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Research Article

Teachers' artificial intelligence use and flexible thinking skills: Evidence from a predictive correlational study

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This study investigates the relationship between teachers' use of artificial intelligence (AI) technologies and their flexible thinking skills within learning processes, addressing a critical gap in the literature where limited research has examined this connection in the context of teacher education. A predictive correlational research design was employed to determine the direction and strength of the relationships between variables and to identify predictors of flexible thinking. The study population consisted of teachers working in public and private institutions across Türkiye, with a convenience sample of 195 teachers included in the final analysis. Data were collected using a Demographic Information Form, the Teacher Perception Scale on the Use of AI in Education, and the Flexible Thinking in Learning Scale. The findings indicated that teachers generally demonstrated moderate to high levels of perception regarding AI use and flexible thinking. Significant differences emerged among teachers who had received AI-related training, as they exhibited higher levels of cognitive flexibility and openness to learning technologies. Regression analyses further revealed that AI use significantly predicted flexible thinking, although the predictive power was modest. This study contributes uniquely to the field by demonstrating a positive association between AI use and flexible thinking in teacher education—a relationship that has been scarcely addressed in prior research. The results underscore the importance of integrating AI-focused training programs into teacher professional development to foster adaptability and innovative pedagogical approaches. Practical recommendations are provided for policymakers, teacher education institutions, and practitioners to strengthen the role of AI in enhancing teachers' flexible thinking skills.

Keywords: Artificial intelligence; Flexible thinking; Flexible thinking in learning; Teachers' use of artificial intelligence

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1. Introduction

The field of AI first entered the academic literature with the Dartmouth Conference in 1959. Broadly, AI refers to the ability of machines or computer systems to replicate human cognitive functions such as learning, reasoning, problem-solving, and decision-making (Russell & Norvig, 2021). The capabilities of AI are typically categorized into four dimensions: thinking humanly, thinking rationally, acting humanly, and acting rationally. Thinking humanly focuses on modeling human cognitive processes, including learning and decision-making. Thinking rationally emphasizes logical reasoning and perceptual abilities that enable machines to respond based on structured logic. Acting humanly refers to systems that perform tasks in ways considered

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intelligent if carried out by humans, often involving natural language processing, robotics, or affective computing. Finally, acting rationally concerns the design of systems capable of making optimal decisions by analyzing data and applying algorithms (Russell & Norvig, 2021; U.S. Department of Education, 2023).

AI refers to the theory and development of computer systems capable of performing tasks that typically require human intelligence, such as visual perception, speech recognition, learning, decision-making, and natural language processing. It encompasses computational methods designed to achieve goals autonomously by drawing inferences from theoretical frameworks or patterns in data. In contrast, augmented intelligence represents a human-centered partnership model in which humans and AI collaborate to enhance cognitive performance, including learning, decision-making, and the acquisition of new experiences (Regona et al., 2022; U.S. Department of Education, 2023).

Recent research has examined how AI can be effectively integrated into education (U.S. Department of Education, 2023). One of its primary goals is to support sustainable development by promoting lifelong, inclusive, and equitable quality education. Lifelong education emphasizes ensuring access to equal and high-quality learning opportunities for all children. In this context, AI-based educational applications are increasingly used to deliver equitable services and expand opportunities (İşler & Kılıç, 2021; Mnguni, 2023). AI also holds significant potential for reaching children who are unable to benefit from traditional schooling, including those with special needs receiving home education, hospitalized students, or children affected by sudden life events such as earthquakes and disasters. Overall, the use of AI in education contributes to fostering inclusivity, equity, and quality in learning environments (Ajani et al., 2025; Öztemel, 2020).

AI enables collaborative teaching methods when students cannot be physically present in the same location. It offers students options regarding when and where they want to engage in active learning. In collaborative education methods, AI facilitates computer-supported asynchronous activities. Students participating in asynchronous learning groups can be observed by their teachers. Educators motivate students to participate, monitor their engagement, and assess their performance in this context (Arslan, 2020). It is possible to use AI to develop easier learning styles for difficult subjects. AI can individualize learning. In areas where teachers may not be sufficient, AI applications can create virtual learning assistants. In situations requiring repetition or monitoring, AI can establish collaborative learning environments to help students maintain focus. AI assistants have already taken their place in educational applications (İşler & Kılıç, 2021; Sarıtiken, 2024).

Computer-assisted learning environments are widely used in education. They provide alternatives to support students' learning strategies through digital tools and AI. AI facilitates learning by understanding each student's learning pace, preferences, learning styles, strengths, and weaknesses. It develops algorithms to help students navigate different content according to their interests and needs. While creating formulas that personalize learning, AI offers equal opportunities to students with the help of teachers and schools. Intelligent tutoring systems are commonly used in developing countries (Arslan, 2020). Standard assessment methods in education have certain drawbacks. These include inequalities in access to technology, high costs, and the lack of consideration for emotional factors (Özer et al., 2023). Teachers spend more time than necessary evaluating students' assignments. Designing and implementing assessments can be challenging. They may measure only the student's immediate performance rather than providing a detailed analysis of learning. Assessments can be monotonous and may not adapt to the specific knowledge and skills of students. For these reasons, educators are increasingly using AI to evaluate students' assignments. AI is used to grade multiple-choice questions and essays (Çavuş, 2024; Swiecki et al., 2022).

AI can pose ethical threats in educational environments. Therefore, educators should be supported in developing AI literacy (Meylani, 2024). AI may encourage students toward shortcuts, foster reliance on ready-made information, and potentially devalue knowledge (Özer et al., 2023).

When AI applications are introduced to students, it is crucial to pay attention to universal values. Applications that respect and protect human rights, fundamental freedoms, and human dignity should be promoted. Universal diversity and inclusivity practices must be ensured. At the core of all applications should be the goal of creating peaceful, just, and interconnected societies. AI applications need to be based on a set of principles. The foremost principle is that they should be applied proportionately, moderately, and without causing harm to any individual. Security and safety are of paramount importance (Meylani, 2024). Data must be securely protected. Applications should be fair and non-discriminatory, with particular sensitivity toward issues such as gender inequality. Applications must be sustainable. Privacy and data protection rights must be strictly observed. AI systems should be transparent and explainable. Responsibility and accountability must be prioritized. Awareness and literacy should be encouraged. Applications should be multi-stakeholder, practical, and collaborative. All these universal values and principles must be integrated into all educational AI applications during their development and implementation (Feijóo et al., 2021; UNESCO, 2022).

In recent years, educational science research has increasingly focused on the dynamic relationships between AI and approaches to diversity, equity, and inclusion. According to data collected from scientific studies between 2013 and 2022, the trends in the use of AI in education have been examined. The main applications of AI in education during this period include: Personalized Learning, Automated Academic Assistants, Continuous Student Assessment, Intelligent Frameworks for Tutoring, Adapted Content for Instruction, Assignment Assistants, Virtual Reality, Dropout Prevention, Support for Students with Special Needs, Gamification, Enhanced Textbooks, and AI Ethics Policy. However, despite the rapid development of AI, the education system has not been able to keep pace with this momentum (Pham, 2025).

Successful use of AI in education is reported in various documents (e.g. Pratiwi et al., 2025). When using AI in learning and teaching environments, educators must remain at the center of instruction. There are moments during class management when teachers make real-time decisions. Teachers engage in an educational cycle that includes preparation, planning, reflection on teaching, and professional development. It is crucial for teachers to participate in decisions related to the design of AI-supported technologies. There is a cycle in which teachers are involved in selecting educational technologies and shaping their evaluation. Through this process, educators can provide appropriate learning environments not only for their own classrooms but also for the classrooms of their colleagues (U.S. Department of Education, 2023). AI-powered tools can identify students’ thoughts and respond to their interests in ways previous tools could not. By leveraging large language datasets, AI has the potential to tailor application-based problems to students’ areas of interest and discern the meaning behind students’ incorrect answers. If teachers can effectively predict and understand the responses given by students in the classroom, they can think creatively about new answers. This makes it possible to understand how and why a student might have produced a particular response (Ng et al., 2025).

In China, efforts are underway to develop AI technology that recognizes students' facial expressions and responds accordingly. A platform has been established that teaches foreign languages to many students at the cost of a single teacher. A "Super Teacher" capable of answering millions of questions asked by students simultaneously is being developed (Feijóo et al., 2021). In South America, Uruguay has implemented the Mathematics Adaptive Platform (PAM), an online adaptive learning tool aligned with the national mathematics curriculum. PAM offers personalized feedback tailored to each student's skill level, based on detailed analysis of learner interactions and experiences (Perera & Aboal, 2019). The platform has been widely adopted in primary education, with approximately half of all third- through sixth-grade students using it by 2016. Longitudinal data indicate that use of PAM leads to modest but meaningful gains in mathematics test scores—on the order of 0.2 standard deviations—and the impact is more pronounced among students from lower socioeconomic backgrounds (Perera & Aboal, 2019).

Nguyen et al. (2018) developed the project “Simpler Voice: Overcoming Literacy”, which leverages technology to address poverty by supporting adults who are illiterate or have limited literacy skills. In Brazil, a developing country, AI applications are widely implemented in schools to provide students with personalized learning experiences. Similarly, in Kenya, AI technologies are adapted to each student’s skills and abilities. Through a mobile platform aligned with national curriculum standards, students can access lessons delivered via SMS, making education more inclusive and accessible (UNESCO, 2023).

In Türkiye, the "National Artificial Intelligence Strategy 2021-2025," prepared in cooperation between the Presidency Digital Transformation Office and the Ministry of Industry and Technology, was enacted by Presidential Decree No. 2021/18 and published in the Official Gazette No. 31574 on August 20, 2021. When examining Türkiye’s AI goals, they can be summarized as follows: ensuring the emergence of products that respond to national needs and global trends with pioneering, inclusive, and sustainable solutions; training researchers; and playing an active role in the development of the entrepreneurship ecosystem in AI technologies (Yalçın, 2024).

According to the results of Güneyli et al. (2024), factors such as age, gender, education level, school type, institutional level, and monthly income had no significant effect on teachers’ AI awareness. However, when usage patterns were examined, it was found that practical training in universities would be more beneficial than receiving theoretical knowledge about AI. Özer et al. (2023) examined teachers' opinions regarding the use of AI in schools. According to the results, AI-based instructional tools have significant potential to improve student achievement. AI positively impacts areas such as personalized learning experiences, efficient learning environments, and the development of critical thinking skills. Additionally, AI facilitates classroom management and student assessments for teachers. It also has the potential to process data more systematically and provide objective feedback. Köse et al. (2023) investigated the importance of AI in education from the perspectives of teachers. According to the results, teachers showed a positive attitude toward the use of AI in education. They stated that AI could facilitate teachers’ tasks in educational processes and believed it could provide students with a more enjoyable and lasting learning experience. However, some teachers expressed concerns that AI, being an expensive technology, might lead to inequality among students. They also pointed out the potential risks related to data privacy for both students and teachers and the possibility that excessive use of technology could cause student laziness. The findings highlighted the need to ensure equal opportunities in education during the implementation of AI technologies. Teachers emphasized the importance of data privacy and expressed a desire to receive regular training on AI.

Flexible thinking refers to an individual's ability to restructure and utilize their existing knowledge according to changing circumstances (McCrae & Sutin, 2009). With the widespread advancement of digitalization, it has become essential for individuals to continuously update their knowledge and skills and to adopt the philosophy of lifelong learning (OECD, 2019). One of the main categories of essential skills required in today’s era has been defined as 21st-century skills (Khalili et al., 2024). In order to meet the demands of the new century, individuals' capacity for flexible thinking plays a critical role (Li, 2020). Today, teachers are also expected to continuously update themselves to respond to the changing needs of education (Directorate General for Teacher Training, 2017). Within this framework, flexibility plays a crucial role in enabling teachers to adjust learning objectives, content, and methods according to changing contexts and expectations (Pepin et al., 2017). Teachers’ ability to adapt to dynamic changes in learning environments, develop multifaceted solutions, address unconventional problems, and transfer knowledge across different contexts is of critical importance. This adaptability is a fundamental requirement for responding to dynamic classroom conditions and evolving student expectations (Barak & Levenberg, 2016; Deed et al., 2020). Teachers' level of flexibility directly influences their supportive behaviors toward student diversity, their sense of self-efficacy, and the way they implement evidence-based intervention strategies in inclusive classrooms (Lübke et al., 2021).

In the study conducted by Özen (2022), the impact of teachers' cognitive flexibility on their attitudes toward distance education practices during the COVID-19 period was examined. According to the research findings, there was a low-level relationship between teachers' levels of cognitive flexibility and their attitudes toward mandatory distance education. It was found that cognitive flexibility could predict only a small portion of these attitudes. In the study conducted by Erarslan (2023), it was aimed to determine whether English teachers' levels of cognitive flexibility and grit differed according to demographic variables, and to reveal the relationship between these two skills. The qualitative findings obtained showed that during the pandemic period, teachers coped with challenges by developing strategies focused on cognitive flexibility and grit.

The concept of flexible learning is often linked to, and discussed in relation to, blended and online learning models (Anthony et al., 2020). In a study by Cataudella et al. (2024), teachers' digital transformation processes during the pandemic were examined, revealing a positive relationship between these processes and their cognitive flexibility. This finding suggests that teachers' cognitive flexibility plays a crucial role in adapting to technological change and embracing new digital tools.

Given the globalized nature of technological developments, policies addressing the use of AI in education to promote equity and inclusion are increasingly being formulated at an international level. Worldwide, efforts are underway to establish a human-centered approach to AI in education. Several noteworthy examples illustrate the effective use of AI in this context. In the United States, the Department of Education has issued recommendations on the future of teaching and learning in relation to AI, emphasizing the role of emerging technologies in advancing digital equity and inclusion. In the United Kingdom, the Department for Education has published a policy document on the use of generative AI in education, including large language models such as ChatGPT and Google Bard (now Gemini), highlighting their potential to reduce teacher workload and enhance instructional practices. In Norway, the Directorate for Education and Training regularly publishes updated guidelines for integrating AI in schools, stressing the need for education systems to evolve alongside societal and technological change. These guidelines also provide recommendations for curriculum updates, the promotion of critical thinking and ethical awareness, and pedagogical and assessment practices designed to prepare students for a future shaped by AI. Despite such global developments, there remains a limited body of research on AI in education within the Turkish context. This study seeks to address this gap by contributing to the understanding of how AI can be integrated into teacher education and learning practices in Türkiye.

AI is rapidly gaining importance as a technology that reshapes instructional methods in today's education systems, offers innovative solutions to pedagogical processes, and creates opportunities for personalized learning. In recent years, it has been increasingly observed that educators frequently benefit from AI applications during the teaching process (Feijóo et al., 2021; Hamane & Khalki, 2024; Nguyen et al., 2018; Perera & Aboal, 2019). Today, the expectation from educational activities is to cultivate individuals who know how to think, actively participate in the teaching-learning process to acquire knowledge, take responsibility for their own learning, are equipped with critical thinking skills, and are beneficial and productive members of society. When examining research on the use of AI in early childhood education, a two-dimensional perspective is important. The first dimension highlights the invaluable benefits of using AI in early childhood education. It facilitates teachers' workload, emphasizes individualized work, and provides teachers engaged in administrative tasks with more time to focus on children. The second dimension stresses the importance of cautious and prudent use of AI in early childhood education (McCowan, 2023; Zhou et al., 2020). The Turkish Ministry of National Education [MoNE] has planned a structured approach and is ready to equip teachers with the necessary tools in this regard. Therefore, this study focuses on teachers working with young children. In educational research, flexible thinking skills and AI applications have gained prominence. Teachers are primarily expected to possess these skills themselves. For this reason, the present study aims to examine teachers' use of AI and their flexible thinking skills in learning. Accordingly, the following research questions were addressed:

RQ 1) How is the perception of AI use in education distributed according to socio-demographic characteristics?

RQ 2) How is the perception of flexible thinking in learning distributed according to socio-demographic characteristics?

RQ 3) What are the variables affecting teachers' flexible thinking skills?

In recent years, the potential role of AI in education (Holmes et al., 2021; Luckin, 2018) and teachers' perceptions of such technologies (Zawacki-Richter et al., 2019) have gained increasing attention. At the same time, cognitive flexibility has emerged as a critical competency for teachers to adapt to innovative pedagogical practices and to develop effective strategies in rapidly changing learning environments (Martin & Rubin, 1995; Spiro & Jehng, 1990). However, there is still a notable gap in the literature directly examining the relationship between AI use and cognitive flexibility within the context of teacher education. This study aims to address this gap by investigating how teachers' use of AI relates to their cognitive flexibility, considering demographic and professional factors. Moreover, the study provides both theoretical and practical contributions by offering implications for teacher education programs and professional development initiatives.

2. Method

2.1. Research Model

This study aims to examine the relationship between teachers' levels of using AI technologies and their flexible thinking skills in learning processes. Additionally, it investigates whether these two variables differ according to various demographic and professional factors. Within the scope of this research, a predictive correlational research design, a subtype of quantitative methodology, was employed. This design is particularly useful when the objective is not only to explore associations between variables but also to make data-driven predictions (Creswell & Creswell, 2018).

2.2. Population and Sample

The population of this study consists of teachers working in public and private schools across Türkiye. However, considering limitations related to time, accessibility, and data collection processes, the sample was selected from teachers working in specific provinces. Convenience sampling was employed based on practicality and accessibility, which, while advantageous in terms of time and resources, carries certain limitations.

A total of 200 teachers were initially reached, and to minimize the effect of outliers, z-scores were calculated. Data from 5 participants falling outside the ±3 standard deviation range were excluded, resulting in a final sample of 195 valid cases. Data collection was conducted using both online survey forms and face-to-face applications in order to increase participation and ensure diversity in responses. Participants were drawn from three major provinces—Ankara, İzmir, and İstanbul—representing different geographical and socio-cultural contexts. Ethical approval for the research was obtained from the Social and Human Sciences Scientific Research and Publication Ethics Committee of Ege University (Approval No: 2877, Decision No: 05/02, Date: 28 May 2025), and informed consent was obtained from all participants prior to data collection.

Table 1 shows that the majority of teachers in the study are female. In terms of age distribution, most participants are 30 years and older, with a particularly notable proportion aged 36 and above. Regarding institution type, teachers employed in public schools constitute the majority. As for teaching subjects, preschool, special education, and classroom teachers are represented at similar rates.

Table 1
Frequency and percentages of teachers' socio-demographic information

Variables	*Frequency (f)*	*Percentage (%)*
Gender		
Female	155	79.5
Male	40	20.5
Age Group		
26 years and under	44	22.6
27-30 years	50	25.6
31-35 years	39	20.0
36 years and above	62	31.8
Type of Institution		
Public school	151	77.4
Private school	44	22.6
Teaching Subject		
Preschool	69	35.4
Special education	66	33.8
Classroom teacher	60	30.8
Taking AI Course During Education		
Yes	18	9.2
No	177	90.8
Attending AI PD Programme		
Yes	26	13.3
No	169	86.7

Evaluating the formal education background related to AI, it is seen that the number of teachers who have taken AI courses during their undergraduate education or participated in related training is quite limited, with the vast majority not having attended such programs. This situation indicates the need for supporting teachers in terms of AI literacy.

2.3. Instruments

2.3.1. Demographic information form

Demographic information form included questions about age, gender, type of institution, work experience, and whether they have taken any courses related to AI.

2.3.2. Teacher Perception Scale on the Use of AI in Education

Developed by Üzüm et al. (2024), this scale measures teachers' perceptions of AI use in education with 15 items across three dimensions: Teaching Perception, Learning Perception, and Ethical Perception. Field testing involved 597 teachers during the 2023–2024 academic year across two stages. Exploratory and confirmatory factor analyses confirmed the three-factor structure, and reliability was robust, with Cronbach's alpha values of .87 for the overall scale, .82 for learning perception, .79 for teaching perception, and .79 for ethical perception. This tool offers a psychometrically sound, practical measure for assessing AI-related perceptions among educators.

2.3.3. Flexible Thinking in Learning Scale

Adapted to Turkish by Aktaş et al. (2024) from Barak and Levenberg's (2016) original, this scale measures flexible thinking across three subdimensions: Acceptance of Learning Technologies, Open-Mindedness in Learning, and Adaptation to New Learning Situations. The adaptation involved forward and backward translation by language and field experts, followed by a pilot study to refine clarity and applicability. The finalized scale was administered to 516 teachers, and analysis confirmed its structural equivalence and cultural relevance.

2.4. Reliability and Normality Analysis of Data Collection Instruments

To provide evidence of the reliability of the measurements obtained from the Teacher Perception Scale on the Use of AI in Education and the Flexible Thinking in Learning Scale, along with their sub-dimensions used in this study, Cronbach's alpha coefficients were calculated. Additionally, skewness and kurtosis coefficients were used to assess the normality of the measurements. The results are presented in Table 2.

Table 2
Descriptive statistics, skewness and kurtosis values, and reliability analysis of the measurement instruments.

Variables	*Min.*	*Maks.*	*M*	*SD*	*Skewness*	*Kurtosis*	*Cronbach α*
Perceived Teaching	2.29	5.00	3.87	0.53	−0.35	0.24	.670
Perceived Learning	2.00	5.00	4.26	0.73	−0.85	0.07	.774
Perceived Ethics	2.00	5.00	4.12	0.63	−0.66	0.04	.620
Total Score of AI Use	2.35	5.00	4.08	0.53	−0.72	0.37	.786
Acceptance of Learning Technologies	2.40	6.00	4.83	0.92	−0.45	−0.56	.881
Open-mindedness in Learning	1.71	6.00	5.17	0.77	−1.01	1.32	.891
Adaptation to New Learning Situations	2.43	6.00	4.98	0.86	−0.58	−0.43	.940
Total Score of Cognitive Flexibility	3.00	6.00	4.99	0.74	−0.46	-0.51	.946

Upon examining Table 2, it is observed that the skewness and kurtosis values of the measurement instruments and their subdimensions used in the study fall within the range of ±2.00. This finding indicates that the distributions of the data can be considered approximately normal (Kline, 2015). Based on this result, the variables were assumed to be normally distributed, and parametric statistical methods were employed in the difference analyses.

The reliability coefficients obtained for the measurement instruments and their subfactors ranged from .620 to .946. According to the literature, a reliability coefficient of .70 or above indicates a high level of reliability (Salvucci et al., 1997), while values between .60 and .70 are considered to represent an acceptable level of reliability (Griethuijsen et al., 2014). In this context, it was concluded that the reliability values obtained from the total scores and subdimensions of the instruments used in the study fall within acceptable to high levels of reliability.

In the present study, as the instruments used were based on five-point and six-point Likert scales, the category range was calculated as .80 for the five-point scale and .83 for the six-point scale using the formula above. Accordingly, the midpoint was determined as 3.00 for the five-point scale and 3.50 for the six-point scale.

When the mean scores regarding teachers' perceptions across various dimensions were examined, it was observed that teachers demonstrated a moderate level of perception in the Perceived Teaching scale. In contrast, perceptions in the Perceived Learning and Perceived Ethics dimensions were found to be high, indicating that teachers hold notably positive attitudes toward learning processes and ethical principles. The total score related to AI use was at a moderate level, suggesting that teachers perceive their competence in using this technology to be somewhat limited.

The levels of acceptance of learning technologies and open-mindedness in learning were found to be high, reflecting a tendency among teachers to adapt to learning processes through innovative approaches. Additionally, teachers' adaptation to new learning situations was also identified as high, indicating their ability to respond flexibly to changing learning environments. Finally, the total score for cognitive flexibility was determined to be high, which suggests that teachers possess strong tendencies in generating alternative solutions, being open to change, and maintaining mental flexibility in their thinking processes.

2.5. Data Analysis

In line with the aim of the study, the analysis process was structured based on various statistical techniques. First, descriptive statistics based on frequency and percentage values were used to identify the socio-demographic characteristics of the teachers. Then, mean and standard deviation values related to the measurement instruments were calculated to determine the central tendency and distribution patterns. To assess the normality of the measurements, skewness and kurtosis coefficients were examined, and Cronbach's alpha coefficient was used for reliability analyses.

For comparisons between two independent groups, the independent samples *t*-test was employed. In cases where significant differences were found, Cohen's *d* effect size was calculated to evaluate the practical significance of the findings. In interpreting the effect size, values of $d \leq 0.19$ were considered negligible, between 0.20–0.49 as small, between 0.50–0.79 as medium, and 0.80 and above as large. For comparisons involving three or more groups, one-way analysis of variance (ANOVA) was conducted.

To reveal the direction and strength of the relationships between variables, correlation analyses were performed using Pearson correlation coefficients. In addition, multiple linear regression analysis was conducted to identify the factors predicting teachers' cognitive flexibility skills. All analyses were carried out using JASP (version 0.18.1.0) and SPSS (version 25) statistical software. A significance level of .05 was adopted, and p-values below this threshold were considered statistically significant.

3. Findings

In line with the purpose of the study, the differences in perception levels related to the variables were examined according to socio-demographic characteristics. First, an independent samples *t*-test was conducted to determine whether teachers' perceptions of AI use in education differed by gender. The findings obtained from this analysis are presented in Table 3.

Table 3
Comparison of Perceptions of AI Use in Education by Gender

Variables and Gender	*N*	*M*	*SD*	*df*	*t*	*p*	*d*
Perceived Teaching							
Female	155	3.86	0.52	193	0.70	.490	--
Male	40	3.92	0.57				
Perceived Learning							
Female	155	4.24	0.74	193	0.88	.382	--
Male	40	4.35	0.68				
Perceived Ethics							
Female	155	4.12	0.62	193	0.12	.907	--
Male	40	4.11	0.68				
Total Score							
Female	155	4.07	0.52	193	0.51	.610	--
Male	40	4.12	0.58				

An examination of Table 3 shows that there is no statistically significant difference in teachers' scores on the use of AI in education with respect to gender ($p > .05$). This indicates that teachers' perception levels of AI use in education are comparable regardless of gender. Following this analysis, differences in teachers' perception levels were further examined across age groups, and the results are presented in Table 4.

Table 4
Comparison of Perceptions of AI Use in Education by Age Group

Variables and Age group	*N*	*M*	*SD*	*df*	*F*	*p*	*Difference*
Perceived Teaching							
26 years and under	44	3.82	0.55	3-191	0.27	.845	--
27-30 years	50	3.86	0.57				
31-35 years	39	3.89	0.50				
36 years and above	62	3.91	0.51				
Perceived Learning							
26 years and under	44	4.23	0.80	3-191	0.32	.814	--
27-30 years	50	4.35	0.68				
31-35 years	39	4.22	0.81				
36 years and above	62	4.24	0.66				
Perceived Ethics							
26 years and under	44	4.18	0.65	3-191	0.67	.573	--
27-30 years	50	4.17	0.64				
31-35 years	39	4.01	0.65				
36 years and above	62	4.10	0.59				
Total Score							
26 years and under	44	4.08	0.58	3-191	0.18	.909	--
27-30 years	50	4.12	0.53				
31-35 years	39	4.04	0.54				
36 years and above	62	4.08	0.49				

As shown in Table 4, no statistically significant difference was found in teachers' scores on the use of AI in education across age groups ($p > .05$). This finding indicates that teachers' perception levels of AI use in education do not vary by age. Teachers' perceptions were further compared by institution type, and the results are presented in Table 5.

Table 5
Comparison of Perceptions of AI Use in Education by Institution Type

Variables and Institution type	*N*	*M*	*SD*	*df*	*t*	*p*	*d*
Perceived Teaching							
Public School	151	3.88	0.53	193	0.51	.614	--
Private School	44	3.84	0.54				
Perceived Learning							
Public School	151	4.27	0.73	193	0.33	.738	--
Private School	44	4.23	0.71				
Perceived Ethics							
Public School	151	4.10	0.63	193	0.58	.565	--
Private School	44	4.16	0.62				
Total Score							
Public School	151	4.08	0.54	193	0.08	.938	--
Private School	44	4.08	0.51				

Table 5 shows that there is no statistically significant difference in teachers' scores on the use of AI in education by institution type ($p > .05$). This indicates that teachers' perception levels of AI use in education are similar regardless of the type of institution in which they work. Following this analysis, differences in teachers' perceptions were examined according to teaching subject, and the results are presented in Table 6.

Table 6
Comparison of Perceptions of AI Use in Education by Teaching Subject

Variables and Teaching subject	*N*	*M*	*SD*	*df*	*F*	*p*	*Difference*
Perceived Teaching							
Preschool	69	3.88	0.53				
Special Education	66	3.87	0.51	2-192	0.01	.995	--
Classroom Teacher	60	3.88	0.56				
Perceived Learning							
Preschool	69	4.41	0.66				
Special Education	66	4.21	0.67	2-192	2.51	.084	--
Classroom Teacher	60	4.14	0.83				
Perceived Ethics							
Preschool	69	4.03	0.65				
Special Education	66	4.21	0.54	2-192	1.39	.251	--
Classroom Teacher	60	4.11	0.68				
Total Score							
Preschool	69	4.11	0.50				
Special Education	66	4.09	0.47	2-192	0.26	.772	--
Classroom Teacher	60	4.04	0.62				

Upon examining Table 6, it is observed that there is no statistically significant difference in teachers' scores regarding the use of AI in education based on teaching subject ($p > .05$). Accordingly, it was determined that teachers' perception levels of AI use in education are similar regardless of their teaching subject. After examining the differences in teachers' perception levels of AI use in education by teaching subject, differences according to whether teachers have taken an AI course were examined. The findings obtained are presented in Table 7.

Table 7
Comparison of perceptions of AI Use in education by AI course enrollment status

Variables and AI course enrollment	*N*	*M*	*SD*	*df*	*t*	*p*	*d*
Perceived Teaching							
Yes	18	3.74	0.47	193	1.14	.257	--
No	177	3.89	0.54				
Perceived Learning							
Yes	18	4.26	0.66	193	0.03	.979	--
No	177	4.26	0.73				
Perceived Ethics							
Yes	18	3.78	0.63	193	2.44	.016	0.60
No	177	4.15	0.62				
Total							
Yes	18	3.93	0.44	193	1.31	.192	--
No	177	4.10	0.54				

Table 7 shows that there is no statistically significant difference in the total score, teaching perception, and learning perception related to AI use in education according to whether teachers have taken an AI course or not ($p > .05$). Accordingly, it was determined that teachers' perception levels regarding the use of AI in education are similar regardless of their AI course enrollment status.

However, a statistically significant difference was found in teachers' ethical perception scores regarding AI use according to AI course enrollment status ($t_{193} = 2.44$, $p < .05$, $d = 0.60$). Examination of the means indicates that teachers who did not take an AI course during their undergraduate education have higher ethical perceptions compared to those who did, and this difference has a moderate effect size in practical terms.

Following this analysis, the difference according to AI workshop attendance was analyzed, and the findings are presented in Table 8.

Table 8

Comparison of AI use perception in education according to AI workshop attendance status

Variables and AI workshop attendance	*N*	*M*	*SD*	*df*	*t*	*p*	*d*
Perceived Teaching							
Yes	26	3.77	0.37	193	1.02	.310	--
No	169	3.89	0.55				
Perceived Learning							
Yes	26	4.25	0.61	193	0.07	.943	--
No	169	4.26	0.74				
Perceived Ethics							
Yes	26	3.89	0.58	193	1.96	.052	--
No	169	4.15	0.63				
Total							
Yes	26	3.97	0.36	193	1.53	.133	--
No	169	4.10	0.55				

Table 8 indicates that teachers' scores on the use of AI in education and its sub-dimensions do not differ significantly based on whether they have attended an AI course ($p > .05$). This sat teacher' perception levels of AI use in education are similar regardless of their AI workshop attendance. The analysis then focused on teachers' flexible thinking skills in learning. The first analysis focused on gender, and the results are presented in Table 9.

Table 9

Comparison of perception of flexible thinking in learning by gender

Variables and Gender	*N*	*M*	*SD*	*df*	*t*	*p*	*d*
Acceptance of learning techniques							
Female	155	4.77	0.95	193	0.70	.490	--
Male	40	5.07	0.74				
Openness to learning							
Female	155	5.16	0.79	193	0.88	.382	--
Male	40	5.21	0.66				
Adaptation to new learning situations							
Female	155	4.94	0.89	193	0.12	.907	--
Male	40	5.12	0.73				
Total							
Female	155	4.96	0.76	193	0.51	.610	--
Male	40	5.13	0.63				

As seen in Table 9, the scores related to teachers' flexible thinking in learning processes do not differ statistically significantly according to gender ($p > .05$). Accordingly, it was determined that teachers' perception levels regarding flexible thinking are similar regardless of their gender. In the following, the differences according to age groups were analyzed, and the findings are presented in Table 10.

Analysis of Table 10 shows that there is no statistically significant difference in teachers' total scores of flexible thinking in learning and the acceptance of learning technologies sub-dimension according to age groups ($p > .05$). Accordingly, it was determined that teachers' perception levels of flexible thinking and acceptance of learning technologies are similar regardless of their age. However, teachers' scores for openness in learning show a statistically significant difference according to age groups ($F(3\text{-}191) = 2.84$, $p < .05$). To identify the source of this difference,

Table 10
Comparison of perceptions related to flexible thinking in learning according to age groups

Variables and Age group	*N*	*Mean*	*SD*	*df*	*F*	*p*	*Difference*
Acceptance of Learning Techniques							
26 years and under(1)	44	4.70	0.97	3-191	0.42	.740	--
27-30 years (2)	50	4.85	0.83				
31-35 years (3)	39	4.88	0.72				
36 years and above (4)	62	4.89	1.06				
Openness in Learning							
26 years and under(1)	44	4.98	0.96	3-191	2.84	.039	4 > 1
27-30 years (2)	50	5.03	0.70				
31-35 years (3)	39	5.29	0.65				
36 years and above (4)	62	5.34	0.70				
Adaptation to New Learning Situations							
26 years and under(1)	44	4.83	0.84	3-191	3.12	.027	3 > 2
27-30 years (2)	50	4.76	0.91				
31-35 years (3)	39	5.24	0.70				
36 years and above (4)	62	5.09	0.90				
Total							
26 years and under(1)	44	4.84	0.82	3-191	2.07	.106	--
27-30 years (2)	50	4.88	0.68				
31-35 years (3)	39	5.13	0.60				
36 years and above (4)	62	5.11	0.78				

Bonferroni post hoc test (due to homogeneity of variances) was conducted, and it was found that teachers aged 36 and above had higher levels of openness compared to teachers aged 26 and under.

Teachers' scores for adaptation to new learning situations also showed a statistically significant difference according to age groups ($F(3\text{-}191) = 3.12$, $p < .05$). The Bonferroni post hoc test revealed that teachers aged 31-35 had higher adaptation levels compared to teachers aged 27-30. Subsequently, differences by institution type were examined, and the results are presented in Table 11.

Table 11
Comparison of Perceptions of Flexible Thinking in Learning by Institution Type

Variables and Institution type	*N*	*M*	*SD*	*df*	*t*	*p*	*d*
Acceptance of Learning Techniques							
Public School	151	4.80	0.93	193	0.99	.324	--
Private School	44	4.95	0.86				
Openness in Learning							
Public School	151	5.16	0.77	193	0.11	.916	--
Private School	44	5.18	0.77				
Adaptation to New Learning Situations							
Public School	151	4.92	0.88	193	1.55	.124	--
Private School	44	5.15	0.80				
Total							
Public School	151	4.96	0.75	193	1.05	.294	--
Private School	44	5.10	0.69				

When examining Table 11, it is seen that teachers' scores related to flexible thinking do not show a statistically significant difference according to the type of institution they work in ($p > .05$). Accordingly, it was determined that teachers' perception levels of flexible thinking are similar regardless of the type of institution they are employed at.

As another variable, teaching subject was investigated, and the findings are presented in Table 12.

Table 12
Comparison of perceptions of flexible thinking in learning according to teaching subject

Variables and Teaching subject	*N*	*M*	*SD*	*df*	*F*	*p*	*Difference*
Acceptance of learning techniques							
Preschool	69	4.88	0.96	2-192	1.26	.287	--
Special Education	66	4.69	0.88				
Classroom Teacher	60	4.93	0.91				
Open-mindedness in learning							
Preschool	69	5.26	0.63	2-192	0.85	.428	--
Special Education	66	5.09	0.78				
Classroom Teacher	60	5.14	0.88				
Adaptation to new learning situations							
Preschool	69	5.11	0.78	2-192	2.84	.061	--
Special Education	66	4.77	0.94				
Classroom Teacher	60	5.04	0.85				
Total							
Preschool	69	5.08	0.68	2-192	1.87	.157	--
Special Education	66	4.85	0.74				
Classroom Teacher	60	5.04	0.78				

When Table 12 is examined, it is seen that teachers' scores related to flexible thinking do not show a statistically significant difference according to their teaching subject ($p > .05$). Accordingly, it was determined that teachers' perception levels regarding flexible thinking are similar regardless of their branch. After examining the differences in teachers' perception levels of flexible thinking according to branch, differences according AI course attendance during their (under)graduate education were analyzed, and the findings are presented in Table 13.

Table 13
Comparison of perceptions of flexible thinking in learning according to AI course attendance status

Variables and AI course attendance	*N*	*M*	*SD*	*df*	*t*	*p*	*d*
Acceptance of learning techniques							
Yes	18	5.39	0.70	193	2.73	.007	0.68
No	177	4.78	0.92				
Open-mindedness in learning							
Yes	18	5.44	0.53	193	1.57	.119	--
No	177	5.14	0.78				
Adaptation to new learning situations							
Yes	18	5.40	0.77	193	2.19	.030	0.54
No	177	4.93	0.86				
Total							
Yes	18	5.41	0.57	193	2.55	.012	0.63
No	177	4.95	0.74				

Table 13 shows that teachers' perception levels regarding flexible thinking differ statistically significantly according to their AI course attendance status ($t_{193} = 2.55$, $p < .05$, $d = 0.63$). Examining the means, it was found that teachers who took an AI course during their undergraduate education have higher flexible thinking skills compared to those who did not take the course, and this difference has a medium practical effect size.

Teachers' perception levels regarding the acceptance of learning technologies also differ statistically significantly according to AI course attendance ($t_{193} = 2.73$, $p < .05$, $d = 0.68$). The means indicate that teachers who took an AI course have higher acceptance levels of learning technologies compared to those who did not take the course, with a medium practical effect size.

However, teachers' perception levels related to openness in learning do not differ statistically significantly by AI course attendance ($p > .05$). Accordingly, it was determined that teachers' perception levels of openness in learning are similar regardless of whether they took an AI course.

Teachers' perception levels regarding adaptation to new learning situations differ statistically significantly by AI course attendance ($t_{193} = 2.19$, $p < .05$, $d = 0.54$). The means indicate that teachers who took an AI course have higher adaptation levels to new learning situations compared to those who did not, with a medium practical effect size.

In terms of AI PD programme attendance of teachers, the findings are presented in Table 14.

Table 14
Comparison of flexible thinking perception according to AI PD programme attendance

Variables and AI PD programme attendance	*N*	*M*	*SD*	*df*	*t*	*p*	*d*
Acceptance of learning techniques							
Yes	26	5.36	0.78	193	3.22	.002	0.68
No	169	4.75	0.91				
Open-mindedness in learning							
Yes	26	5.46	0.64	193	2.08	.039	0.44
No	169	5.12	0.78				
Adaptation to new learning situations							
Yes	26	5.44	0.76	193	3.00	.003	0.63
No	169	4.90	0.86				
Total							
Yes	26	5.42	0.63	193	3.25	.001	0.69
No	169	4.93	0.73				

When Table 14 is examined, it is seen that teachers' perception levels regarding flexible thinking differ statistically significantly according to whether they have taken an AI course ($t(193) = 3.25$, $p < .05$, $d = 0.69$). Examining the means, it was found that teachers who took an AI course have higher flexible thinking skills compared to those who did not, and this difference has a moderate practical effect size.

Teachers' perception levels regarding the acceptance of learning technologies also show a statistically significant difference based on AI course attendance ($t(193) = 3.22$, $p < .05$, $d = 0.68$). The means indicate that teachers who attended an AI course have a higher acceptance level of learning technologies than those who did not, with a moderate practical effect size.

Teachers' perception levels of openness in learning differ significantly by AI course attendance as well ($t(193) = 2.08$, $p < .05$, $d = 0.44$). The means show that teachers who attended an AI course have a higher level of openness in learning compared to those who did not, and this difference has a small practical effect size.

Teachers' perception levels of adaptation to new learning situations also significantly differ based on AI course attendance ($t(193) = 3.00$, $p < .05$, $d = 0.63$). The means reveal that teachers who took an AI course have a higher adaptation level to new learning situations compared to those who did not, with a moderate practical effect size.

In another analysis, the relationships between the total scores and subdimensions of the AI use and flexible thinking scales were examined. The results are presented in Table 15. Table 15 shows a significant positive and strong relationship between teaching perception and learning perception ($r = .65$, $p < .001$). Similarly, teaching perception demonstrates strong and positive correlations with both ethical perception ($r = .61$, $p < .001$) and the total score of AI usage ($r = .87$, $p < .001$). Learning perception is also significantly and highly correlated with ethical perception ($r = .45$, $p < .001$) and AI usage ($r = .85$, $p < .001$). These findings indicate that teaching and learning perceptions are closely related to the level of AI usage.

Table 15
Correlations between variables

Variables	*1*	*2*	*3*	*4*	*5*	*6*	*7*
1. Teaching Perception	--						
2. Learning Perception	.65**	--					
3. Ethical Perception	.61**	.45**	--				
4. AI Usage Total Score	.87**	.85**	.80**	--			
5. Acceptance of Learning Tech.	.13	.22*	.10	.18*	--		
6. Openness in Learning	.20*	.26*	.17*	.25*	.57**	--	
7. Adaptation to New Learning Situations	.14*	.22*	.08	.18*	.62**	.69**	--
8. Flexible Thinking Total Score	.18*	.27*	.13	.23*	.86**	.85**	.89**

* p < .05; ** p < .001

A strong and positive correlation was also observed between ethical perception and the AI usage total score (r = .80, p < .001). Additionally, weaker correlations were found between ethical perception and openness in learning (r = .17, p < .05), acceptance of learning technologies (r = .10, p > .05), and flexible thinking score (r = .13, p > .05). However, the variable openness in learning showed strong positive and significant correlations with acceptance of learning technologies (r = .57, p < .001), adaptation to new learning situations (r = .69, p < .001), and flexible thinking score (r = .85, p < .001). Flexible thinking score was significantly correlated with openness in learning (r = .86, p < .001), adaptation to new learning situations (r = .89, p < .001), acceptance of learning technologies (r = .85, p < .001), learning perception (r = .27, p < .05), and teaching perception (r = .18, p < .05). These results reveal that flexible thinking is strongly associated with individuals' tendencies toward openness and their ability to adapt to new learning environments.

The relationship between the total AI usage score and the total flexible thinking skills score was also found to be statistically significant, positive, but low in magnitude (r = .23, p < .05).

Finally, a multiple linear regression analysis was conducted to identify the variables influencing teachers' flexible thinking skills (see Table 16). Prior to the analysis, assumptions for multiple linear regression were examined. First, to assess the normality of the residuals, the ZPRED-ZRESID plot was inspected and found to be elliptical, indicating normally distributed residuals. Second, to verify the linearity assumption between predictor and outcome variables, relevant scatterplots were examined and confirmed. Third, to check for multicollinearity, Variance Inflation Factor (VIF) and tolerance values were assessed; VIF values ranged from 1.60 to 2.19, and tolerance values ranged from 0.46 to 0.63, indicating no multicollinearity problem among predictors. Lastly, skewness and kurtosis values were inspected to confirm the normal distribution of the dependent variable.

Table 16
Variables Affecting Teachers' Flexible Thinking Skills

	Unstandardized Coefficients		*Standardized Coefficients*		
Variables	*b*	*Std. Error of B*	*β*	*t*	*p*
Constant	3.79	0.41	--	9.30	.000
Teaching Perception	0.00	0.14	.00	0.02	.983
Learning Perception	0.26	0.09	.26	2.80	.006
Ethical Perception	0.02	0.10	.01	0.17	.869
R = 0.27				R^2 =0.07	
$F_{3\text{-}191}$ = 4.863				p = .003	

Table 16 shows a low but significant relationship between teachers' flexible thinking skills and the independent variables (R = 0.27; R^2 = 0.07; p < .05). The independent variables included in the study collectively explain 7% of the variance in teachers' levels of flexible thinking. The F value presented in Table 16 indicates that the model is statistically significant. Among the independent variables, learning perception was found to have a statistically significant effect on teachers' flexible thinking levels, with the following relative importance: learning perception (β = .26; p < .05). Accordingly, a one standard deviation increase in teachers' learning perception corresponds to a 0.26 standard deviation increase in their flexible thinking levels. Thus, as teachers' learning perception increases, their flexible thinking levels also increase.

4. Discussion

This study examined teachers' perceptions of AI use in education and their flexible thinking skills in learning across various demographic characteristics. The results revealed that teachers generally hold positive and high-level perceptions toward both AI use and flexible thinking skills.

Interestingly, the study also found that teachers who had taken an AI course scored significantly lower on the "ethical perception" dimension, suggesting that teachers with AI-related training tend to evaluate the technology more critically. This finding supports Meylani's (2024) argument that teachers should be informed about the potential ethical risks associated with AI. Regarding flexible thinking, teachers reported relatively high levels of ability, indicating their capacity to adapt to changing learning environments and generate innovative solutions. Age was found to significantly influence teachers' openness to learning and their adaptation to new situations. This is consistent with Cataudella et al. (2024), who concluded that age and experience positively affect flexible thinking skills. Similarly, Erarslan (2023) observed that professional experience enhances teachers' cognitive flexibility, underscoring the role of accumulated practice in fostering adaptability.

The findings also suggest that factors beyond learning perception may influence teachers' flexible thinking skills. Indeed, prior research indicates that flexibility is shaped not only by cognitive processes but also by individual and contextual factors such as life experiences, professional seniority, organizational culture, and personality traits (Karwowski, 2014; Scott et al., 2004). This helps explain why only 7% of the variance was accounted for in the present study. The positive relationship found between learning perception and flexible thinking can be explained by the tendency of teachers who value learning to remain open to innovations and new knowledge. Literature frequently notes that individuals who are open to learning exhibit greater cognitive flexibility and employ more creative strategies in problem-solving (Dweck, 2006; Martin & Rubin, 1995). Similarly, Zhao (2010) demonstrated that positive learning attitudes strengthen adaptability and innovative thinking. Thus, the present findings align with prior research highlighting the link between openness to learning and flexible thinking.

Another important result was that teachers who had completed AI-related training demonstrated significantly higher levels of flexible thinking and stronger acceptance of technological innovations. This suggests that pedagogical knowledge and experience with AI may not only enhance teachers' technological competencies but also foster their cognitive flexibility. However, the majority of teachers reported having no formal AI training, indicating that AI literacy remains limited within the education system. Güneyli et al. (2024) similarly found that teachers' knowledge about AI is low, but practical training increases awareness—consistent with the present results.

To strengthen interpretation, the findings were compared with previous studies. The result that AI-related training supports flexible thinking is consistent with Zawacki-Richter et al. (2019), who emphasized the role of professional development in fostering openness to technology. Likewise, Luckin (2018) stressed that exposure to AI facilitates adaptability in learning processes, while Spiro and Jehng's (1990) cognitive flexibility theory suggests that diverse and complex technological experiences nurture adaptive and innovative thinking. By contrast, Holmes et al. (2021) reported significant demographic differences in AI adoption across international contexts, whereas the present study found no meaningful variations in most demographic variables such as gender, teaching subject, and institution type. This discrepancy may stem from contextual differences in sampling. The current research focused on teachers in three metropolitan provinces in Türkiye

(Ankara, İzmir, and İstanbul), while Holmes and colleagues analyzed larger, more heterogeneous international populations. Furthermore, while Martin and Rubin (1995) demonstrated that personality traits influence cognitive flexibility, the present findings suggest that professional training in AI may play a stronger role than demographic or dispositional factors.

Taken together, these results highlight both areas of convergence—such as the positive role of AI-related training—and divergence—particularly regarding demographic predictors—emphasizing the contextual sensitivity of AI adoption and its connection to flexible thinking in education. By situating Turkish teachers' experiences within a local educational and cultural framework, this study contributes to international discussions on AI and pedagogy.

Recent research further underscores the importance of AI literacy in supporting teachers' pedagogical flexibility. Sperling (2024) emphasized the need to integrate AI literacy into teachers' professional knowledge to strengthen agency, while Chiu (2024) expanded the concept to include not only technical skills but also confidence and self-efficacy as essential for effective teaching. Similarly, Ravi et al. (2023) showed that AI literacy curricula foster ethical awareness and creative adaptation among teachers, thereby enhancing pedagogical responsiveness. These studies converge with the present findings, suggesting that cultivating AI literacy can broaden teachers' openness to innovative learning designs and strengthen their capacity for flexible thinking.

5. Conclusion

This study examined teachers' perceptions of artificial intelligence (AI) use and their flexible thinking skills in learning across various demographic variables. The findings indicate that teachers generally demonstrate moderate to high levels of perception regarding both AI use and flexible thinking skills.

Teachers who received formal AI education (through courses or classes) exhibited greater acceptance of learning technologies, stronger adaptation to new learning situations, and higher cognitive flexibility. This suggests that AI-related professional development programs play a crucial role in fostering innovative and flexible approaches to teaching and learning. With respect to flexible thinking, the results further showed that openness to new ideas and adaptation to changing learning environments significantly increased with age, suggesting that age may enhance individuals' flexible thinking capacity.

Overall, the findings reveal that teachers' attitudes toward utilizing AI technologies are evolving positively and that their cognitive flexibility supports educational transformation. However, the lack of sufficient formal training in AI highlights the need for greater institutional support in this area. As one of the few studies addressing teachers' perceptions of AI and flexible thinking skills in Türkiye, this research contributes meaningfully to the literature. The findings underscore the necessity of equipping teachers with up-to-date competencies in the face of rapid technological change, consistent with Ng et al. (2025), who emphasized the integration of AI and digital pedagogy in teacher education.

An important point concerns the relatively low predictive power ($R^2 = .07$) of AI use for teachers' flexible thinking skills. This modest effect size suggests that while AI-related practices and perceptions contribute to cognitive flexibility, they are not the sole determinant. Prior studies emphasize that cognitive flexibility is a multidimensional construct shaped by diverse factors, including professional experience, personal motivation, institutional culture, and broader socio-educational contexts (Martin & Rubin, 1995; Spiro & Jehng, 1990). Thus, the limited predictive power found in this study may be attributed to the complex and dynamic nature of cognitive flexibility, which cannot be fully explained by AI use alone. Contextual limitations such as sample size, the regional concentration of participants, and reliance on self-reported measures may have further reduced the explained variance.

These findings point to the need for future studies to adopt more comprehensive models that incorporate psychological, pedagogical, and technological predictors to better account for variability in flexible thinking skills. Accordingly, teacher education policies should prioritize structured AI literacy initiatives and continuous professional development opportunities that combine technological competence with ethical and pedagogical awareness.

6. Limitations

The findings of this study are limited to a sample of 195 teachers from İzmir, İstanbul, and Ankara. The data were obtained through self-reported responses and were restricted to quantitative measures. In addition, the study focused exclusively on preschool, special education, and classroom teachers. Another limitation is the use of convenience sampling, which reduces the generalizability of the results. Finally, as the study employed a cross-sectional design, causal inferences between AI use and flexible thinking cannot be drawn.

7. Recommendations

In light of the findings, several recommendations can be made to enhance teachers' AI literacy and foster flexible thinking skills. The Ministry of National Education should develop national strategies to systematically integrate AI literacy and digital pedagogy into teacher education policies. Large-scale training initiatives and awareness programs need to be organized to ensure that all teachers, regardless of region or school type, have equal opportunities to access AI-supported resources. Financial incentives and infrastructure investments should also be prioritized to reduce inequalities among schools with varying technological capacities. In parallel, clear ethical frameworks should be established to guide teachers in addressing the challenges of AI use in education.

Teacher training programs should move beyond general digital competence courses and explicitly integrate AI-focused modules. These modules should combine theoretical components—such as ethical issues, algorithmic decision-making, and pedagogical implications—with practical applications, including the design of AI-assisted lesson plans and the use of adaptive learning platforms. Interdisciplinary approaches should be emphasized to ensure that teachers can link AI with subject-specific pedagogical practices. Structured mentoring systems could also be institutionalized, whereby experienced teachers, who scored higher in open-mindedness and adaptability in this study, support novice teachers in adopting AI tools and developing flexible thinking skills.

Teachers themselves should be encouraged to participate in continuous professional development programs focusing on technology-enhanced instructional strategies. Such programs should offer hands-on experiences with AI tools, enabling teachers to experiment with classroom practices in controlled environments before implementing them more broadly. Professional learning communities could also be established to facilitate the exchange of experiences and strategies for AI integration. Given that flexible thinking skills tend to increase with age and experience, early-career teachers in particular should be provided with opportunities to practice adaptability through problem-based, collaborative, and technology-supported learning activities.

Finally, future research should employ mixed-method or longitudinal designs to capture the dynamic nature of teachers' AI adoption and the development of flexible thinking skills. Qualitative approaches such as classroom observations, interviews, and focus groups could provide deeper insights into teachers' attitudes, ethical concerns, and contextual challenges. Experimental studies examining the direct effects of teachers' AI use on students' learning processes and outcomes would also make valuable contributions. In addition, cross-national comparative studies could explore how cultural, institutional, and policy contexts shape the relationship between AI use and cognitive flexibility.

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References

Ajani, O. A., Gamede, B., & Matiyenga, T. C. (2025). Leveraging artificial intelligence to enhance teaching and learning in higher education: Promoting quality education and critical engagement. *Journal of Pedagogical Sociology and Psychology, 7*(1), 54-69. https://doi.org/10.33902/jpsp.202528400

Aktas, N., Demirgül, S. A., & Sancar, I. V. (2024). Adaptation of flexible thinking in learning scale to Turkish culture. *Journal of Educational Technology & Online Learning, 7*(1), 71–83.

Anthony, B., Kamaludin, A., Romli, A., Raffei, A. F., Phon, D. N., Abdullah, A., & Ming, G. L. (2020). Blended learning adoption and implementation in higher education: A theoretical and systematic review. *Technology, Knowledge and Learning, 27,* 531-578. https://doi.org/10.1007/s10758-020-09477-z

Arslan, K. (2020). Artificial intelligence and its applications in education. *Journal of Western Anatolia Educational Sciences, 11*(1), 71–88. https://dergipark.org.tr/tr/pub/baebd/issue/55426/690058

Barak, M., & Levenberg, A. (2016). A model of flexible thinking in contemporary education. *Thinking Skills and Creativity, 22,* 74–85.

Cataudella, S., Mascia, M. L., Agus, M., Ifenthaler, D., Tomczyk, L., & Penna, M. P. (2024). A pilot study on individual and contextual factors influencing teachers' digitalisation process. *Contemporary Educational Technology, 16*(4), ep532. https://doi.org/10.30935/cedtech/15189

Chiu, T. K. F. (2024). What are artificial intelligence literacy and competency? A conceptual study. *Computers and Education: Artificial Intelligence, 5,* 100190. https://doi.org/10.1016/j.caeai.2024.100190

Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches*. Sage.

Çavuş, M. N. (2024). A review on AI-based assessment and evaluation in education. *International Journal of English for Specific Purposes, 2*(1), 39–54. https://dergipark.org.tr/tr/pub/joinesp/issue/82173/1492424

Deed, C., Blake, D., Henriksen, J., Mooney, A., Prain, V., Tytler, R., Zitzlaff, T., Edwards, M., Emery, S., Muir, T., Swabey, K., Thomas, D., Farrelly, C., Lovejoy, V., Meyers, N., & Fingland, D. (2020). Teacher adaptation to flexible learning environments. *Learning Environments Research, 23,* 153–165.

Dweck, C. S. (2006). *Mindset: The new psychology of success.* Random House.

Erarslan, A. (2023). Cognitive flexibility and grit during times of crisis for Turkish EFL teachers. *Psychology in the Schools, 60*(7), 2296–2319.

Feijóo, C., Fernández, J., Arenal, A., Armuña, C., Ramos, S., Maghiros, I., Vuorikari, R., Cabrera, M., & Punie, Y. (2021). *Educational technologies in China – Pre- and post-pandemic lessons.* Publications Office of the European Union. https://doi.org/10.2760/604641

Griethuijsen, R. A. L. F., Eijck, M. W., Haste, H., Brok, P. J., Skinner, N. C., Mansour, N., Savran Gencer, A., & BouJaoude, S. (2014). Global patterns in students' views of science and interest in science. *Research in Science Education, 45*(4), 581–603. https://doi.org/10.1007/s11165-014-9438-6

Güneyli, A., Burgul, N. S., Dericioğlu, S., Cenkova, N., Becan, S., Şimşek, Ş. E., & Güneralp, H. (2024). Exploring teacher awareness of artificial intelligence in education: A case study from Northern Cyprus. *European Journal of Investigation in Health, Psychology and Education, 14*(8), 2358–2376. https://doi.org/10.3390/ejihpe14080156

Hamane, S., & Khalkı, S. (2024). AI in education: Transforming the teaching profession and unlocking future opportunities in Algeria. *Journal for Educators, Teachers and Trainers, 15*(4), 69–78.

Holmes, W., Bialik, M., & Fadel, C. (2021). *Artificial intelligence in education: Promises and implications for teaching and learning.* Center for Curriculum Redesign.

Işler, B., & Kılıç, M. Y. (2021). The use and development of artificial intelligence in education. *Journal of Education and New Methods, 5*(1), 1–11. https://doi.org/10.17932/IAU.EJNM.25480200.2021/ejnm_v5i1001

Karwowski, M. (2014). Creative mindsets: Measurement, correlates, consequences. *Psychology of Aesthetics, Creativity, and the Arts, 8*(1), 62–70. https://doi.org/10.1037/a0034898

Kaşkaya, A., & Ateş, Ş. (2025). The effect of artificial intelligence-supported visualization applications on students' writing disposition in the creative writing process. *Journal of Pedagogical Research, 9*(2), 5-21. https://doi.org/10.33902/JPR.202531916

Khalili, T., Ketabi, S., Pnevmatikos, D., & Nejadansari Mahabadi, D. (2024). A meta-analysis on the (quasi) experimental studies of critical thinking in second language education in Iran. *Language Related Research, 14*(6), 245–270.

Kline, R. B. (2015). *Principles and practice of structural equation modeling.* Guilford Press.

Köse, B., Radıf, H., Uyar, B., Baysal, İ., & Demirci, N. (2023). The importance of artificial intelligence in education according to teachers' opinions. *Journal of Social, Humanities and Administrative Sciences, 9*(71), 4203–4209. https://doi.org/10.29228/JOSHAS.74125

Li, T. (2020). Use of magic performance as a schema disruption method to facilitate flexible thinking. *Thinking Skills and Creativity, 38,* 100735.

Luckin, R. (2018). *Machine learning and human intelligence: The future of education for the 21st century.* UCL Institute of Education Press.

Lübke, L., Pinquart, M., & Schwinger, M. (2021). The role of flexibility in the realization of inclusive education. *Sustainability, 13*(8), 4452.

Martin, M. M., & Rubin, R. B. (1995). A new measure of cognitive flexibility. *Psychological Reports, 76*(2), 623–626. https://doi.org/10.2466/pr0.1995.76.2.623

McCowan, T. (2023). The climate crisis as a driver for pedagogical renewal. *Teaching in Higher Education, 28*(5), 933–952.

McCrae, R. R., & Sutin, A. R. (2009). Openness to experience. In M. R. Leary & R. H. Hoyle (Eds.), *Handbook of individual differences in social behavior* (pp. 257–273). Guilford Press.

Meylani, R. (2024). Artificial intelligence in the education of teachers: A qualitative synthesis of the cutting-edge research literature. *Journal of Computer and Education Research, 12*(24), 600–637. https://doi.org/10.18009/jcer.1477709

Mnguni, L. (2023). A critical reflection on the affordances of web 3.0 and artificial intelligence in life sciences education. *Journal of Pedagogical Sociology and Psychology, 5*(2), 1-9. https://doi.org/10.33902/jpsp.202322298

Ng, D. T. K., Chan, E. K. C., & Lo, C. K. (2025). Opportunities, challenges and school strategies for integrating generative AI in education. *Computers and Education: Artificial Intelligence, 8,* 100373. https://doi.org/10.1016/j.caeai.2025.100373

Nguyen, M. N., Thomas, S., Gattiker, A. E., Kashyap, S., & Varshney, K. R. (2018). *SimplerVoice: A key message & visual description generator system for illiteracy* (arXiv.1811.01299). arXiv. https://doi.org/10.48550/arXiv.1811.01299

OECD. (2019). *Going digital: Shaping policies.* https://doi.org/10.1787/9789264312012-en

Özen, F., & Üçüncü, A. S. (2022). The effect of teachers' cognitive flexibility on attitudes towards compulsory distance education during the COVID-19 pandemic. *International Journal of Psychology and Educational Studies, 9*(2), 492–508.

Özer, S., Sancar Yazıcı, A., Akgül, S., & Yıldırım, A. (2023). Teachers' views on the use of artificial intelligence in schools. *National Journal of Education, 3*(10), 1776–1794. https://uleder.com/index.php/uleder/article/view/360

Öztemel, E. (2020). Artificial intelligence and the future of humanity. In M. Şeker, Y. Bulduklu, C. Korkut, & M. Doğrul (Eds.), *Information technologies and communication: Individual and societal security* (pp. 95–112). TUBA. https://doi.org/10.53478/TUBA.2020.002

Pepin, B., Gueudet, G., & Trouche, L. (2017). Refining teacher design capacity: Mathematics teachers' interactions with digital curriculum resources. *ZDM, 49,* 799–812.

Perera, M., & Aboal, D. (2019). *The impact of a mathematics computer-assisted learning platform on students' mathematics test scores.* United Nations University – Maastricht Economic and Social Research Institute on Innovation and Technology.

Pham, S. T. H. (2025). Empirical investigation of the experience of educators and politicians with the emergence of artificial intelligence in education. *Technology in Society, 83,* 102965. https://doi.org/10.1016/j.techsoc.2025.102965

Pratiwi, H., Riwanda, A., Hasruddin, H., Sujarwo, S., & Syamsudin, A. (2025). Transforming learning or creating dependency? Teachers' perspectives and barriers to AI integration in education. *Journal of Pedagogical Research, 9*(2), 127-142. https://doi.org/10.33902/JPR.202531677

Ravi, P., Broski, A., Stump, G., Abelson, H., Klopfer, E., & Breazeal, C. (2023). *Understanding teacher perspectives and experiences after deployment of AI literacy curriculum in middle-school classrooms* (arXiv:2312.04839). arXiv. https://doi.org/10.48550/arXiv.2312.04839

Regona, M., Yigitcanlar, T., Xia, B., & Li, R. Y. M. (2022). Opportunities and adoption challenges of AI in the construction industry: A PRISMA review. *Journal of Open Innovation: Technology, Market, and Complexity, 8*(1), 45. https://doi.org/10.3390/joitmc8010045

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

Salvucci, S., Walter, E., Conley, V., Fink, S., & Saba, M. (1997). *Measurement error studies at the National Center for Education Statistics.* National Center for Education Statistics.

Sarıtiken, H. (2024). Teachers' perspectives on artificial intelligence applications in Turkish language teaching. *Journal of Pedagogical Sociology and Psychology, 6*(3), 233-247. https://doi.org/10.33902/jpsp.202433205

Scott, G., Leritz, L. E., & Mumford, M. D. (2004). The effectiveness of creativity training: A quantitative review. *Creativity Research Journal, 16*(4), 361–388. https://doi.org/10.1080/10400410409534549

Sperling, K. (2024). In search of artificial intelligence (AI) literacy in teacher professional knowledge: A scoping review. *Teaching and Teacher Education, 139,* 104519. https://doi.org/10.1016/j.tate.2023.104519

Spiro, R. J., & Jehng, J. C. (1990). Cognitive flexibility and hypertext: Theory and technology for the nonlinear and multidimensional traversal of complex subject matter. In D. Nix & R. Spiro (Eds.), *Cognition, education, and multimedia* (pp. 163–205). Lawrence Erlbaum Associates.

Swiecki, Z., Khosravi, H., Chen, G., Martinez-Maldonado, R., Lodge, J. M., Milligan, S., & Gašević, D. (2022). Assessment in the age of artificial intelligence. *Computers and Education: Artificial Intelligence, 3,* 100075. https://doi.org/10.1016/j.caeai.2022.100075

U.S. Department of Education. (2023). *Artificial intelligence and future of teaching and learning: Insights and recommendations.* Office of Educational Technology. https://tech.ed.gov

UNESCO. (2022). *Recommendation on the ethics of artificial intelligence.* https://unesdoc.unesco.org/ark:/48223/pf0000381137

UNESCO. (2023). *Global education monitoring report 2023: Technology in education – A tool on whose terms?* https://doi.org/10.54676/UZQV8501

Üzüm, B., Elçiçek, M., & Pesen, A. (2024). Development of teachers' perception scale regarding artificial intelligence use in education: Validity and reliability study. *International Journal of Human–Computer Interaction, 41*(5), 2776–2787. https://doi.org/10.1080/10447318.2024.2385518

Yalçın, A. (2024). Artificial intelligence applications developed by public institutions for society in Turkey. *Istanbul Aydın University Journal of Social Sciences, 16*(2), 185–215. https://doi.org/10.17932/IAU.IAUSBD.2021.021/iausbd_v16i2002

Zawacki-Richter, O., Marín, V. I., Bond, M., & Gouverneur, F. (2019). Systematic review on artificial intelligence applications in higher education. *International Journal of Educational Technology in Higher Education, 16*(1), 39. https://doi.org/10.1186/s41239-019-0171-0

Zhao, Y. (2010). Preparing globally competent teachers: A new imperative for teacher education. *Journal of Teacher Education, 61*(5), 422–431. https://doi.org/10.1177/0022487110375802

Zhou, X., Van Brummelen, J., & Lin, P. (2020). *Designing AI learning experiences for K-12* (arXiv.2009.10228). arXiv. https://doi.org/10.48550/arXiv.2009.10228