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# Teachers' perceptions towards using artificial intelligence in mathematics education

# تصورات المعلمين حول استخدام الذكاء الاصطناعي في تعليم الرياضيات

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Written by:

**Majed Ali Alsharidah**[1]

https://orcid.org/0000-0002-4509-9919

**Abouelftouh Mokhtar Alkramiti**[2]

https://orcid.org/0000-0002-2698-9334

**Abstract**

This study aimed to reveal teachers' perceptions about using artificial intelligence applications in mathematics education. A questionnaire consisting of (21) statements was designed and applied to (382) middle school mathematics teachers. The study used a mixed methodology of the sequential explanatory type. Based on the results, most of the mathematics teachers do not use artificial intelligence applications in mathematics teaching practices. By conducting interviews with a sample of them, the reasons for this were revealed, which is that some applications do not accurately support the Arabic language. This result is also due to teachers' weak conceptual background in using artificial intelligence. The results also revealed that there is a high degree of agreement among mathematics teachers about the importance of artificial intelligence for the mathematics teacher, students, and classroom interaction. The results indicated that there were no statistically significant differences between male and female and the experience of teachers in using artificial intelligence in mathematics education. Accordingly, implications and suggestions for researchers and math teachers are presented to maximize the benefit of AI applications in mathematics education.

**Keywords:** Artificial intelligence, mathematics education, mathematics teacher' Perceptions.

**الملخص:**

هدفت الدراسة الحالية إلى الكشف عن تصورات المعلمين حول استخدام تطبيقات الذكاء الاصطناعي في تعليم الرياضيات، وتم تصميم استبانة مكونة من (21) عبارة، تم تطبيقها على (382) معلماً ومعلمة رياضيات في المرحلة المتوسطة بمنطقة الرياض التعليمية، واستخدمت الدراسة المنهجية المختلطة من النوع التفسيري التتابعي لدمج البيانات الكمية والنوعية. وبناءً على النتائج فإن أغلب معلمي الرياضيات المشاركين في الدراسة لا يستخدمون تطبيقات الذكاء الاصطناعي في ممارسات تدريس الرياضيات، ومن خلال إجراء المقابلات مع عينة منهم تم الكشف عن أسباب ذلك، ومنها أن بعض التطبيقات لا تدعم اللغة العربية بشكل دقيق، كما كشفت النتائج عن وجود درجة عالية من الاتفاق بين معلمي الرياضيات حول أهمية الذكاء الاصطناعي بالنسبة لمعلم الرياضيات والطلاب والتفاعل الصفي، كما أشارت نتائج الدراسة إلى عدم وجود فروق ذات دلالة إحصائية بين متوسط تصورات المعلمين حول استخدام الذكاء الاصطناعي في تدريس الرياضيات وفقًا لمتغيري الجنس والخبرة، وعليه تم تقديم المضامين والمقترحات للباحثين ومعلمي الرياضيات لتعظيم الاستفادة من تطبيقات الذكاء الاصطناعي في تعليم الرياضيات.

**الكلمات المفتاحية:** الذكاء الاصطناعي، تعليم الرياضيات، معلمو الرياضيات، تصورات المعلمين

[1] Faculty of Education, Prince Sattam bin Abdulaziz University, Saudi Arabia. WoS Researcher ID: DWC-0939-2022 - Email: m.alsharidah@psau.edu.sa

[2] Faculty of Education, Damietta University, Egypt. WoS Researcher ID: ADA-5307-2022 - Email: a.alkramiti@gmail.com

## Introduction

Billionaire Ray Dalio famously said, “We are heading toward a new world in which you either be able to write algorithms...or you will be replaced by algorithms” (Holmes et al., 2019). As an expression of the necessity of keeping pace with the requirements of the Fourth Industrial Revolution, and contributing to its development and benefiting from it, rather than confronting it and not dealing with it.

In 1955, McCarthy et al., (2006) refer to that first used the term AI in a research workshop and defined the AI problem as “making a machine behave in ways that would be called intelligent if a human were so behaving” (p. 12). AI has a noticeable impact on various aspects of life, including education. This branch of science, which studies the development of machines that can simulate the thinking process of humans, has changed the interaction between the elements of the education system: the learner, the teacher, and the institution. Introducing AI into existing systems can simply enhance human actions in terms of time savings, ease of access, and other positive effects (Zafari et al., 2022). However, the teaching methods followed in education systems are usually traditional and theory based. This often causes learners who are accustomed to experience-based learning to fail. AI is revolutionizing various fields, and its application in education, particularly in mathematics, has gained considerable attention. This theoretical framework aims to explore the potential impact of AI on mathematics education, drawing on key concepts from educational technology, cognitive psychology, and AI research.

The educational process has witnessed many developments in recent years due to the development of technology. Searching on the Internet has become an essential part of the various stages of education, and tablets have now replaced books, or some of them, in our schools (Vaerenbergh & Pérez-Suay, 2021). But all these developments that surprised us yesterday may lose their luster. Considering the expected increase in the adoption of AI in education at a tremendous rate. AI is critical to UNESCO’s efforts to achieve Sustainable Development Goal 4 by 2030 – “Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.” In doing so, the United Nations aims to fulfill the promise of “AI for All” in the hope that the technology will help provide equal educational opportunities (Sajid, 2023). Many achievements based on AI technologies have exceeded human capabilities: a chess machine defeated the world champion in 1997, and in 2016 other machines beat one of the world’s best players in the game “Go” and excellent players in poker. Computers prove - or help prove - mathematical theorems. Knowledge is built automatically from huge data measured in terabytes or even petabytes, using machine learning techniques (Shakarian et al., 2023).

Applications of AI affect almost all sectors, especially in the field of education, as it has become possible to transform many of the current routine educational tasks into automated processes, and this would change the nature of many teacher roles. Features of AI in education include facial and speech recognition, facial analysis, natural language processing and other AI techniques to track each student's performance in the classroom in real time, analyze their emotions and engagements, monitor results in quantitative form, and advise accordingly (Knox, 2020). Applications of AI algorithms and systems in education have gained increasing interest year after year. It has been observed that the number of papers published in the topics “AI” and “Education” from Web of Science and Google Scholar has increased since 2010 (Wardat et al., 2023). Note that papers published in 2015-2019 constituted a large proportion, with approximately 70% of all papers indexed. As education develops, researchers are trying to apply advanced AI techniques, such as deep learning and data mining, to deal with complex issues and customize the teaching method for each student according to his or her preferred learning style (Chen et al., 2020).

The science of AI aims to develop systems that achieve a level of intelligence like human intelligence or better than it, and its applications are designed to imitate the actions of the human mind. The goal is to place human knowledge inside the computer within what is known as knowledge bases, and then the computer can, through software tools, search these rules and do by comparison and analysis, to extract and conclude the best answers and solutions to different problems. This is like what a person does when he tries to solve new problems that he encounters in his daily life, based on his previous experiences and experiences, through his expectations of possible outcomes, and through his skills in deduction and comparison between the best available solutions (Muhammad, 2021).

Based on the fourth goal of the Sustainable Development Goals (SDG), which refers to ensuring equitable and inclusive quality education and promoting lifelong learning opportunities for all. It emphasizes equal

learning opportunities for all throughout life. AI technologies are used to ensure equitable and comprehensive access to education for all groups and classes globally.

The use of AI in education requires the development of programs and infrastructure for individual learning, as well as financial and technical resources. In addition, there is a need to develop effective methods for evaluating the success and outcomes of such systems, and on the other hand, it requires teachers to be flexible and adaptable to these developments (Zavalevskyi et al., 2024, 203).

Incorporating technology into education requires more than just orienting math teachers on how to use it; it also requires them to understand how to integrate it into their curriculum effectively (Wardat et al., 2024). The current era is witnessing a scientific civilizational shift in various knowledge and information in general and in the field of education in particular. Examples of terms that have become famous in the field of scientific research include the following: educational technology, AI, ChatGPT, machine learning, deep learning (Schorcht et al., 2024), education for the twenty-first century, Twenty-first century competencies, teacher preparation for the twenty-first century, Saudi Vision 2030, Fourth Industrial Revolution, exponential technology, personal learning, competency-based learning, individual learning, adaptive learning. All these implications have resulted in strong trends towards the optimal use of AI applications in the field of education in general and in mathematics education in particular. Applications of AI in education have met some supporters and opponents. Several related studies have reported that learning outcomes are more effective when using AI to aid learning compared to traditional teacher-centered learning (Alzahrani, 2023; Hwang, 2021; Edwards et al., 2018; Ee & Huh, 2018; Cumming, 2008). While Reinhold et al. (2021)'s study emphasized the importance of emotional support in using AI in mathematics education.

Several Arabic countries, including Saudi Arabia, UAE, Libya, Oman, Lebanon, Palestine, and Egypt, have started researching and utilizing AI within their systems and processes (Alzahrani, 2022, 296).

The current study is an extension of studies concerned with teachers' perceptions of contemporary educational issues related to teaching mathematics according to AI tools. The middle stage of general education was chosen because of its importance on the educational ladder, as it is the academic stage in which the student is allowed to use educational technologies in learning mathematics. Like a calculator. Therefore, the aim of the current study was to reveal the perceptions of middle school mathematics teachers about the use of AI applications in education in the Kingdom of Saudi Arabia. The problem of the study can be formulated in the following questions:

**Questions**

1. To what extent do teachers use AI applications in mathematics education?
2. What are teachers' perceptions about the use of AI in mathematics education?
3. To what extent do teachers' perceptions about AI differ according to the gender variable?
4. To what extent do teachers' perceptions about AI differ according to the variable of years of experience in teaching mathematics?

**Literature review**

**The concept of AI**

AI refers to the development of computer systems that can perform tasks that typically require human intelligence. These tasks include learning, reasoning, problem-solving, perception, language understanding, and decision-making. The goal of AI is to create machines or systems that can exhibit capabilities commonly associated with human intelligence, such as understanding natural language, recognizing patterns, adapting to new situations, and improving performance over time through learning (Molefi et al., 2024).

AI is the ability of computers to "perform cognitive tasks" that are commonly associated with human thinking, especially in problem solving and learning (Wang et al., 2021). The increasing use of AI in education is due to advances in technology, which means that technology can be used to enhance learning and research. One of the most common and important applications of AI is by teachers in a formal classroom environment, where they use information and communication technology (ICT) to deliver materials to their

students. They can also be used to tailor learning materials to meet the needs of individuals, reducing heavy workloads in environments where workload is a burden on teachers (Alzahrani, 2023). AI is the science that makes machines capable of making decisions and acting intelligently by imitating humans and their way of thinking. We humans obtain information from the outside world, process it in our minds, and make judgments and conclusions based on it and based on our previous experiences.

**Relation between AI and educational technology**

Alzahrani (2022) refers to the fact that integrated education must adapt to the profound changes imposed by the Fourth Industrial Revolution, which is one of the most important global challenges facing education and learning today (p. 295). Polián et al. (2024) aimed to improve the use of AI in education by analyzing international experience. The main methods used in the study were general scientific methods, documentary analysis, econometric statistics, and factor analysis. The results showed a rapid growth in the demand for AI in virtual learning systems in all countries under study. The results revealed a trend towards increasing demand for these applications. The study confirmed that AI plays an important role in the educational process and that future research should focus on evaluating its effectiveness in training teachers and specialists.

Many authors emphasize that one of the most important components of the development of modern information technology is the use of AI applications, especially in the field of education (Ryzheva et al., 2024, 286). Figure 1. shows the chronological development and relationship between AI, machine learning, and deep learning from 1950 to 2010 onwards. AI, as a broad and advanced term for computer intelligence, began between the 1950s and 1980s, followed by the introduction of machine learning technology between the 1980s and 1980s. In 2010, learning through algorithms was put on the agenda, and finally, after 2010, deep learning emerged as an advanced technology for implementing machine learning via neural networks to complete very complex thinking tasks. In this context, the following sections examine the two vital techniques of machine learning and deep learning to better understand and explore the world of AI. In addition, Natural Language Processing (NLP) and one of its best examples, intelligent personal assistants, are discussed in detail (Goksel & Bozkurt, 2019).

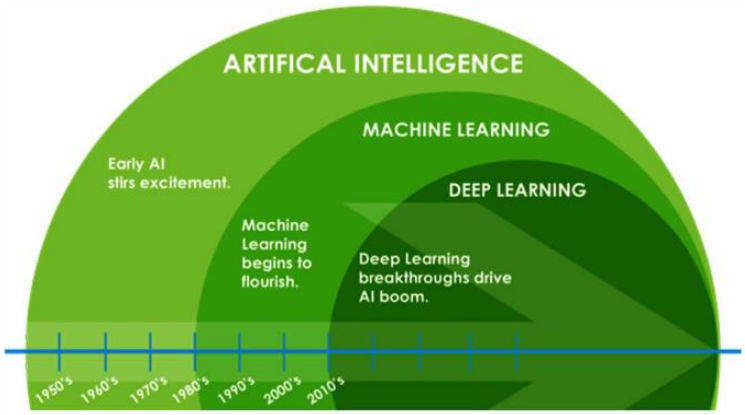


***Figure 1.*** The relationship between AI, machine learning, and deep learning

The field of AI in education (AIED) has witnessed significant developments over the past 25 years. When we reflect on our past and shape our future (Roll & Wylie, 2016). A robot can be designed to help the teacher complete teaching tasks in the classroom (Timms, 2016).

**Benefits of AI applications in Math education**

AI now plays a major role in creating individual learning paths for each student in math education. It can analyze and process large amounts of data, considering individual needs and abilities. AI can recommend personalized learning materials and tasks that meet specific needs. With the help of specialized AI systems, teachers are provided with tools to create unique curricula that help develop individual skills and learning achievements for each student, considering students' strengths, weaknesses, goals, and interests. AI can also provide continuous monitoring of learning progress and adapt programs in real time (Zavalevskyi et al., 2024, 204).

Experts (Blanchard et al., 2009; Chen et al., 2020; Goksel & Bozkurt, 2019; Roll & Wylie, 2016; Shakarian et al., 2023; Alzahrani, 2023) agree on the importance of AI in education in the twenty-first century because of its many advantages, including the ability to learn (Machine Learning), the ability to organize and understand science (Knowledge Representation), the ability to analyze language (NLP), and the ability to understand sound ( Speech Recognition, understanding and analyzing images and video, Computer Vision, problem solving, creativity, emotional and social coping, moving robots and general intelligence (AGI), which includes doing all of the above, explaining academic subjects, providing immediate feedback on the answers, providing academic advice and guidance to students about the best A department that can be enrolled in college or to study subjects that suit their mental abilities. Reaching many students helps make classes accessible to everyone, especially if they speak different languages or suffer from hearing disabilities. Sawalma & Al-Saeed (2023) showed the effectiveness of an application based on AI in developing logical thinking skills and motivation towards learning computer course.

Therefore, integrating technology and traditional teaching methods has many benefits. They range from intelligent teaching systems and smart content creation for students to automating administrative tasks. Sajid (2023) states that there are many benefits of AI in the field of education, including:

- Enhance student engagement: AI applications contribute to making the learning experience more interactive and engaging through personalized interaction and personalization.
- Improving mathematical comprehension: AI contributes to an accurate and detailed explanation of mathematical concepts, enhancing students' understanding.Adapting educational resources:
- Enabling machine learning allows adapting educational resources and exercises according to each student's level and style of learning.
- Stimulate inquiry and critical thinking: AI applications encourage inquiry and the development of critical thinking skills in mathematics topics.
- The applications of AI in mathematics education represent an important progress in improving the quality of education and activating effective interaction between teachers and students.

**limitations and Ethical of AI in Math education (AIED)**

Ryzheva et al. (2024) point out that AI has provided many opportunities for learning and teaching, but it still requires the guidance of teachers and is not a substitute for them (p. 285). Davis (2024) emphasized that there are limitations of AI in dealing with verbal problems in mathematics. It consists in the lack of clarity of the input at times. Which in turn affects the outputs and the correct solution of problems . Especially if the problem includes graphics, charts, or special symbols depending on the input language used. Hwang (2022) revealed that AI had a low to small effect size on the student's achievement in elementary mathematics in Korea.

There is no doubt about the importance of ethical considerations in implementing AI, including issues related to data privacy, algorithmic bias, and the need for transparent decision-making (Bulger & Barnes, 2018). The recent developments of AI have resulted in a lot of excitement and discussions. Generative AI is discussed chatbots with a large language model (LLM) that can be used to easily create original content. There is also agreement among educational experts on the importance of AI in scientific research and education, especially the use of programs such as ChatGPT in mathematics education, where it can be used to summarize complex texts, expand conceptual knowledge of math concepts, analyze data, and create claims, complete repetitive and time-consuming administrative tasks, etc. However, there are some considerations related to research ethics and academic integrity related to plagiarism. It can also result in impairment in some students' skills, such as critical thinking, problem solving and decision-making (Mohamed et al, 2022).

No discussion on AIED would be complete without mentioning the ethics of incorporating AI into our educational systems. A complete discussion of this is beyond the scope of this study, but we have a new responsibility to ensure that society has sufficient AIED literacy – that is, enough to ensure that we use these new technologies appropriately, effectively, and ethically (Becker, 2017, 45).

**Applications of AI in mathematics education**

Applications of AI in mathematics education refer to the use of advanced AI techniques, such as machine learning and natural language processing, to improve learning processes and enhance students'

understanding of mathematical concepts. These apps give teachers and students access to interactive, AI-driven tools to provide accurate explanations, personalize educational support, and stimulate mathematical curiosity (Pedro et al., 2019).

GPT is a generative AI-based LLM that understands human language and can process images via the ChatGPT interface. It automatically completes and processes human input (prompt) using stochastic processes (Schorcht et al., 2024). ChatGPT is one of the important applications of AI that appeared during 2022, and it has many contributions to education in general and to mathematics education in particular, and the performance of ChatGPT changes significantly based on the number of calculations and the number of variables and unknowns in the input (Shakarian et al., 2023). ChatGPT should be developed by specialists in mathematics and application programming (Alaswad et al., 2023). (Dao & Le, 2023) provided a complete analysis of ChatGPT's abilities to deal with mathematics, as the study showed that ChatGPT is highly successful in providing answers to questions on topics including exponential and logarithmic functions, geometric progression, and computational progression. The study found that ChatGPT had difficulty correctly answering questions on topics including derivatives, applications, spatial geometry, and spatial calculus. In addition, the results indicated that ChatGPT has the potential to be an effective educational tool for mathematics, but more work is needed to enhance its handling of graphical data and address the challenges posed by increasingly difficult questions. Frieder et al. (2023) indicated that ChatGPT can be used more successfully as a mathematical assistant to query facts, acting as a mathematical search engine and knowledge base interface. But he is underperforming in dealing with passing the math test at the graduate level, so it is better for him to look for another assistant.

AI has changed the rules of the game in many areas, including math. Many AI-powered math solution applications have emerged, providing more than just definitive solutions. They offer step-by-step detailed solutions. This approach helps build a deeper understanding of math concepts and promotes mathematical problem solving and abilities. Through a survey of websites, the best applications for AI math solving available today can be expressed in Figure 2. These applications use advanced algorithms, deal with a range of topics from many branches of mathematics, such as calculus, algebra, and statistics, and provide interactive graphs (Smodin, 2023).

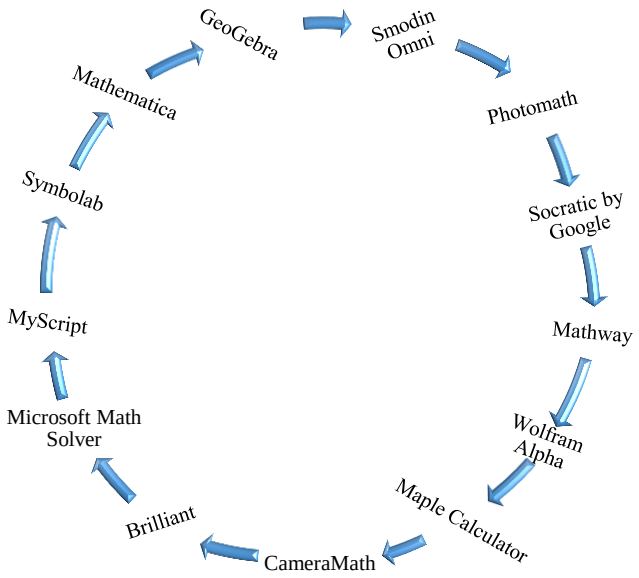


***Figure 2.*** AI applications in math education

**Teachers' perceptions of AI**

The Teachers' perceptions are so profound that a teacher's performance cannot develop without changing the way he or she thinks and perceives. Perceptions are very important in shaping teachers' beliefs, and they are a lens that transmits what is inside them to the educational reality. We also see the reflections of these perceptions on educational practices. Perceptions have three components: the teacher, the goal that is being perceived, and the situation in which the perception occurs. Each of these components affects the teacher's perception or interpretation of the situation.

Teachers' perceptions of mathematics education issues are necessities that should not be ignored in mathematics education research. Ryu & Han (2018) revealed positive attitudes and perceptions among teachers about the educational uses of AI. The results showed that teachers with high experience in advanced schools believe that AI-based education can help improve creativity. Teachers with more years of teaching experience also showed a higher interest in AI and a higher level of understanding of its connection to the subject matter. One of the most important recommendations of the study is to provide educational programs that focus on increasing teachers' awareness of the educational uses of AI.

Reinhold et al. (2021) indicated that workshop-based in-service teacher training can enhance teachers' perceptions about using of digital media in teaching mathematics, raise their self-efficacy, and reduce their anxiety toward teaching mathematics using digital tools. Wang et al. (2020) explained that there is concern among most teachers regarding the use of AI in education. Shin (2020) aimed to highlight the need for AI in future mathematics education as seen by pre-service math teachers and the role of teachers in the use of AI. Among the most prominent findings of the study, in terms of teaching, teachers said that the use of AI in school mathematics is the need of the moment, and that different types of classrooms can be implemented, and accurate knowledge and information transferred, but there are limitations in cognitive and emotional interaction. In terms of learning, AI also provides individual learning, can be used for complementary learning (lifelong learning) outside the classroom, and can stimulate interest in learning, but it can hinder students' ability to think independently. In terms of assessment, AI is objective, fair and can reduce teachers' work, but it has limitations in written and essay questions and process-oriented assessment. When AI was used, the teacher's role considered by potential teachers was teaching, emotional interaction, informal assessment, and mentorship, and AI's role was individual learning, rote learning, standardized assessment, and administrative work.

Aldarayseh (2023) show a high acceptability of the use of AI in the classroom by science teachers, with positive correlations to self-efficacy, ease of use, expected benefits, attitudes, and behavioral intentions. Park and Kwon (2024) confirmed that the developed AI program was effective in technology education and career exploration. In addition, it was possible to confirm the technological educational value of the AI education program that focuses on solving technological problems. Chounta et al. (2022) exploring teachers' perceptions of AI as a tool to support their practice in Estonian K-12 education. The results indicated that teachers need support to be efficient and effective in their work practice; AI can be used to provide this support. Furthermore, teachers perceived AI as a tool to support them in accessing, adapting, and using multilingual content. Al-Shehri (2023) stressed that there is a medium to high level of awareness among special education teachers of the advantages and possibilities of employing AI applications in solving learning difficulties problems, and the level of emotional and behavioral trends was high.

Chai et al. (2021) recommends teachers to promote self-efficacy and emphasize the potential use of AI for social good. By doing so, students are likely to have a higher appetite for AI learning, and thus can be better prepared for an AI-powered future. Teachers' lack of knowledge of AI is an obstacle to its widespread adoption in schools. Most importantly, understand teachers' willingness and intention to employ AI in education. Therefore, Ayanwale et al. (2022) confirmed an important relationship regarding behavioral intent and AI readiness. Meanwhile, AI anxiety has little to do with teachers' behavioral intentions. Similarly, AI for Social Good does not predict teachers' readiness for AI. So far, the potential of AI has not been fully exploited in mathematics education. To effectively integrate AI into education, Celik (2023) has developed a scale to measure knowledge related to the use of educational AI based on the Technological, Educational and Content Knowledge Framework (TPACK). In addition to the ethical aspects related to AI. The results indicated that if teachers have more knowledge to interact with AI-based tools, they will have a better understanding of the pedagogical contributions of AI. Al-Massad and Al-Farani (2023) showed that the degree of availability of skills for using AI applications in education from the perspective of secondary school teachers in terms of planning, implementation and evaluation was moderate. The results showed that there were statistically significant differences at the level (0.05) regarding the degree of employing AI applications in education from the perspective of secondary school teachers due to the variables (training courses - academic qualification - years of experience). Khawaji (2024) indicated that the level of knowledge and practices of digital skills teachers for AI applications in providing middle school students with digital skills was average. The results indicated that there were no statistically significant differences between the respondents' answers about the use of AI applications in providing middle school students with digital skills due to the variables of academic qualification and years of experience, while there were

statistically significant differences due to the variable of obtaining training programs in the field of AI for the benefit of teachers who have access to training programs.

Antonenko and Abramowitz (2023) have emphasized that some teachers have misconceptions about the concept of AI, such as "AI is just a fad" or "AI is only for tech professionals." Or "AI is expensive" or "AI can be learned automatically". "AI doesn't need humans." Although there were some misconceptions about AI, most of the teachers involved in the study were enthusiastic about integrating AI tools and applications into their own educational practices. Al-Qawabah (2024) showed that in-service teachers need to be trained to use existing AI-based tools more effectively. To integrate AI into mainstream education, teachers must participate in the process of co-designing materials considering contextual conditions and, most importantly, curriculum. Teachers' input during development can help put AI into perspective, leading to tangible impacts and significant educational progress. Zhang et al. (2023) indicated that perceived utility and perceived ease of use were the most important factors influencing pre-service teachers' intentions to use AI technology, with perceived benefit having a greater impact than perceived ease of use. Molefi et al. (2024) looks at the acceptance and use of AI among a sample of 315 in-service teachers in Lesotho City, focusing on the mediating role of school support and resources (SSR). The results reveal a significant positive correlation between perceived benefit and perceived usability and a positive attitude towards AI, with school support playing a pivotal role as a complementary mediator in these relationships. The study highlights the need for ongoing training programs designed to enhance teachers' abilities in the use of AI-based technologies. These programs should not only focus on technical aspects, but also emphasize practical implementation in diverse teaching scenarios.

## Methodology

### Method

The current study used a mixed methodology of the sequential explanatory type. To answer the outlined research questions, phase one focused on quantitative data collection and analysis from (questionnaire responses), while phase two focused on qualitative data collection and analysis from (Interview tool responses) (Ivankova et al., 2006, p.4).

Creswell (2014) defined mixed methods as methods which "involve combining or integration of qualitative and quantitative research and data in a research study. Qualitative data tends to be open-ended without predetermined responses while quantitative data usually includes closed-ended responses such as those found on questionnaires or psychological instruments" (Creswell, 2014, p.48).

### Participants

**Table 1.**
*Demographic information of the Participants (N = 382)*

| | **Mathematics teachers** | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Characteristics** | Using AI in math education | | | | Not using AI in math education | | | |
| | | Male | Female | | Male | Female | | Total |
| **Experience years** | Less than 10 years | 35 | 31 | 66 | 58 | 70 | 128 | 194 |
| | 10 years and more | 33 | 33 | 66 | 55 | 67 | 122 | 188 |
| | Total | 68 | 64 | 132 | 113 | 137 | 250 | 382 |

Table 1 showed the demographic information of the participants; male and female middle school mathematics teachers at the Wadi Al-Dawasir Educational Administration in the Riyadh region of the Kingdom of Saudi Arabia during the first semester of the 2024 academic year.

### Materials

The questionnaire in this study included five sections covering different aspects: basic data, the extent of the use of AI in mathematics education, the importance of (AI) for mathematics teachers, the importance of AI for students, and the importance of AI in classroom interaction. Teachers were asked to rate their level of agreement with each item on a scale of 1 to 5, where 1 = "strongly disagree" and 5 = "strongly

agree". The questionnaire was written in clear and direct Arabic language to prevent any possible ambiguity. The questionnaire items were drawn from well-established and proven studies in the field of the use of AI in education, such as: Antonenko and Abramowitz (2023), Chai et al. (2021), Chounta et al. (2022) and Khawaji (2024). To ensure the validity of the questionnaire, it was presented to a group of specialists in teaching mathematics, educational technologies and psychology, and the questionnaire items were modified considering their opinions. To ensure the stability of the resolution, it was applied to a sample of mathematics teachers other than the basic sample in the study (n = 35) and the reliability coefficient was calculated (Cronbach alpha reliability = 0.872). The questionnaire in its final form consisted of (21) items in addition to the basic data related to math teachers. As shown in table 2, table 3.

**Table 2.**
*Questionnaire sections*

| | The sections | Number of Items |
|---|---|---|
| **1** | Extent of the use of AI in mathematics education. | 1 |
| **2** | The importance of AI for mathematics teachers. | 6 |
| **3** | The importance of AI for students. | 6 |
| **4** | The importance of AI in classroom interaction. | 8 |
| | Total of items | 21 |

**Table 3.**
*Cronbach's alpha coefficients to measure the reliability of the questionnaire*

| | The sections | Cronbach's Alpha |
|---|---|---|
| **1** | Extent of the use of AI in mathematics education. | 0.89 |
| **2** | The importance of AI for mathematics teachers. | 0.86 |
| **3** | The importance of AI for students. | 0.91 |
| **4** | The importance of AI in classroom interaction. | 0.88 |
| | Reliability of the questionnaire | 0.872 |

**Data collection procedures and ethical consideration**

Data were collected from in-service middle school mathematics teachers in the Wadi Al-Dawasir Educational Administration in the Riyadh region of the Kingdom of Saudi Arabia during the second semester of the 2023 academic year. Before data collection, approvals were taken from the university and the Department of Education to apply the research tools to mathematics teachers. Pursuant to Approval No. 4500609622/21-5-1445. Study participants were provided with detailed information about the study objectives, participation, and potential risks or benefits. They were free to decide whether to participate, and their consent was obtained before initiating the study. Personal information and answers were treated with the highest level of confidentiality, and the data was anonymized to ensure that teachers' identities remained protected. In addition, there was a time of about three to four months. This intentional waiting period allowed teachers sufficient time to reflect on their personal experiences with AI applications and apply the newly acquired knowledge and skills into their teaching practices. Furthermore, the study was thoroughly reviewed by the relevant ethics committee associated with the Sattam university to which the researchers are affiliated. The survey link to the study (https://forms.gle/yFYAMsmJhRq2vxKQ6) was shared with teachers through various channels, including WhatsApp platforms, to encourage widespread participation.

**Statistical Analysis**

For the data analysis, the Statistical Package for Social Sciences (SPSS 24.0) was used. The following statistical measures were calculated: Frequencies and percentages of population description for primary data. Cronbach's alpha coefficient) to measure the stability of the search instrument. Mean, to calculate the value given by the study sample on each of the phrases of the study variables and the main section, as well as the order of the statements in terms of the degree of response by Mean (M), Standard Deviation (SD), to identify the extent to which the opinions of the sample members deviate for each phrase of the study variables and for each of the main sections from their Mean. T test, to find out the differences between the responses of the study sample according to gender and experience variables.

**Results**

In this section, the results of the study are presented, represented by answering the quantitative and qualitative study questions, where the results are displayed in tables and then commented on, followed by a discussion of these results according to the related studies results.

**Q1: To what extent do teachers use AI applications in mathematics education?**

To answer this question, frequencies, and percentages of the participants 'responses were calculated as shown in Table 4.

**Table 4.**
*Responses of study participants about using AI in mathematics education (N = 382)*

| Do you use AI in mathematics education? | F | % |
|---|---|---|
| **Yes** | 132 | 35% |
| **No** | 250 | 65% |

Note: F refer to the frequency of responses

Table 4 illustrates that (35%) of math teachers using AI in mathematics education, 65% of them do not rely on AI applications in teaching mathematics.

By conducting interviews with 10 teachers, through Zoom and recording the interviews after the teachers' consent, the responses were analyzed, where the analysis focused on identifying the reasons for the reluctance to use artificial intelligence applications in education despite their recognition of their importance in teaching mathematics, and the study relied on the content analysis method to identify these reasons. The results of the analysis indicated that ((Teacher 1) stated that his use of AI applications is limited to the GeoGebra program for plotting functions in Cartesian coordinates, and to ensure that students solve some problems correctly, and he has no objection to using other techniques that may be useful in teaching mathematics. (Teacher 2) mentioned that he had heard about the use of AI applications, and he had a desire to employ them in teaching specific mathematics lessons. While (Teacher 3) mentioned that he tried to use ChatGPT application in some mathematics lessons, but the Arabic language was an obstacle in obtaining accurate results, especially verbal problems in algebra. Teacher 6 also confirmed that he used ChatGPT application, and it was more useful for mathematical knowledge, but it was not useful for solving problems. (Teacher 4) also mentioned that he tried to experiment with some AI applications in solving geometry problems, but he obtained incorrect results, and this may be because the applications still need to be developed to support the Arabic language.

(Teacher 8) also mentioned that she used the Math Solver website, and it was useful in many lessons. While (Teacher 9) indicated that she used the Desmos application, and it was very useful in drawing functions of all kinds and solving algebraic equations in one variable and more.

Teachers 5, 7, and 10 stated that they use Smodin Omni, it is an AI-based math solver, assists high school students to overcome challenging math problems. The advanced algorithms interpret and solve math problems with speed and accuracy, replacing the usual frustration and confusion associated with math homework. It's a tool for unlocking academic potential. By consistently delivering accurate solutions and promoting a deeper understanding of math concepts. They advise all mathematics teachers to use AI applications available on the Smodin Omni website, depending on the nature of the subject being taught.

**Q2: What are teachers' perceptions towards using AI in mathematics education?**

To answer this question, Means, standard deviations, and percentages of the participants 'responses were calculated as shown in Table 5, Table 6, Table 7.

**Table 5.**
*Responses of the participants about the importance of (AI) to math teachers (N = 132)*

| Item | | | Degree of agreement | | | | | M | SD | Agreement | R |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Strongly agree | Agree | Neutral | Disagree | Strongly disagree | | | | |
| **1** | AI is suitable for teaching all branches of mathematics | F | 0 | 22 | 66 | 44 | 0 | 2.83 | 0.694 | Medium | 6 |
| | | % | 0 | 16.7 | 50.0 | 33.3 | 0 | | | | |
| **2** | The use of AI applications increases the effectiveness of mathematics education | F | 0 | 88 | 33 | 11 | 0 | 3.58 | 0.643 | High | 4 |
| | | % | 0 | 66.7 | 25.0 | 8.3 | 0 | | | | |
| **3** | AI applications help teachers to plan mathematics lessons | F | 0 | 44 | 66 | 22 | 0 | 3.17 | 0.452 | Medium | 5 |
| | | % | 0 | 33.3 | 50.0 | 16.7 | 0 | | | | |
| **4** | AI contributes to deepening the mathematical concepts in innovative ways | F | 22 | 66 | 33 | 11 | 0 | 3.75 | 0.832 | High | 2 |
| | | % | 16.7 | 50.0 | 25.0 | 8.3 | 0 | | | | |
| **5** | I am interested in developing my skills in using AI in teaching mathematics | F | 11 | 77 | 33 | 11 | 0 | 3.67 | 0.748 | High | 3 |
| | | % | 8.3 | 58.3 | 25.0 | 8.3 | 0 | | | | |
| **6** | I have a desire to use AI in mathematics education | F | 44 | 66 | 22 | 0 | 0 | 4.17 | 0.690 | High | 1 |
| | | % | 33.3 | 50.0 | 16.7 | 0 | 0 | | | | |
| **Weighted average** | | | | | | | | **3.53** | **0.491** | **High** | |

Note: M refers to the Main, SD refer to standard deviation, and R refer to the rank of item.

Table 5 illustrates that there is agreement between mathematics teachers with a high degree (M = 3.53, SD = 0.491) about the importance of AI to mathematics teachers. The item "I have a desire to use AI in mathematics education" came in the first rank with (M = 4.17, SD = 0.690), and the item "AI contributes to deepening the mathematical concepts in innovative ways" came in the second rank with (M = 3.75, SD = 0.832), the item "I am interested in developing my skills in using AI in teaching mathematics" came in the third rank with (M = 3.67, SD = 0.748), whereas the item "AI is suitable for teaching all branches of mathematics" came in the last rank with (M = 2.83, SD = 0.694).

**Table 6.**
*Responses of the participants about the importance of AI to students (N = 132)*

| Item | | | Degree of agreement | | | | | M | SD | Agreement | R |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Strongly agree | Agree | Neutral | Disagree | Strongly disagree | | | | |
| 1 | AI contributes to developing students' higher order thinking skills in learning mathematics | F | F | 22 | 88 | 11 | 11 | 3.92 | 0.762 | High | 2 |
| | | % | % | 16.7 | 66.7 | 8.3 | 8.3 | | | | |
| 2 | Low-achieving students in mathematics benefit from AI applications | F | F | 11 | 55 | 55 | 11 | 3.50 | 0.767 | High | 5 |
| | | % | % | 8.3 | 41.7 | 41.7 | 8.3 | | | | |
| 3 | AI contributes to stimulating students' mathematical curiosity | F | F | 22 | 66 | 44 | 0 | 3.83 | 0.690 | High | 3 |
| | | % | % | 16.7 | 50.0 | 33.3 | 0.0 | | | | |
| 4 | Using AI achieves equality and justice in assessing student learning | F | F | 0 | 55 | 55 | 22 | 3.25 | 0.724 | Medium | 6 |
| | | % | % | 0.0 | 41.7 | 41.7 | 16.7 | | | | |
| 5 | AI applications provide additional support for students with special needs | F | F | 33 | 66 | 33 | 0 | 4.00 | 0.710 | High | 1 |
| | | % | % | 25.0 | 50.0 | 25.0 | 0.0 | | | | |
| 6 | AI develops positive attitudes among students towards learning mathematics | F | F | 11 | 77 | 22 | 22 | 3.58 | 0.865 | High | 4 |
| | | % | % | 8.3 | 58.3 | 16.7 | 16.7 | | | | |
| **Weighted average** | | | | | | | | **3.68** | **0.475** | **High** | |

Table 6 illustrates that there is agreement between mathematics teachers with a high degree (M = 3.68, SD = 0.475) about the importance of AI to students. The item "AI applications provide additional support for students with special needs" came in the first rank with (M = 4.00, SD = 0.710), and the item "AI contributes to developing students' higher-order thinking skills in learning mathematics" came in the second rank with

(M = 3.92, SD = 0.762), the item "AI contributes to stimulating students' mathematical curiosity" came in the third rank with (M = 3.83, SD = 0.690), whereas the item "Using AI achieves equality and justice in assessing student learning" came in the last rank with (M = 3.25, SD = 0.724).

**Table 7.**
*Responses of study participants about the importance of AI in classroom interaction (N = 132)*

| Item | | | Degree of agreement | | | | | M | SD | Agreement | R |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Stro. agree | Agree | Neutral | Disagree | Stro. disagree | | | | |
| 1 | Using of AI contributes to building a collaborative environment | F | 22 | 44 | 44 | 22 | 0 | 3.50 | 0.961 | High | 7 |
| | | % | 16.7 | 33.3 | 33.3 | 16.7 | 0 | | | | |
| 2 | AI contributes to providing interactive training that responds to the needs of each student individually | F | 11 | 77 | 44 | 0 | 0 | 3.75 | 0.597 | High | 1 |
| | | % | 8.3 | 58.3 | 33.3 | 0.0 | 0 | | | | |
| 3 | Using of AI systems is useful in analyzing students' performances and understanding their behavior patterns in the classroom | F | 11 | 77 | 33 | 11 | 0 | 3.67 | 0.748 | High | 4 |
| | | % | 8.3 | 58.3 | 25.0 | 8.3 | 0 | | | | |
| 4 | Using of AI applications is useful in providing immediate assistance based on students' performance in classroom interaction | F | 11 | 66 | 22 | 33 | 0 | 3.42 | 0.957 | High | 8 |
| | | % | 8.3 | 50.0 | 16.7 | 25.0 | 0 | | | | |
| 5 | Interactive applications based on AI are useful in improving students' mathematical communication skills | F | 22 | 55 | 44 | 11 | 0 | 3.67 | 0.853 | High | 5 |
| | | % | 16.7 | 41.7 | 33.3 | 8.3 | 0 | | | | |
| 6 | The use of AI applications achieves a balance between the roles of the teacher and students in classroom interactions | F | 11 | 88 | 22 | 11 | 0 | 3.75 | 0.724 | High | 2 |
| | | % | 8.3 | 66.7 | 16.7 | 8.3 | 0 | | | | |
| 7 | Using AI is useful in organizing class time to participate in activities and tasks effectively | F | 11 | 77 | 33 | 11 | 0 | 3.67 | 0.748 | High | 6 |
| | | % | 8.3 | 58.3 | 25.0 | 8.3 | 0 | | | | |
| 8 | Using AI reduces classroom problems between students | F | 22 | 66 | 33 | 11 | 0 | 3.75 | 0.832 | High | 3 |
| | | % | 16.7 | 50.0 | 25.0 | 8.3 | 0 | | | | |
| **Weighted average** | | | | | | | | **3.65** | **0.618** | **High** | |

Table 7 illustrates that there is agreement between mathematics teacher with a high degree (M = 3.65, SD = 0.618) about the importance of AI in classroom interaction. The item "AI contributes to providing interactive training that responds to the needs of each student individually" came in the first rank with (M = 3.75, SD = 0.597), and the item "The use of AI applications achieves a balance between the roles of the teacher and students in classroom interactions" came in the second rank with (M = 3.75, SD = 0.724), the item "Using AI reduces classroom problems between students" came in the third rank with (M = 3.75, SD = 0.832), whereas the item "Using of AI applications is useful in providing immediate assistance based on students' performance in classroom interaction" came in the last rank with (M = 3.42, SD = 0.957).

**Q3: To what extent do teachers' perceptions about using AI in math education differ according to the gender variable (Male/ Female)?**

$H_o1$: There is no significant difference between male and female teachers in their perceptions about using AI in math education.

To answer this question, and to verify the validity of the first hypothesis, T-test was calculated for Independent Samples Test as shown in Table 8.

**Table 8.**
*Independent Samples t-test results according to gender variable*

| | Gender | N | Mean | Std. Deviation | Df | t-test value | Sig. (2-tailed) | Significance |
|---|---|---|---|---|---|---|---|---|
| **Total Average Items of perceptions** | Male | 68 | 3.57 | 0.3929 | 130 | 1.749 | 0.083 | Not significant at 0.05 |
| | Female | 64 | 3.71 | 0.5254 | | | | |

Table 8. illustrate that There is no statistically significant difference between the average of the teachers' perceptions about using AI in math education ($\alpha<0.05$) according to the gender variable (Male/ Female), then we must accept null hypothesis ($H_0 1$).

**Q4: To what extent do teachers' perceptions about using AI in math education differ according to experience variable (less than 10 years/ from 10 years or more)?**

$H_o 2$: There is no significant difference between the experience less than 10 years and experience from 10 years or more in their perceptions about using AI in math education.

To answer this question, and to verify the validity of the second hypothesis, T-test was calculated for Independent Samples Test as shown in Table 9.

**Table 9.**
*Independent Samples t-test results according to gender variable*

| | Experience | N | Mean | Std. Deviation | Df | t-test value | Sig. (2-tailed) | Significance |
|---|---|---|---|---|---|---|---|---|
| **Total Average Items of perceptions** | less than 10 years | 66 | 3.56 | 0.3099 | 130 | 1.625 | 0.107 | Not significant at 0.05 |
| | from 10 years or more | 66 | 3.68 | 0.5426 | | | | |

Table 9. illustrate that There is no statistically significant difference between the average of the teachers' perceptions about using AI in math education ($\alpha<0.05$) according to the experience variable (less than 10 years/ from 10 years or more), then we must accept null hypothesis ($H_0 2$).

**Discussion**

The current study is an extension of studies concerned with teachers' perceptions of contemporary educational issues related to teaching mathematics according to AI tools. The middle stage of general education was chosen because of its importance in the educational ladder, as it is the academic stage in which the student is allowed to use educational technologies in learning mathematics, like a calculator. Therefore, the aim of the current study was to reveal the perceptions of middle school mathematics teachers about the use of AI applications in education in the Kingdom of Saudi Arabia. This is an important factor in their success in teaching mathematics and dealing with modern innovations in educational technologies.

The first result indicates a low percentage of teachers who use AI applications in their mathematics teaching practices. By conducting interviews with a sample of them, the reasons for this were revealed, which are that some applications do not accurately support the Arabic language. This result is also due to the weak conceptual background of teachers in using AI. This result is consistent with the study of Ayanwale et al. (2022) who indicated teachers' weakness in conceptual knowledge of AI. It is also consistent with the study of Al-Massad and Al-Farani (2023) which showed that the degree of availability of skills for using AI applications in education from the perspective of secondary school teachers in terms of planning, implementation and evaluation was moderate. While this result is not consistent with Aldarayseh (2023) Which confirmed a high acceptability of the use of AI in the classroom by science teachers. Wardat et al. (2023) showed that ChatGPT lacks a deep understanding of geometry and cannot effectively correct misconceptions.

The second result illustrates that there is agreement between mathematics teacher with a high degree about the importance of AI to mathematics teacher. Evidence of this is a high percentage of teachers' agreement on the following statement: "I have a desire to use AI in mathematics education", and the statement "AI contributes to deepening the mathematical concepts in innovative ways", and the statement "I am interested

in developing my skills in using AI in teaching mathematics". This result is consistent with the study of Molefi et al. (2024) who consider the acceptance and use of AI among a sample of in-service teachers in the city of Lesotho, focusing on the mediating role of school support and resources (SSR), revealed a significant positive relationship between perceived usefulness, perceived ease of use, and positive attitude toward AI. It is also consistent with the study of Wang et al. (2020) which explained that there is concern among most teachers regarding the use of AI in education. Likewise, Shin (2020) study emphasized the need for AI in mathematics education in the future, as seen by mathematics teachers, and among the most prominent findings of the study, teachers said that the use of AI in school mathematics is the need of the moment, and that different types of classrooms can be implemented, and accurate knowledge and information transferred.

The third result illustrates that there is agreement between mathematics teachers with a high degree about the importance of AI to students. Confirming that AI applications provide additional support for students with special needs, and AI contributes to developing students' higher-order thinking skills in learning mathematics. This result is consistent with Chounta et al. (2022) which indicated that teachers perceived AI as a tool to support them in accessing, adapting, and using multilingual content. Likewise, Al-Shehri (2023) stressed the advantages and possibilities of employing AI applications in solving learning difficulties problems, and the level of emotional and behavioral trends was high.

The fourth result illustrates that there is agreement between mathematics teachers with a high degree about the importance of AI in classroom interaction. AI contributes to providing interactive training that responds to the needs of each student individually, and AI applications achieve a balance between the roles of the teacher and students in classroom interactions. Using AI reduces classroom problems between students. This result is consistent with Celik (2023) which indicated that if teachers have more knowledge to interact with AI-based tools, they will have a better understanding of the pedagogical contributions of AI.

The fifth result illustrates that There is no statistically significant difference between the average of the teachers' perceptions about using AI in math education according to the gender variable (Male/ Female). This result may be due to the presence of general agreement among teachers about the importance of AI in mathematics education, regardless of gender difference.

The sixth result illustrate that There is no statistically significant difference between the average of the teachers' perceptions about using AI in math education according to the experience variable (less than 10 years/ from 10 years or more). This result is consistent with the results of the study of Khawaji (2024) and the study of Al-Aiban and Al Qais (2023), where the results showed that there are no statistically significant differences between the average scores of the study sample members' assessment of the degree of possessing the use of AI skills and its impact on the level of quality of educational services through the years of experience variable. While this result differs from the results of the Ryu & Han (2018) study, which found that teachers with a greater number of years of teaching experience have a higher use of AI, and a higher level of understanding of its connection to the academic subject. And the results of Al-Massad and Al-Farani (2023) which showed that there were statistically significant differences at the level (0.05) regarding the degree of employing AI applications in education from the perspective of secondary school teachers due to the years of experience variable.

**Conclusion**

In the current study, the results of a questionnaire administered to 380 middle school mathematics teachers were analyzed. The results showed that a small percentage of teachers use artificial intelligence in mathematics classes. Despite their belief in the importance of artificial intelligence, which was evident from the results of interviews with a sample of them, some of the underlying reasons for this were the difficulty of dealing with some artificial intelligence applications in Arabic. However, some teachers who used these applications in English language obtained results closer to the truth. Accordingly, the current study recommends developing intensive training programs for mathematics teachers to train them on the techniques of using the most important artificial intelligence applications. However, the current study provided a sample of middle school mathematics teachers' perceptions of the use of AI in education. The study showed that teachers have positive perceptions about AI in relation to teaching practices, student learning styles, changing the typical learning environment, and making it interactive. However, there are some difficulties that have caused some teachers to refrain from using AI applications in teaching mathematics, and this requires conducting more extensive and in-depth studies on these obstacles and how

to overcome them. Based on the results of the study, the researchers recommend the following recommendations and research proposals: It is necessary to hold training programs for middle school teachers on the use of AI applications in math education. The need to raise information awareness about AI through organizing conferences and seminars with the aim of mathematics teachers about the importance of AI in education. Applications of AI should also be included in professional development programs for teachers in mathematics education. Future research should consider teachers' perspectives and perceptions to understand how they employ AI applications to teach mathematics, and what difficulties they face in these teaching practices, in addition to the importance of conducting studies that investigate students' perspectives and impressions about AI.

**Ethics statement**

The studies involving human participants were approved by the Prince Sattam bin Abdulaziz University and the Department of Education in Wadi Al-Dawasir Governorate, Riyadh Region; to apply the questionnaire with mathematics teachers. Pursuant to Approval No. 4500609622/21-5-1445.

**Author contributions**

MA: Formal analysis, Resources, Writing – original draft. AA: Writing – review & editing.

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**Data sharing statement**

Data supporting the findings and conclusions are available upon request from the authors.

**Conflict of interest**

The authors declare that there is no conflict regarding the publication of this paper.

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