	440	4.23	.722			
	(3) Secondary (Gr.5-8)	292	4.24	.739			
	(4) High school (Gr.9-12)	170	4.10	.819			
Critical Thinking	(1) Pre-school	79	4.21	.717	3.503	**.015***	**0.011**
	(2) Primary (Gr.1-4)	440	3.92	.779			
	(3) Secondary (Gr.5-8)	292	4.03	.717			
	(4) High school (Gr.9-12)	170	3.99	.741			
CT-Skills	(1) Pre-school	79	4.10	.474	3.805	**.010***	**0.012**
	(2) Primary (Gr.1-4)	440	3.93	.508			
	(3) Secondary (Gr.5-8)	292	3.96	.484			
	(4) High school (Gr.9-12)	170	3.88	.479			

Note. p <.05, AI: artificial Intelligence, CT: computational thinking, Gr: Grade, Post-hoc: practical knowledge [2>1, 3>1, 4>1]; ability to associate [3>1, 4>1]; AI-awareness [2>1, 3>1, 4>1]; creativity [1>2, 1>3, 1>4]; critical thinking [1>2]; CT-skills [1>2, 1>3, 1>4].

According to Table 8, as teachers' educational level increases, their AI awareness increases, while their CT skills decrease in total scores. Preschool teachers' AI awareness was significantly lower than that of other teachers, while their CT skills were significantly higher. There was no difference in teachers' AI awareness, belief-attitude, and theoretical knowledge sub-dimensions based on teaching level. The same situation applies to the algorithmic thinking, problem solving, and cooperativity CT skills sub-dimensions. The effect size for the total score and the sub-dimensions was very small.

3.2.6. Type of School (Public vs. Private)

Table 9 presents the results of the independent-samples *t*-test conducted to determine whether the AI awareness and CT skills of teachers in public schools differ from those in private schools.

Table 9

AI awareness and CT skills according to the type of school

Variables	Groups	*n*	*M*	*SD*	*t*	*p*	*d*
Practical Knowledge	Public	928	63.17	8.573	.840	.401	0.12
	Private	53	62.15	9.396			
Belief-Attitude	Public	928	49.81	9.810	2.557	**.011***	**0.36**
	Private	53	46.26	10.096			
Ability to Associate	Public	928	35.82	6.839	.813	.416	0.11
	Private	53	35.04	6.889			
Theoretical Knowledge	Public	928	41.29	6.339	.654	.513	0.09
	Private	53	40.70	6.738			
AI-Awareness	Public	928	190.09	26.785	1.569	.117	0.22
	Private	53	184.15	27.589			
Algorithmic Thinking	Public	928	3.72	.970	1.701	.094	0.26
	Private	53	3.45	1.120			
Creativity	Public	928	4.37	.530	-.436	.663	0.06
	Private	53	4.40	.434			
Problem Solving	Public	928	3.37	1.134	-2.081	**.038***	**0.29**
	Private	53	3.70	1.052			
Cooperativity	Public	928	4.23	.738	.807	.420	0.11
	Private	53	4.14	.875			
Critical Thinking	Public	928	3.99	.744	-.135	.893	0.01
	Private	53	4.00	.897			
CT-Skills	Public	928	3.94	.498	-.193	.847	0.04
	Private	53	3.96	.456			

Note. p <.05, AI: artificial Intelligence, CT: computational thinking

According to Table 9, teachers working in public schools had higher scores on the AI awareness belief-attitude sub-dimension. In contrast, teachers working in private schools had higher CT skills problem-solving sub-dimension scores. The effect sizes for both sub-dimensions were small (*d* = 0.36, 0.29).

3.2.7. School Location

Table 10 presents the results of the independent-samples *t*-test conducted to determine whether there is a difference in AI awareness and CT skills between teachers working in rural and urban schools.

Table 10

AI awareness and CT skills according to school location

Variables	Groups	*n*	*M*	*SD*	*t*	*p*	*d*
Practical Knowledge	Urban	769	63.34	8.449	1.523	.128	0.12
	Rural	212	62.32	9.177			
Belief-Attitude	Urban	769	49.97	9.644	2.033	**.043***	**0.17**
	Rural	212	48.34	10.504			
Ability to Associate	Urban	769	35.85	6.741	.630	.529	0.05
	Rural	212	35.52	7.202			
Theoretical Knowledge	Urban	769	41.23	6.223	-.185	.853	0.02
	Rural	212	41.33	6.845			
AI-Awareness	Urban	769	190.40	26.083	1.296	.196	0.11
	Rural	212	187.51	29.413			
Algorithmic Thinking	Urban	769	3.72	.974	.892	.373	0.07
	Rural	212	3.65	1.001			
Creativity	Urban	769	4.36	.540	-.876	.382	0.06
	Rural	212	4.39	.470			
Problem Solving	Urban	769	3.40	1.131	.358	.720	0.03
	Rural	212	3.37	1.137			
Cooperativity	Urban	769	4.24	.759	1.724	.085	0.14
	Rural	212	4.14	.691			
Critical Thinking	Urban	769	3.98	.760	-.350	.727	0.03
	Rural	212	4.00	.725			
CT-Skills	Urban	769	3.95	.499	.563	.573	0.07
	Rural	212	3.93	.484			

Note. p <.05, AI: artificial Intelligence, CT: computational thinking

According to Table 10, teachers' AI awareness and CT skills did not differ between urban and rural settings. However, teachers working in urban schools had statistically significantly higher AI awareness belief-attitude subscale scores. The effect size was very small.

3.2.8. In-Service Training

Table 11 presents the results of the independent groups *t*-test conducted to determine whether teachers' AI awareness and CT skills differ according to whether they have received in-service training on educational technologies.

Table 11

AI awareness and CT skills according to in-service training

Variables	In-Service Training	*n*	*M*	*SD*	*t*	*p*	*d*
Practical Knowledge	Yes	631	64.19	8.292	5.319	**.000***	**0.35**
	No	350	61.18	8.861			
Belief-Attitude	Yes	631	50.06	10.372	1.968	**.049***	**0.12**
	No	350	48.83	8.801			
Ability to Associate	Yes	631	36.49	6.925	4.418	**.000***	**0.29**
	No	350	34.50	6.502			
Theoretical Knowledge	Yes	631	41.94	6.521	4.735	**.000***	**0.30**
	No	350	40.01	5.863			
AI-Awareness	Yes	631	192.69	27.130	4.612	**.000***	**0.31**
	No	350	184.52	25.544			
Algorithmic Thinking	Yes	631	3.78	.964	3.307	**.001***	**0.23**
	No	350	3.56	.994			
Creativity	Yes	631	4.42	.489	4.243	**.000***	**0.29**
	No	350	4.27	.573			
Problem Solving	Yes	631	3.38	1.125	-.495	.621	0.03
	No	350	3.41	1.146			
Cooperativity	Yes	631	4.25	.739	1.470	.142	0.09
	No	350	4.18	.756			
Critical Thinking	Yes	631	4.04	.734	3.143	**.002***	**0.20**
	No	350	3.89	.774			
CT-Skills	Yes	631	3.98	.477	3.461	**.001***	**0.23**
	No	350	3.87	.519			

Note. p <.05, AI: artificial Intelligence, CT: computational thinking

Teachers who received in-service training on educational technologies had higher AI awareness (t = 4.612; $p < 0.05$; d = 0.31) and CT skills (t = 3.461; $p < 0.05$; d = 0.23) than those who did not. The effect sizes for the total score and the sub-dimensions were small (d = 0.12↔0.35).

3.2.9. Using AI Tools

Table 12 presents the results of the independent-samples *t*-test conducted to determine differences in AI awareness and CT skills among teachers who reported using AI tools.

Table 12

AI awareness and CT skills according to AI usage

Variables	AI Usage	*n*	*M*	*SD*	*t*	*p*	*d*
Practical Knowledge	Yes	286	66.62	7.801	8.460	**.000***	**0.59**
	No	695	61.68	8.527			
Belief-Attitude	Yes	286	52.83	9.291	6.693	**.000***	**0.47**
	No	695	48.30	9.780			
Ability to Associate	Yes	286	38.01	6.696	6.682	**.000***	**0.47**
	No	695	34.86	6.692			
Theoretical Knowledge	Yes	286	42.79	6.554	4.900	**.000***	**0.34**
	No	695	40.62	6.172			
AI-Awareness	Yes	286	200.25	25.876	8.092	**.000***	**0.57**
	No	695	185.46	26.060			
Algorithmic Thinking	Yes	286	3.80	.969	1.908	.057	0.14
	No	695	3.66	.983			
Creativity	Yes	286	4.43	.487	2.564	**.010***	**0.18**
	No	695	4.34	.539			
Problem Solving	Yes	286	3.40	1.183	.179	.858	0.01
	No	695	3.39	1.111			
Cooperativity	Yes	286	4.19	.803	-.775	.438	0.06
	No	695	4.23	.721			
Critical Thinking	Yes	286	4.09	.697	2.651	**.008***	**0.19**
	No	695	3.95	.770			
CT-Skills	Yes	286	4.00	.462	2.148	**.032***	**0.17**
	No	695	3.92	.507			

Note. p <.05, AI: artificial Intelligence, CT: computational thinking

Table 12 shows that teachers who used AI tools had significantly higher AI awareness than those who did not (t = 8.092; p < 0.05; d = 0.57). AI awareness was also higher in all sub-dimensions in favour of those who used AI tools (d = 0.34↔0.59). Teachers who reported using AI tools had higher total CT skills scores than those who did not (t = 2.148; p < 0.05; d = 0.17). Significant differences occurred in the creativity and critical thinking sub-dimensions. The effect size for CT skills was very small (d = 0.17↔0.19).

3.2.10. Approving the AI Usage in Education

Table 13 presents the results of the independent-samples *t*-test conducted to determine differences in AI awareness and CT skills among teachers who think AI should be used in education.

Table 13

AI awareness and CT skills according to approving the AI usage

Variables	Approving	*n*	*M*	*SD*	*t*	*p*	*d*
Practical Knowledge	Yes	820	63.96	8.543	7.041	**.000***	**0.61**
	No	161	58.85	7.699			
Belief-Attitude	Yes	820	50.54	9.714	6.716	**.000***	**0.58**
	No	161	44.96	9.244			
Ability to Associate	Yes	820	36.42	6.554	6.707	**.000***	**0.58**
	No	161	32.55	7.359			
Theoretical Knowledge	Yes	820	41.64	6.309	4.320	**.000***	**0.37**
	No	161	39.29	6.270			
AI-Awareness	Yes	820	192.55	26.643	7.506	**.000***	**0.65**
	No	161	175.65	23.268			
Algorithmic Thinking	Yes	820	3.73	.965	1.888	.059	0.16
	No	161	3.57	1.044			
Creativity	Yes	820	4.40	.510	3.475	**.001***	**0.31**
	No	161	4.23	.582			
Problem Solving	Yes	820	3.41	1.146	1.040	.298	0.09
	No	161	3.31	1.059			
Cooperativity	Yes	820	4.23	.749	1.097	.273	0.09
	No	161	4.16	.730			
Critical Thinking	Yes	820	4.01	.751	2.023	**.043***	**0.17**
	No	161	3.88	.749			
CT-Skills	Yes	820	3.96	.498	3.138	**.002***	**0.27**
	No	161	3.83	.468			

Note. p <.05, AI: artificial Intelligence, CT: computational thinking

Teachers who advocated the use of AI in education had significantly higher AI awareness than those who did not (t = 7.506; p < 0.05; d = 0.65). A difference was found in both the total score and the sub-dimensions. The calculated effect size was small in the theoretical knowledge sub-dimension and moderate in the other dimensions. Teachers' CT skills were also higher than those who advocated using AI in education (t = 3.138; p < 0.05; d = 0.27). The calculated effect size for the difference in the creativity and critical thinking sub-dimensions of CT skills was small.

3.3. The Relationship Between Teachers' CT Skills and AI Awareness (RQ3)

Table 14 presents the results of the Pearson correlation analysis conducted to determine whether there is a correlation between teachers' AI awareness and CT skills.

Table 14

Correlation between teachers' CT skills and AI awareness

Variables	1	2	3	4	5	6	7	8	9	10
(1) Algorithmic Thinking	1									
(2) Creativity	.42*	1								
(3) Problem Solving	-.18*	-.003	1							
(4) Cooperativity	.35*	.59*	-.05	1						
(5) Critical Thinking	.61*	.69*	-.15*	.56*	1					
(6) CT-Skills	.68*	.76*	.34*	.64*	.75*	1				
(7) Practical Knowledge	.34*	.41*	-.05	.31*	.36*	.39*	1			
(8) Belief-Attitude	.35*	.28*	-.19*	.24*	.33*	.27*	.57*	1		
(9) Ability to Associate	.39*	.29*	-.17*	.24*	.37*	.31*	.57*	.68*	1	
(10) Theoretical Knowledge	.34*	.35*	-.12*	.21*	.32*	.31*	.61*	.59*	.73*	1
(11) AI-Awareness	.42*	.39*	-.16*	.30*	.41*	.38*	.82*	.86*	.86*	.83*

According to the correlation analysis, a moderately significant, positive relationship was found between teachers' AI awareness and CT skills ($r = .38$; $p < .05$). As teachers' AI awareness increases, their CT skills increase, and vice versa. Furthermore, significant correlations were found in all sub-dimensions. However, the lowest correlation was between the CT problem-solving sub-dimension and the AI theoretical knowledge sub-dimension [$r = -.127$; $p < .05$], and the highest correlation was between the CT creativity sub-dimension and the AI practical knowledge sub-dimension [$r = .412$; $p < .05$].

DISCUSSION AND CONCLUSION

4.1. Teachers' AI Awareness and CT Skill Level

Participating teachers' AI awareness levels were well above average (3.72/5.00). The highest mean was found in the practical knowledge dimension, indicating that teachers consider themselves competent in using AI. In contrast, the lowest mean was found in the belief-attitude dimension. Güneyli et al. (2024) also reached similar conclusions. These results suggest that teachers are hesitant regarding their perspectives on AI and their level of adoption of this technology. Çam et al. (2021) found that although pre-service teachers were aware of AI, their knowledge mainly remained theoretical. While they accepted the role of AI in education, they needed more guidance on how to use it. Similarly, Erdoğdu and Çakır (2024) stated that pre-service teachers' AI literacy levels were moderate and had deficiencies in the usage, evaluation, and ethics dimensions. On the other hand, Uygun et al. (2024) revealed that while teachers' theoretical knowledge was strong, their practical knowledge and integration skills were moderate. This situation highlights teachers' difficulty in applying theoretical knowledge to practice and the need for further training. Furthermore, concerns that AI could threaten the teaching profession can also be considered a factor influencing awareness levels.

In this study, we also measured teachers' CT skills and found that their total scale score was above average (3.94/5.00). Regarding sub-dimensions, the highest mean was found in creativity, while the lowest was in problem solving. These findings suggest that teachers effectively demonstrate creative thinking skills in CT processes. However, they fail to achieve the same level of competence in problem-solving and require further development in this area. Adopting teaching methods conducive to the development of problem-solving skills can foster relevant skills. One such approach is problem-based learning, which enhances individuals' competencies in solving real-life problems, supports their ability to access information, and serves as a guiding force in the learning process (Topal et al., 2025). Yaman and Yalçın (2005) determined that the problem-based learning approach improved prospective teachers' creative thinking skills more than traditional methods. Therefore, it can be said that teachers' CT skills are high, and problem-solving is the dimension most in need of development.

4.2. AI Awareness and CT Skills According to Sociodemographic and Professional Variables

This study examined how teachers' AI awareness varies across sociodemographic and professional variables. Güneyli et al. (2024) stated that teachers' AI awareness is independent of demographic characteristics, but in this study, we found differences and significant effect sizes across many variables. We visualized the results on the differentiation of teachers' AI awareness and CT skills across various sociodemographic variables in Figure 1.

Figure 1

Heat map of effect sizes

	Gender		School Location		Type of School		Married		Graduate		In-service Training		AI Usage		AI Should Be Used	
	Female	Male	Urban	Rural	Public	Private	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
CT-T									0,22		0,23		0,17		0,27	
Cr											0,29		0,18		0,31	
Co									0,20							
A-T		0,35					0,15		0,30		0,23					
C-T		0,13									0,20		0,19		0,17	
P-S	0,32					0,29		0,24								
AIA-T		0,35							0,25		0,31		0,57		0,65	
P-K		0,27							0,28		0,35		0,59		0,61	
B-A		0,31	0,17		0,36						0,12		0,47		0,58	
A-A		0,34							0,20		0,29		0,47		0,58	
T-K		0,23							0,26		0,30		0,34		0,37	

Note. CT-T: computational thinking (total score), Cr: Creativity, Co: Cooperativity, A-T: Algorithmic Thinking, C-T: Critical Thinking, P-S: Problem Solving, AIA-T: Artificial Intelligence Awareness (Total), P-K: Practical Knowledge, B-A: Belief-Attitude, A-A: Ability to Associate, T-K: Theoretical Knowledge, In-Service Training: It is about whether the teacher has received in-service training on educational technologies (AI, digital tools, technology integration, etc.), AI Usage: It is about whether teachers use AI models/tools, AI Should Be Used: It is about whether teachers agree that AI should be used in the teaching process.

Gender. The first significant finding we identified was that male teachers had higher AI awareness. İçöz and İçöz (2024) reached the same conclusion, but they worked with preservice teachers. Interest in digital systems, using them more effectively, and following developments in the AI field may have contributed to this difference. Banaz and Demirel (2024) found that female preservice teachers had higher AI literacy than male preservice teachers. Considering that awareness is more cognitive and theoretical than literacy, it can be assumed that female preservice teachers are more competent in practical applications and use technology more consciously and systematically. However, these findings from the literature are insufficient to make a strong argument. In this context, diversifying self-report-based measurement methods may be necessary to strengthen the existing evidence for AI awareness and AI literacy for teachers and preservice teachers. Indeed, Demir and Beyazhançer (2024) found that preservice teachers' AI self-efficacy perceptions did not differ significantly by gender. Therefore, prospective teachers believe they can successfully apply their AI knowledge and skills.

Teachers' CT skills did not differ in total scores based on gender. However, male teachers had higher algorithmic thinking skills, while female teachers had higher problem-solving skills. Lin and Wong (2024) determined that males generally performed better in algorithmic thinking skills than females. Similarly, Iqbal Malik et al. (2019) noted that males were more successful in algorithmic thinking, while females excelled in problem-solving. This evidence suggests that female teachers can develop faster, more effective, and more creative solution strategies in problem-solving processes, while male teachers can solve problems in a more planned and systematic manner. We also found that male teachers had higher critical thinking skills. However, the effect size was very small. Indeed, some studies in the literature have found evidence that female students have higher critical thinking skills (Albarracín-Vivo et al., 2024; Salahshoor & Rafiee, 2016; Shubina & Kulakli, 2019). Bagheri and Ghanizadeh (2016) found that gender is not a determining factor in critical thinking skills. Although Korkmaz et al. (2015) found that male students in higher education perceive themselves as more successful than female students in critical thinking, they also noted that this perception does not fully align with the literature. In conclusion, there is strong evidence in favour of male teachers for algorithmic thinking and in favour of female teachers for problem-solving skills. However, it can be argued that the observed differences in critical thinking skills cannot be explained solely by gender.

Marital status. Another finding is that teachers' AI awareness scores did not differ significantly by marital status. This suggests that whether teachers are married or single has no impact on AI awareness. Studies directly examining the impact of marital status on AI awareness are pretty limited in the literature. A study by İçöz and İçöz (2024) found that single prospective teachers had higher AI awareness levels than married prospective teachers. This finding suggests that marital status may affect technology awareness. Factors like single teachers having more free time and opportunities to engage with new technologies may explain this difference in awareness levels. However, a study by Abbak (2018) examining classroom teachers' competence and innovation levels found no significant differences by marital status. While they do not directly focus on AI awareness and are not directly consistent with the current study, it can be considered that the impact of marital status on technological and innovative approaches in education may be limited in general.

According to the findings regarding CT skills, single teachers had higher problem-solving skills, while married teachers had higher algorithmic thinking skills. This suggests marriage may contribute to individuals' more planned, systematic, and solution-focused thinking. Orim and Egwo (2020) found that married teachers employed a more disciplined, planned teaching process. While this is unrelated to algorithmic thinking, it suggests that systematic, structured study habits can support a more organised, progressive thinking process. The higher problem-solving skills of single teachers may be related to their tendency toward more flexible, independent decision-making. However, some studies in the literature (Demirtaş & Dönmez, 2008; Güleç, 2020; Serin, 2006) suggest that marital status does not significantly affect problem-solving skills. The very small effect size we detected also supports this evidence. In conclusion, our results contribute to the limited literature on the effect of marital status on cognitive skills and indicate that married individuals may exhibit a more structured thought process, especially in algorithmic thinking.

Graduate. This study found that teachers with graduate degrees have higher AI awareness. Research directly examining the impact of education level on AI awareness is limited. Uygun et al. (2024) suggest that younger graduate-level teachers have higher AI awareness. Razia et al. (2023) suggest that AI literacy in higher education institutions is increasing and that academic staff are increasingly adapting to AI technologies. However, the relevant research found no evidence that AI literacy increases with increasing education. In this context, the higher levels of awareness found among graduates in the current study suggest that education may effectively increase knowledge and awareness of AI. Madoń (2024) states that as education levels increase, individuals interact with AI, and these technologies become more prevalent in individuals' lives.

We found that teachers with graduate degrees also have higher CT skills. Teachers with graduate degrees were found to be more successful, particularly in algorithmic thinking and cooperation. These findings suggest that teachers' algorithmic thinking and cooperativity skills improve as their level of education increases. Gasaymeh and AlMohtadi (2024) report that individuals progress in more systematic thinking and problem-solving processes as their academic level increases. Romero et al. (2017) note that collaborative learning positively affects cognitive skills. In this context, the fact that teachers with graduate degrees have more opportunities to engage in collaborative projects and group work during academic processes may have supported the development of these skills.

Professional experience. Another finding is that teachers' AI awareness did not differ based on professional experience. Only teachers with 1-5 years of experience were found to have significantly higher AI awareness on the belief-attitude subscale than teachers with 11-15 years of experience. Eker and Halıcı Gürbüz (2024) suggest that professional experience is not a determining factor in teachers' attitudes toward AI. Factors such as familiarity with digital technologies, awareness of educational technologies, and openness to innovative approaches may have improved novice teachers' perceptions and attitudes toward AI.

A significant difference was found in teachers' CT skills based on their professional experience. This difference was present in all sub-dimensions except the critical thinking sub-dimension. As professional experience increases, so do cooperation, algorithmic thinking, and creative skills. However, the opposite was true for problem-solving. Teachers with 6-15 years of experience had higher CT skill scores than novice teachers and teachers with 16 or more years of experience. This suggests that teachers with limited professional experience and the most experienced teacher group have lower proficiency in computational thinking skills. A similar situation applies to the algorithmic thinking sub-dimension. Therefore, it can be assumed that when teachers reach a certain level of professional maturity, they become more systematic in their thinking and more conscious of their use of technology. However, these skills decrease among teachers with 16 years of experience. A study by Şimşek et al. (2013) found that the technology-based teaching skills of more experienced faculty decrease. Similarly, a study by Ağırtaş and Çavuş (2022) found that academics aged 40 and over have a decreasing interest in technology. This suggests that educators may be less inclined to adapt to technology and innovation after many years of work.

The literature examines the impact of age on CT skills in various ways. Korkmaz et al.'s (2015) study indicates that individuals in older age groups have higher CT skills, with algorithmic, critical, and problem-solving skills particularly developing in this age group. Studies in the literature have yielded varying results based on age. Age does not significantly affect problem-solving skills, but individuals' interactions with technology and learning approaches may differ by age (Kutluca, 2018; Schreglmann & Doğruluk, 2012). These findings reveal the relationship between professional experience and CT skills. While studies directly focusing on this topic are limited in the literature, Fagerlund et al.'s (2022) study indicates that professional experience is an important factor in teaching CT. Consequently, professional experience improves CT skills to a certain extent, but these skills tend to stabilise or decline over many years of experience. This situation highlights the importance of continuous professional development and adaptation to new teaching methods.

Teaching level. Another finding we found was that AI awareness varies depending on the teaching level at which teachers work. The lower average scores of preschool teachers, particularly on the practical knowledge sub-dimension, can be explained by the lower prevalence of AI-based technologies in preschool education. Uyak et al. (2023) reported that preschool teachers generally use technology as a visual support tool in the classroom, while technological integration at the cognitive level remains limited. Mart and Kaya's (2024) study also indicated that, despite preservice teachers' positive attitudes toward AI, their practical knowledge is limited and varies by age and grade level. Therefore, we believe that exploring the practices and potential benefits of AI in preschool education will be important.

The findings reveal differences in CT skills across teachers' teaching levels. Preschool teachers scored higher than teachers at other levels on CT skill total score, creativity, and critical thinking. This finding may be related to the greater adoption of play and creative drama activities in preschool education. However, the effect size for this finding is very small. Contrary to these findings, Korkmaz (2009) argued that teaching level does not significantly affect critical thinking dispositions. Therefore, more substantial evidence is needed to support the claim that teaching level influences teachers' CT skills.

School location. There is no difference in AI awareness between teachers in public and private schools. We found that public school teachers have a more positive perspective on AI than private school teachers, solely in terms of beliefs and attitudes. The relatively limited number of participants in this study who worked in private schools may have contributed to this finding. On the other hand, Mariam Mathews et al. (2024) note that private schools are adopting AI and digital technologies faster than public schools, while budget and infrastructure constraints in public schools hinder integration. Similarly, Aldawsari (2024) states that there is no statistical difference in awareness between public and private schools, but that in public schools, lack of infrastructure and financial support hinders integration. These contradictory findings suggest that AI awareness and attitudes depend not solely on technological infrastructure; teachers' work environments, opportunities, and experiences can also be determinants. The fact that public school teachers, despite greater access to technology, have developed a more conscious, inquisitive attitude toward AI supports this finding. The widespread use of technology in private schools does not definitively indicate that it directly strengthens teachers' beliefs about AI. Conversely, it can be concluded that public school teachers may develop a higher awareness of AI despite limited resources.

The findings of this study also showed that CT skills did not differ across school types. Only in the problem-solving subscale were teachers in private schools significantly more successful. This finding can be explained by the infrastructure provided by private schools and the supportive policies implemented for teacher professional development. Indeed, Fraillon et al. (2020) argued that in different countries, administrations provide various supports to schools to enable teachers to use ICT more effectively, and that private school teachers generally have greater access to professional development opportunities in this regard.

School type (urban or rural). Teachers' awareness of AI does not differ by school location. Only teachers in urban schools had higher beliefs and attitudes toward AI than teachers in rural schools. However, research suggests significant differences between rural and urban areas in access to digital educational tools, teachers' digital skills, and AI awareness. Ökten (2024) notes that access to digital educational tools is limited in rural areas and that students from low-income households struggle to access digital resources. This creates similar access limitations for students and teachers in rural areas, making it difficult for them to adapt to technology. Nerse (2020) notes that, due to limited access to digital tools, rural teachers' digital literacy and technology adoption are lower than those of their urban counterparts, thereby directly affecting students' interactions with technology. Du et al. (2024) note that teachers working in urban areas have higher AI awareness, attributing this to their greater exposure to AI applications and experience with these technologies. Therefore, access to digital resources and opportunities to interact with technology may play a decisive role in teachers' AI awareness.

We also found that teachers' CT skills did not differ by the school's location. While this is an important finding regarding equal opportunities, it also raises the question of how teachers in rural areas overcome disadvantages and acquire these skills. Simmonds et al. (2019) noted that teachers in rural areas lack confidence in CT. However, we believe that the recent acceleration of digitalisation in education, particularly the accessibility of teachers in rural areas to professional development through distance education platforms, supports this equality of opportunity. Therefore, it can be argued that teachers' CT skills in rural schools vary depending on the infrastructure provided by countries, economic conditions, educational policies, and differences in digitalisation levels.

In-service training on educational technologies. In this study, in addition to determining whether teachers' AI awareness and CT skills differ according to various socio-demographic variables, in order to enrich the findings, we also examined the differentiation according to whether they use AI, whether they support the use of AI in education, and whether they have received in-service training on this subject. In this context, we found that teachers who have received in-service training on educational technologies have higher AI awareness. Gülel et al. (2023) also state that AI training for teachers improves their knowledge in this field and increases their interest in technology. Kaya and Köseoğlu (2024) state that AI seminars for teachers increase awareness. It has been observed that these trainings increase teachers' knowledge levels and positively contribute to preparing course materials, evaluating student work, and integrating into teaching. Gaber et al. (2023) found that individuals with high technology-use skills also have high AI awareness. Consequently, AI awareness can be improved through in-service training on educational technologies. In this context, teachers with advanced digital skills are expected to adapt more easily to new technologies and be more willing to integrate AI into teaching processes. Whether this positive impact is sustainable, reflected in the learning process, or due to the technology's innovation remains unclear.

Teachers who reported receiving in-service training on educational technologies also had higher CT skills. It is suggested that after receiving in-service training, teachers integrate CT skills into STEM lessons more consciously (Wu et al., 2020) and use them more effectively in the classroom (Dagienė et al., 2022). Rodrigues et al. (2025) indicate that training programs significantly improve teachers' algorithmic thinking and problem-solving skills. Similarly, Tripon (2022) emphasised that CT skills develop directly through educational processes and that teachers' problem-solving and analysis skills are strengthened through this training. Therefore, teachers' participation in training to enhance their knowledge of educational and innovative technologies will contribute to the development of CT skills.

Teachers' AI usage. During the period this study was conducted, teachers who reported using AI tools had significantly higher AI awareness and CT skills than those who did not. Seyrek et al. (2024) found that teachers' frequent use of AI tools influenced their perspective on this technology. They also suggested that teachers who use AI more actively in their teaching believe in its potential and tend to use it more widely in the future. Ahmad et al. (2024) found that individuals who use AI tools perceive its benefits more than those who do not. This suggests that AI awareness can develop more through experience than through knowledge acquisition. Banaz and Maden (2024) stated that preservice teachers who follow news about AI develop a more positive attitude toward this technology. Consequently, teachers who actively use AI tools have higher levels of awareness, which may, though to a small extent, affect CT skills. However, teachers' awareness is as important as their effective use of AI.

Approving the AI Usage in education. We found that teachers who believe AI should be used in education have higher AI awareness than those who do not. This suggests that for AI awareness to develop, teachers must first perceive it positively and believe in its effectiveness. A study by Akkol and Balkan (2024) indicates that many teachers are eager to use AI technologies in education but encounter various challenges during integration. Similarly, Köse et al. (2023) emphasised that teachers find AI-supported tools helpful in increasing student achievement and individualising teaching. However, they cannot fully integrate these technologies due to technical limitations and inadequate training. Çam et al. (2021) found that pre-service teachers believe AI can contribute to the educational process, but they differ in their views on its advantages and disadvantages. Therefore, it can be said that AI awareness is directly related not only to positive attitudes toward AI but also to the level of its use and knowledge. Cojean et al. (2023) indicate that teachers believe AI can alleviate workload, but remain reserved toward these technologies due to ethical and data security concerns. In particular, teachers have reservations about how AI-enabled systems will inform student assessments, how data will be stored, and how they will alter teacher-student interactions. Similarly, Köse et al. (2023) also noted that while teachers support AI use, data security, ethical issues, and privacy pose significant obstacles to its integration. Teachers believe in AI's potential benefits in education but require supportive training to use these technologies more effectively (Pokrivcakova, 2023; Rapti & Panagiotidis, 2024).

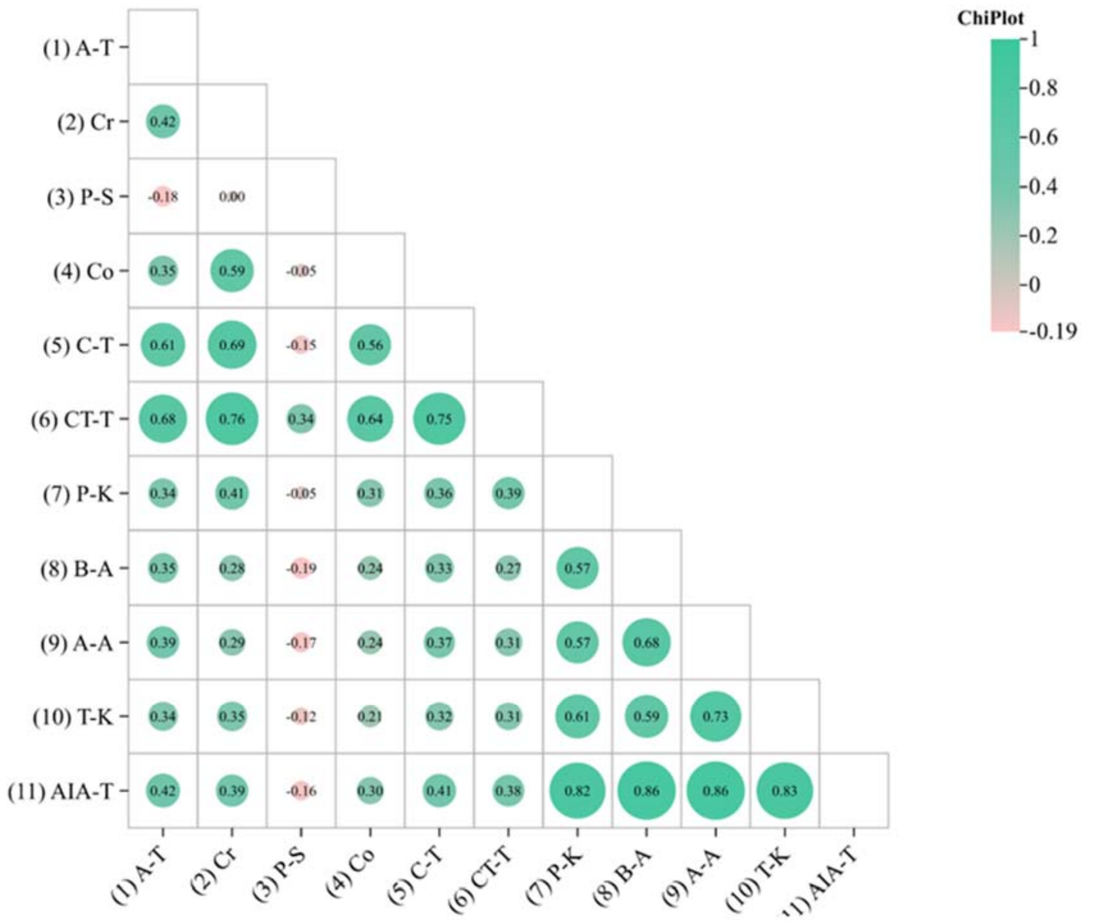
Teachers who believed AI should be used in education also had higher CT skills. Teachers with a positive attitude toward AI were particularly successful in creative and critical thinking skills. The fact that these teachers are aware of and embrace the opportunities offered by AI also indicates that they have a more innovative, critical-thinking-oriented perspective. Rodríguez-García et al. (2020) also demonstrated that using AI tools in education can potentially improve individuals' CT skills. Weng et al. (2024) argued that CT skills enhance AI literacy, thereby supporting the conscious use of AI-based technologies. Therefore, it can be argued that teachers' tendency to support AI relates to how they structure their cognitive processes.

4.3. The Relationship Between AI Awareness and CT Skills

Another finding in this study is that, according to the correlation analysis results, there is a moderately significant positive relationship between teachers' AI awareness levels and their CT skills. The correlation heat map of the relationships between AI awareness and CT skills is visualised in Figure 2.

Figure 2

Correlation Heat Map



Note. A-T: Algorithmic Thinking, Cr: Creativity, P-S: Problem Solving, Co: Cooperativity, C-T: Critical Thinking, CT-T: Computational Thinking (total score), P-K: Practical Knowledge, B-A: Belief-Attitude, A-A: Ability to Associate, T-K: Theoretical Knowledge, AIA-T: Artificial Intelligence Awareness (Total). The correlation heat map was drawn using ChiPlot (https://www.chiplot.online/)

Accordingly, it can be argued that as teachers' AI skills increase, their AI awareness increases, and vice versa. No literature has identified a relationship between teachers' AI skills and AI awareness. However, studies focusing on similar variables support our conclusion. For example, Celik (2023) demonstrated that CT skills directly relate to AI literacy. He also emphasised that AI plays a fundamental role in developing the ability to recognise, evaluate, and effectively use AI-based technologies. Guggemos (2024) found that individuals with higher AI literacy are better at collaborating, a finding consistent with ours. Ertmer and Ottenbreit-Leftwich (2010) suggest that technological awareness can help teachers develop more effective teaching methods by increasing their self-efficacy. Accordingly, it can be predicted that AI awareness can similarly support teachers' self-efficacy and improve their ability to design and implement innovative teaching methods. Kasinidou et al. (2025) demonstrate a positive relationship between teachers' digital skills and AI awareness. However, it has been stated that many teachers have not received AI training and require further training and support to develop their skills in this area. In another study, Koehler et al. (2013) suggest that technological awareness can improve teaching processes. While our findings do not provide strong evidence of a causal effect, when considered alongside other evidence regarding demographic variables, developing AI awareness and CT skills may contribute to adopting pedagogies conducive to more effective and efficient learning by increasing innovation in education. In conclusion, the relationship we found in this study between AI skills and AI awareness suggests that teachers need both to ensure more effective and efficient learning. In other words, teachers' development of AI awareness is reflected in their AI skills, and vice versa.

4.4. Limitations and Recommendations

This study examines teachers' AI awareness and CT skills. We recommend that readers consider some of the study's limitations. Teachers lacking sufficient knowledge or interest in AI and CT topics may have been reluctant to participate. This could be considered a sampling limitation. The higher participation rate among teachers from public schools compared to private schools could also be considered a limitation. Furthermore, the data for this study were collected during the 2024-2025 academic year and are limited to 981 teachers. The continuous development of educational technologies and the increasing access to technology can lead to ongoing changes in teachers' relevant skills. Therefore, readers and practitioners need to consider these issues.

The statistically significant differences we identified and the measurement capacity of the data collection tools may limit the effect sizes we calculated. Using new or revised scales to measure variables such as AI and CT directly related to emerging technologies (e.g., Generative AI) could yield more reliable evidence. We also believe that the findings are based on self-reports and require further validation through research using practice-based measurement tools. Based on the evidence regarding the differences we identified, we believe there is a need to improve teachers' problem-solving skills, increase opportunities to experience AI tools, and include more frequent activities to develop AI awareness and CT skills in pre-service and in-service teacher education. More concretely, modules can be developed with ethical considerations to improve teachers' AI awareness and CT skills in the context of professional development. Furthermore, we recommend encouraging teachers to pursue postgraduate education. This study provided quantitative evidence on differentiation by sociodemographic variables and on the relationship between CT skills and AI awareness. This finding can be supplemented with qualitative findings in future research to better understand teachers' experiences and perspectives on CT and AI. We recommend that readers and new researchers keep in mind that our findings are based on self-report data. Teachers may have considered themselves competent in AI awareness. Therefore, an interventional research process conducted with ethical use in mind could yield more substantial evidence and practice-informed findings regarding both AI literacy and AI skills.

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GENİŞLETİLMİŞ ÖZ

Giriş

Teknolojinin hızla ilerlemesi, eğitim alanının gelecekte yenilikçi teknolojilere daha yatkın hale geleceğini ortaya koymakta ve bu durum yapay zekanın (YZ) eğitimde kalıcı bir yer edinebileceğini göstermektedir (Renz & Hilbig, 2020). Günlük yaşantının ayrılmaz bir parçası haline gelen bu teknolojilerin geliştirilmesi ve kullanılması, başarıyı yakalama hedefi olan her kurum, kuruluş ve devlet açısından hayati önem taşımaktadır (Bughin vd., 2017; Coşkun & Gülleroğlu, 2021; Makridakis, 2017). Ancak bu teknolojilerin geliştirilmesi yetmez, bu sistemleri anlayıp doğru şekilde kullanabilecek bireylerin yetiştirilmesi de gerekir.

Üretken YZ modelleri olarak bilinen ChatGPT, Gemini, Copilot vb. araçların, bireysel öğrenme olanağı sağlaması, öğretmenlere öğretimi planlamada kolaylık sağlayarak zaman kazandırması, sürekli erişilebilir olması, hataları anında düzeltme ve dil becerilerini geliştirme gibi avantajları varken; çıktıların kaynak gösterilmeden kullanılması ve öğrenci ödevlerinde adaletsiz bir öğrenme ortamı yaratması, yanlış bilgi üretme riski ve hile yapma eğilimleri gibi dezavantajları da bulunmaktadır (Fodouop Kouam, 2024; Karaman & Göksu, 2024; Liu vd., 2024; Ofosu-Ampong vd., 2023; Sok & Heng, 2023; Sullivan vd., 2023; van den Berg & du Plessis, 2023). Bu nedenle, üretken YZ araçlarının eğitimde sorumlu ve etik bir şekilde kullanılması büyük önem taşımaktadır. Bu araçların sorumlu bir şekilde kullanımı, eğitimde adaletin ve etik değerlerin korunması açısından önemlidir (Grassini, 2023). Bunu sağlamak, YZ farkındalığına sahip olmakla mümkün olabilir.

Öğretim faaliyetlerinde bilgisayarca düşünme (BD) becerileri de öğrencilerin düşünme süreçlerini desteklemesi bakımından önemlidir. Öğretmenler bu becerilerin öğrencilere kazandırılmasında temel bir rol üstlenebilir; ancak öncelikle kendilerinin bu becerilere sahip olması beklenmektedir. Böylece her iki paydaş da dijital dönüşümü verimli bir şekilde yönetebilir ve bu yeni çağın gerektirdiği becerilere uyum sağlayabilir (Ansen Gürkan vd., 2025; Dai vd., 2020). Csizmadia ve diğerlerine (2015) göre BD, problem çözme sürecinde problemin özünü anlamayı gerektiren bir süreç, Bundy'e (2007) göre ise bilişsel yetileri geliştiren ve farklı disiplinler üzerinde etkileri bulunan bir beceridir. Korkmaz ve diğerleri (2015), BD'yi bireylerin günlük yaşam sorunlarını bilgisayarlar aracılığıyla çözmek için gerekli bilgi ve becerilere sahip olma yetisi olarak tanımlamaktadır. ISTE tarafından yapılan tanıma göre ise BD, teknoloji yardımıyla problem çözmeye yönelik bir düşünme yaklaşımı olarak ifade edilmektedir (ISTE, 2025; Karaçaltı vd., 2018; Korkmaz vd., 2015).

BD, öğrencilerin dijital dünyada karşılaştıkları karmaşık sorunları çözme yeteneklerini geliştiren temel bir beceri olarak öne çıkmaktadır. Bu doğrultuda, dünya genelinde birçok ülke, eğitim müfredatlarını bu beceriyi kazandırmaya yönelik olarak yeniden yapılandırmaktadır. Yadav ve diğerleri (2016), BD becerisinin, yalnızca bilgisayar bilimleriyle sınırlı kalmayıp, erken yaşlardan itibaren çeşitli müfredatlara entegre edilebilecek potansiyele sahip olduğunu vurgulamaktadır. Benzer şekilde Falloon (2024), bu becerilerin erken yaşlarda kazandırılmasının önemine dikkat çekerek, öğrencilerin YZ uygulamalarını amacına uygun olarak kullanma, dijital dünyada daha bilinçli bir şekilde yer alma ve algoritmaların işleyişini kavrama gibi konularda daha bilinçli hale gelmelerine olanak tanıyacağını ifade etmektedir. Nitekim yapılan güncel çalışmalar (Lee & Xiong, 2024; Weng et al., 2024; Liao et al., 2024), YZ'yı öğrenme ortamlarına entegre etmenin BD becerilerini kazandırmada ve genel akademik performansı artırmada başarılı olduğunu ortaya koymuştur. Dolayısıyla öğretmenlerin YZ farkındalık düzeyinin, BD becerilerini kazandırma sürecinde kilit bir rol oynadığı düşünülmektedir. Bu beceriler, yapay zekâ tabanlı programları anlamak ve geliştirmek için de giderek daha önemli hale gelecektir (Mills vd., 2025). Literatür, yapay zekâ ve BT değişkenlerini birlikte inceleyen ve aralarındaki ilişkiyi belirleyen çalışmaların sınırlı olduğunu göstermektedir. Öğretmenler arasında BT ile yapay zekâ farkındalığı değişkenleri arasındaki ilişkiyi inceleyen önceki bir araştırmanın olmaması, çalışmamızın değerini daha da vurgulamaktadır. Bu çalışmada bu iki beceri arasındaki ilişkiyi anlamaya ve kanıt bulmak amaçlanmıştır. Ayrıca bu iki değişkenin çeşitli sosyo-demografik ve mesleki değişkenlere (cinsiyet, medeni durum, lisansüstü eğitim alma durumu, mesleki deneyim, görev yaptığı eğitim kademesi ve türü, görev yaptığı okulun yerleşim yeri, eğitim teknolojileri eğitimi alma durumu, YZ araçları kullanım durumu, YZ'nin eğitimde kullanılmasını destekleme durumu) göre farklılaşıp farklılaşmadığı ortaya konmuştur.

Yöntem

Bu çalışma, ilişkisel tarama modeliyle yürütülmüştür. Bu çalışmanın katılımcıları, Türkiye'nin farklı bölgelerinde devlet veya özel okullarda görev yapmakta olan toplam 981 öğretmenden oluşmaktadır. Verileri toplamak amacıyla Demografik Bilgi Formu, Yapay Zekâ Farkındalık Düzeyi Ölçeği (Ferikoğlu & Akgün, 2022) ve Bilgisayarca Düşünme Ölçeği (Korkmaz vd., 2017) kullanılmıştır. Veriler normal dağılıma sahip olup, bağımsız gruplar *t*-testi, tek yönlü varyans (ANOVA), farkın hangi grup lehine olduğunu tespit etmek için ise verilerin homojen dağılım durumlarına göre Post hoc analiz yöntemlerinden Tukey veya Tamhane testi uygulanmıştır. Son olarak, Pearson korelasyon analizi gerçekleştirilmiştir. Etki büyüklüğünü hesaplamak amacıyla, grup karşılaştırmalarında Cohen's *d* ve eta kare (η^2) kullanılmıştır.

Bulgular, Tartışma ve Sonuç

Araştırmaya katılan öğretmenlerin YZ farkındalığı ve BD beceri düzeyleri incelenmiş ve ortalamanın çok üzerinde olduğu görülmüştür. Bir diğer bulguya göre, erkek öğretmenlerin YZ farkındalığı ve algoritmik düşünme becerileri, kadın öğretmenlerin ise problem çözme becerileri daha yüksek çıkmıştır. Ayrıca bekar öğretmenlerin problem çözme becerileri, evli öğretmenlerin ise algoritmik düşünme becerileri daha yüksek çıkmıştır. Bu çalışmada lisansüstü eğitim yapmış olan öğretmenlerin hem YZ farkındalığı hem de BD beerilerinin daha yüksek olduğunu tespit ettik. Öğretmenlerin mesleki deneyime göre YZ farkındalığı farklılaşmamakta, BD becerilerinde ise mesleki deneyim arttıkça işbirlikli öğrenme, algoritmik düşünme ve yaratıcı düşünme becerisi yükselmektedir. YZ uygulama bilgisi alt boyutunda okul öncesi öğretmenlerin ortalama puanları diğer eğitim kademelerine göre düşük çıkmıştır. Ancak hem BD becerisi toplam puan, hem de yaratıcı düşünme ve eleştirel düşünme becerileri açısından okul öncesi öğretmenleri diğer eğitim kademelerinde görev yapan öğretmenlerden daha başarılı bulunmuştur.

Devlet okulları ile özel okullarda görev yapan öğretmenlerin YZ farkındalığı ve BD becerisi farklılaşmamaktadır. YZ'ya ilişkin inanç-tutum açısından merkezi okullarda görev yapan öğretmenler, daha yüksek puana sahiptir. Ayrıca, eğitim teknolojileri konusunda eğitim aldığını, YZ'yı deneyimlediğini ve eğitimde kullanılması gerektiğini düşünen öğretmenlerin hem YZ farkındalığı hem de BD becerileri daha yüksek çıkmıştır. Öğretmenler, YZ'nin eğitimdeki potansiyel faydasına büyük ölçüde inanmakta, ancak bu teknolojileri daha etkili kullanabilmek için destekleyici eğitimlere ihtiyaç duymaktadırlar (Pokrivcakova, 2023; Rapti & Panagiotidis, 2024). Son olarak YZ farkındalığı ile BD becerileri arasında istatistiki anlamda pozitif yönde bir korelasyon tespit edilmiştir. Bulgulara göre öğretmenlerin BD becerileri arttıkça YZ farkındalığının da arttığı veya tersi söylenebilir. Literatürde BD becerisi ile YZ farkındalığı arasındaki ilişkiyi tespit eden araştırmaya rastlanmamıştır. Ancak benzer değişkenlere odaklanan araştırmalar ulaştığımız sonucu desteklemektedir (Celik, 2023; Ertmer & Ottenbreit-Leftwich, 2010; Kasinidou vd., 2025).

Sınırlılıklar ve Öneriler

Bu çalışma, 2024-2025 akademik yılında 981 öğretmenden toplanan verilerle sınırlıdır. Sonuçlara dayanarak; öğretmenlerin problem çözme becerilerini geliştirmeye, YZ araçlarını deneyimleme fırsatlarını arttırmaya, hizmet öncesi ve hizmet içi eğitimde YZ farkındalığını ve BD becerilerini geliştirme faaliyetlerine daha sık yer verilmesine ihtiyaç olduğu söylenebilir. Bu çalışmada sosyodemografik değişkenlere göre farklılaşmaya ve BD becerileri ile YZ farkındalığı arasındaki ilişkiyi tespit etmeye ilişkin nicel kanıtlar elde ettik. Yeni araştırmalarda, öğretmenlerin BD ve YZ ile ilgili deneyimlerini ve görüşlerini derinlemesine anlayabilmek için nitel bulgularla desteklenebilir. Elde ettiğimiz bulguların öz bildirim verilere dayandığını okuyucuların göz ardı etmemesini öneriyoruz. Dolayısıyla etik hususlar göz önünde bulundurularak gerçekleştirilecek müdaheleli araştırma sürecinde hem AI okuryazarlığına hem de CT becerilerine yönelik daha güçlü ve pratiğe yön verecek somut kanıtlar elde edilebilir.