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# Mathematics teachers' perspectives on utilizing AI in their teaching practices: Examining regional and teaching experience factors

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## Abstract

This study aimed to explore mathematics teachers' perceptions of using AI in their teaching. A sample of 307 mathematics teachers from the University Directorate and the Hifa Educational Region was selected using simple random sampling. Data were collected through a structured questionnaire, specifically designed and psychometrically validated. The study results showed that mathematics teachers' perceptions of using AI tools in their practices were above average overall, and in the subdomains of lesson planning, instructional practices, and students' assessment. However, their perceptions revealed a deep awareness of the challenges that hinder the effective integration of these tools, indicating a dire need for specialized training on the use of AI tools, appropriate classroom infrastructure, and ethical guidelines or policies. Although the study found significant differences in perceptions based on the geographic region, favoring the Haifa region, there were no significant differences related to teachers' experience. This study offered recommendations to help educational decision-makers adopt educational reforms that promote the wise use of AI tools. This aims to improve the effectiveness of teaching mathematics and boost student performance. It also adds to the existing literature by supporting previous studies' evidence on mathematics teachers' perceptions of using AI in their practices and providing further empirical support.

**Keywords:** AI in teaching and learning, Classroom infrastructure, Educational policies, Mathematics education, Mathematics teachers' perceptions, Teacher training.

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## Contents

**Contribution of this paper to the literature**

This study makes an original contribution to the field of mathematics education by offering insights into mathematics teachers' perceptions of using AI tools across various teaching practices, as well as the challenges of implementing these tools. It also analyzes differences in teachers' perceptions based on geographic region and teaching experience.

# 1. Introduction

Artificial Intelligence (AI) functionally refers to a machine's ability to carry out tasks that typically require human intelligence, such as learning and making decisions (Sheikh, Prins, & Schrijvers, 2023). In the last two decades, the use of AI in education has evolved from a supportive resource into a crucial component of teaching practices, improving personalized learning, assessment techniques, and administrative proficiency. This evolution is evident in the remarkable increase in AI-based applications and software aimed at supporting the learning/teaching process, especially since 2020. This reflects a growing global interest in harnessing AI's potential to modernize traditional teaching methods and improve learning environments. El-Shara', Saeed, and Arouri (2025) indicated that the educational benefits of AI surpass those offered by other technological tools previously used in education, providing an unprecedented and ideal opportunity for both students and teachers, particularly in mathematics. AI has enabled personalized learning paths for students that respond to their needs immediately (Borah, 2024; Graesser et al., 2018; Liu, Liu, & Liu, 2024). Intelligent Tutoring Systems (ITS) offer immediate feedback, which is vital for addressing conceptual understanding and enhancing mathematical problem-solving skills. Generative AI applications also provide detailed explanations of mathematical concepts at various levels, aiding conceptual understanding (Bui, Pongsakdi, McMullen, & Veermans, 2024). Teachers' use of AI represents a fundamental shift in their teaching practices, which has undoubtedly generated a range of divergent perspectives among teachers that deserve careful consideration and study. Studies indicate that the extent to which teachers use AI systems is influenced by their understanding of the capabilities offered by these systems and their willingness to adapt to the changes imposed by these systems in their teaching practices (Yim & Wegerif, 2024). Geography, experience, and professional qualifications are among the most prominent factors that contribute to shaping teachers' beliefs about AI. Prasetya, Almuhanna, and Kamalov (2024) and Olaseni (2024) also noted that teachers with more experience generally have more positive perceptions toward AI.

Despite the growing interest of educational systems globally in employing AI tools, most existing studies mainly focus on identifying the most commonly used AI tools in various academic subjects or exploring their potential and benefits in education. Few of these studies have considered the unique characteristics of mathematics as a subject, let alone the perspectives of teachers regarding the use of AI tools in their teaching practices. This results in a lack of sufficient scientific evidence to make reliable generalizations about this crucial aspect that influences teachers' performance and effectiveness. Therefore, this study aims to deepen our understanding of mathematics teachers' perceptions of using AI in their teaching practices, particularly regarding the benefits and challenges of AI. Additionally, the study explores the influences of two factors on teachers' perceptions: geographic location and years of experience. This study analyzes data collected from teachers with varying levels of experience in two geographically distant educational districts: the University Directorate of Education and the Hifa Educational Region. It explores mathematics teachers' perceptions of the benefits of utilizing AI in lesson planning, assessment, and implementation, along with the challenges they encounter. The following research questions guided the study:

1. What are mathematics teachers' perspectives on utilizing AI in their teaching practices?
2. Do mathematics teachers' perceptions of utilizing AI vary based on their years of teaching experience and the educational district?

# 2. Literature Review

## *2.1. Utilizing AI in Mathematics Lesson Planning*

In mathematics education, traditional lesson planning typically requires manual preparation of materials, which can be time-consuming. Before the emergence of generative AI applications in 2022, Mußmann, Hardwig, Riethmüller, Klötzer, and Peters (2020) reported that teachers in Germany work an average of 48.5 hours per week. Yet, only 35% of this time is dedicated to teaching, while 27% is spent on preparing and following up on lessons. However, the recent advent of artificial intelligence tools has revolutionized lesson planning for all subjects, including mathematics. Recent studies indicate that teachers can utilize ChatGPT to create mathematical tasks, highlighting the ability of AI to lessen the time and effort needed for lesson preparation (Durmuş, 2024; Luzano, 2024). The effectiveness of teachers' classroom delivery and, consequently, students' performance, is primarily influenced by the quality of lesson planning (Li, Chen, & Kulm, 2009). This makes planning a critical element of teaching practices (Kang, 2016). Nonetheless, various studies have identified challenges teachers encounter in lesson planning: for instance, they often struggle to create engaging tasks for students (Ainley, 2012) and face challenges in designing student-centered lessons (Mwaraksurmes, 2024). Several recent studies have indicated that generative AI tools such as ChatGPT and MathGPT have enabled the design of high-quality, detailed lesson plans supported by diverse examples and explanations of mathematical concepts, and enhanced by practical assessment tools (El-Shara, Tabieh, & Abu Helu, 2025; Pepin, Buchholtz, & Salinas-Hernández, 2025). These tools have also contributed to the development of dynamic lesson plans that meet the varying individual needs of students (Karaman & Göksu, 2024).

## *2.2. AI as a Means to Enhance Teaching Implementation*

AI systems are rapidly providing support for both teachers and students during mathematics instruction, including enhancing personalized learning and increasing student engagement (Efendi, Panglipur, & Murtinasari, 2024; Paliwal & Patel, 2025). AI algorithms can identify students' needs and diagnose their difficulties, contributing to the creation of learning content specifically designed to address these needs and difficulties. This strategy has proven effective, particularly with students who struggle in traditional learning environments, as AI systems have provided them with the opportunity to learn complex concepts in a way that suits them (Annuš & Kmeť, 2024; Inderjeet & Bhardwaj, 2024). For example, generative AI programs such as ChatGPT, the math problem-solving program MathGPT, and the AI-powered "Learn with Me" program offer personalized learning paths across all mathematical domains, providing students with detailed solutions to mathematical problems. This approach allows students to progress at their own pace, reducing the need for teacher intervention (Paliwal & Patel, 2025; Rane, 2023; Zapata-Rivera et al., 2024). Also, generative AI programs such as ChatGPT and MathGPT provide immediate feedback to students, enabling teachers to quickly identify and address knowledge gaps, thereby improving the overall quality of teaching and ensuring that students receive timely assistance (Luzano, 2024; Xu, 2024). Some studies also indicate that the AI-based computational thinking approach improves students' mathematical problem-solving and critical thinking skills (Abar, Dos Santos, & Vieira De Almeida, 2024; Ali, 2024). This approach leverages AI affordances to help students develop strategies for solving mathematical problems systematically, following a series of logical steps. It also

provides immediate feedback that helps students overcome their misconceptions, understand and correct their mistakes, improve their reasoning, and discover numerical and geometric patterns, thus enhancing their ability to solve mathematical problems (Abar et al., 2024). Analyzing student data and recommending suitable learning paths based on this data, ensuring that lesson plans align with each student's individual needs, is also recognized as another effective use of AI in mathematics teaching. This feature has enhanced teachers' ability to implement differentiated instruction, where teachers consider the varying needs of students (Inderjeet & Bhardwaj, 2024; Sunarto, Hariadi, & Lemantara, 2024).

### 2.3. AI in Mathematics Assessment and Assignment

Artificial intelligence (AI) systems are increasingly providing reliable solutions for mathematics education assessment. Generative AI tools, such as ChatGPT and Copilot, have become highly relied-upon resources for teachers to develop level-specific mathematical exercises and problems, as well as reliable assessments (Busuttil & Calleja, 2025; Magat & Sangalang, 2024). AI-powered assessment tools have also been increasingly used in formative assessment due to their growing ability to provide immediate and accurate feedback on student performance and to identify areas where additional support may be needed (Inderjeet & Bhardwaj, 2024). This allows teachers to continuously adjust their instructional plans based on students' actual needs and to ensure an appropriate level of alignment between the curriculum, student needs, and learning outcomes (Inderjeet & Bhardwaj, 2024; Vootukuri & Jyothi, 2024). Some recent studies have indicated the effectiveness of this approach in addressing shortcomings in mathematics learning, as traditional teaching methods typically do not provide solutions that take into account students' different abilities and needs (Inderjeet & Bhardwaj, 2024; Zreik, 2024). AI-powered assessment tools have also significantly advanced summative assessment by enabling the ability to control the difficulty level of test items in real time based on each student's responses and progress, a process known as adaptive assessment (Inderjeet & Bhardwaj, 2024; Opesemowo, 2025). Marking students' mathematics assignments and tests takes a significant amount of teachers' time, especially if they include essay questions. Fortunately, AI-based automated marking systems have made it possible to automate this time-consuming process with high accuracy, benefiting teachers by freeing up their time and effort to focus on other aspects of their teaching practice (Giri, 2024; Vetrivel, Arun, Ambikapathi, & Saravanan, 2025). It also benefits students by enhancing the accuracy of marking their answers and providing them with detailed feedback (Ogunsakin, 2024; Owan, Abang, Idika, Etta, & Bassey, 2023; Vetrivel et al., 2025). ASSISTments, an AI-powered online assessment tool that provides real-time feedback to students and actionable recommendations to mathematics teachers, has been shown in several studies to have a positive correlation between its use and improved learning outcomes (Feng, Huang, & Collins, 2023). Likewise, AI-based feedback systems such as ScaffoldiaMyMaths provide instant, tailored feedback that enhances the learning experience for low-performance students (Sun, Wang, Yang, & Zheng, 2024).

Recently, several platforms have been developed to enhance mathematics learning and teaching by integrating multiple AI-driven tools. The Halomda platform is one such example. By incorporating ChatGPT and other AI tools, Halomda improves learning experiences at home and in the classroom by providing interactive problem-solving modules, automated assessments, and AI-powered tutoring while also assisting teachers with assignment evaluations (Slobodsky & Durcheva, 2024).

### 2.4. AI in Mathematics Assessment and Assignment

Past studies reported several obstacles and challenges that impede the utilization of AI in mathematics education. Insufficient technological infrastructure is a significant challenge, as numerous studies reported that schools, especially in rural or less developed areas, encounter issues such as slow internet speeds, outdated technology, and restricted access to devices (Elifas & Simuja, 2024; Mehdaoui, 2024). Studies also reported the shortage of targeted teacher training on utilizing AI-based tools as an obstacle, arguing that teachers might find it challenging to incorporate these tools into their teaching practices effectively without having enough training (Almethen, 2024; Magat & Sangalang, 2024). Some studies point to challenges in integrating AI tools into teaching practices, including teachers' resistance to change, especially among less trained teachers (Aljemely, 2024; Lima, Silva, & Pereira, 2024). Other studies have indicated that the integration of AI tools into mathematics education, in particular, has caused psychological stress and burnout among teachers, who already suffer from overwhelming demands due to the challenges of teaching this subject. These studies indicated that the additional work required to learn about AI tools and integrate them into their teaching practices caused additional stress, especially for those already facing heavy workloads (Hashem, Ali, El Zein, Fidalgo, & Abu Khurma, 2024). For example, teaching AI-enhanced digital textbooks requires teachers to change their lesson plans, which can consume a significant portion of their time and cause stress (Kim & Kim, 2024; Zhao & Chang, 2024). Furthermore, keeping up with the rapid development of AI tools poses a constant challenge for mathematics teachers and can trigger anxiety and feelings of inadequacy. Some teachers' perceptions of a lack of the necessary skills and knowledge to effectively integrate AI tools into their teaching practices may generate negative feelings (Almutairi, 2025; Falebita, 2024). Another challenge is that some generative AI tools, while capable of providing detailed solutions for simple mathematical problems and exercises, are sometimes unable to solve complex, multi-step mathematical problems, especially those requiring graph analysis. However, they still provide inaccurate answers, which can confuse students (Bui et al., 2024; Rane, 2023). Some studies indicate that students' overreliance on AI tools in learning mathematics can limit their opportunities to develop critical thinking and problem-solving skills (Rane, 2023). Therefore, these studies recommend balancing the use of AI tools with traditional teaching methods. Some studies have also highlighted the important issue of students' unequal access to AI tools for financial reasons, a challenge that may widen the gap between them (Pandya, 2024; Vootukuri & Jyothi, 2024). Policy-related challenges that have emerged when employing AI tools in mathematics education have also been highlighted in the literature. These challenges include, for example, concerns about student data privacy, biases resulting from AI algorithms, inaccuracy in AI-generated content, and threats related to academic integrity and plagiarism (Kaplan, 2022; López, 2025; Mundo, Santos, & Kim, 2024). This calls for the development of policies regulating the use of AI in education and unified guidelines for its integration, including educating students on ethical practices and stressing transparency when using AI tools (Maulida, Nurossobah, Aura, Nengsih, & Rasilah, 2024; Mundo et al., 2024; Zreik, 2024).

Another significant challenge to the use of AI in teaching practices is the impact of teachers' perceptions, as they are more likely to adopt educational tools that align with their beliefs regarding the pedagogical or practical benefits of these tools (Busuttil & Calleja, 2025; Choi, Kim, & Lee, 2022). Some studies indicate that teachers' perceptions vary by gender and experience, with male teachers generally showing greater acceptance of AI tools and those with 5 to 10 years of experience being more confident in their ability to effectively use AI tools (Yoon & Jang, 2025). Alkramiti and Alsharidah (2024) the study showed that teachers view AI tools as an effective means for enhancing student engagement and increasing the effectiveness of mathematics teaching. However, the study did not reveal statistically significant differences in teachers' perceptions attributable to gender or the level of experience. Wardat, Tashtoush, Alali, and Saleh (2024) investigated the perceptions of mathematics teachers in the Emirate of Abu Dhabi in the United Arab Emirates regarding the AI tools they use, revealing positive perceptions of their role in facilitating mathematics teaching and improving student performance. The study revealed statistically significant differences in the participating teachers' perceptions of the challenges associated with using AI tools, attributed to academic qualifications, with master's degree holders appearing less overwhelmed by these challenges. In Kuwait,

Al-Ruwaished (2023) investigated mathematics teachers' awareness of the potential benefits of employing artificial intelligence tools in their teaching practices, and their perspectives on the most significant obstacles they face in this regard were examined. The study revealed that teachers generally have an average understanding of the benefits of employing these tools in their teaching practices. It indicated that dense curricula and the numerous administrative burdens placed on teachers are the most significant barriers to their use of AI tools. The study revealed no statistically significant differences in teachers' perceptions attributable to teachers' years of experience or their students' age.

## 3. Materials and Methods

### 3.1. Participants

The participants in this study included 307 male and female mathematics teachers, randomly selected from the University Educational District in Jordan (183 teachers) and the Haifa Educational District (124 teachers). Table 1 shows the distribution of sample members by years of experience.

**Table 1.** Distribution of sample members by experience.

| Years of experience | Number | Percentage |
|---|---|---|
| Less than 5 years | 83 | 27 % |
| Five to less than 10 years | 62 | 20 % |
| Ten years or more | 162 | 53 % |
| Total | 307 | 100% |

### 3.2. Data Collection

This study employs a 54-item questionnaire developed by the research team as its primary data collection instrument. Respondents rate each item on a 5-point Likert scale, ranging from Strongly Disagree (1) to Strongly Agree (5), which captures varying levels of agreement or perception. The questionnaire was distributed online to enhance accessibility and simplify participation, while reducing logistical challenges. The 54 items are distributed across four main domains: (1) the use of AI in lesson planning, (2) the use of AI in teaching implementation, (3) the use of AI in assessment, and (4) the challenges of using AI in teaching mathematics. Texts of all items will appear in the subsequent sections. The apparent validity of the study instrument was verified by presenting it to a group of faculty members at Jordanian universities specializing in curriculum, teaching, and educational technology, as well as several educational supervisors of mathematics in the University District and the Haifa District. The referees offered their insights on the clarity, relevance, and suitability of the items for assessing the intended constructs. Their feedback included suggestions to delete some items, modify others, or add new ones. Suggestions agreed upon by at least 80% of the referees, or those representing a scientific, linguistic, or methodological error, were considered. To verify the instrument's reliability, it was administered to a pilot sample from within the study community, consisting of 40 male and female teachers, distributed equally among teachers in the University District and the Haifa District. The internal consistency coefficient was determined using Cronbach's alpha. The reliability coefficients for the questionnaire items across the four domains were as follows: planning domain, 0.97; implementation domain, 0.98; assessment domain, 0.99; and challenges domain, 0.99. The cumulative reliability of all items stands at 0.983.

## 4. Results

To address the first research question in this study, which concerns mathematics teachers' perceptions of using artificial intelligence applications in lesson planning, the means and standard deviations of the participating teachers' quantitative responses on the five-point Likert scale for each of the four main areas of the questionnaire were calculated, as shown in the Table 2.

**Table 2.** Means and standard deviations for the four main domains.

| Domain | Mean | Std. Deviation |
|---|---|---|
| Planning | 3.59 | 0.90 |
| Implementation | 3.52 | 1.35 |
| Assessment | 3.75 | 2.18 |
| Challenges | 3.90 | 2.72 |
| Total | 3.62 | 2.14 |

Notably, the challenges domain had the highest mean, followed by the assessment domain, then the planning domain, while the implementation domain had the lowest. Overall, mathematics teachers rated their perception of using AI tools with a mean score of 3.66. The standard deviation values indicate the extent of variation in responses, with the challenges domain (2.72) and assessment domain (2.18) displaying the highest levels of dispersion, implying a range of perceptions in these areas. In contrast, the planning domain (0.90) and the implementation domain (1.35) show more uniformity in responses. The overall mean (3.62) and standard deviation (2.14) highlight a general pattern of acceptance, though perceptions differ among teachers. Detailed results for all domains are presented below.

### 4.1. Planning Domain

The questionnaire included 13 items related to mathematics teachers' perceptions of using AI tools in lesson planning. Table 2 presents these items alongside the qualitative responses of the participating teachers, measured using a 5-point Likert scale. It also includes the percentage of responses for each item across the five levels of the scale, along with the mean and standard deviation for these responses.

To facilitate the interpretation of data in this table, responses were grouped into broader categories: Strongly Disagree (SD) and Disagree (D) were combined into one category, Neutral (N) was kept as a separate category, and Agree (A), along with Strongly Agree (SA), formed another category. The results show that most teachers believe that using AI tools in planning enriches their practice and provides a range of activities appropriate to the subject (65.5%; 63.5%). Nearly half of the teachers believe that AI tools can suggest appropriate activities to achieve learning outcomes and provide suggestions suitable for the nature of students' roles during class (54.5%; 59.0%). Less than half of the teachers (47.7%) think that using AI tools helps them assign homework appropriately to students. Conversely, 20.5% of teachers do not believe that AI tools can assist them in assigning homework. Nearly half of the teachers (55.3%) support that AI tools can help clarify mathematical concepts. However, a significant group (18.7%) believes their use does not aid in clarifying these concepts. Few teachers (12.7%) disagreed that using AI tools helps provide suggestions for activities that align with learning outcomes, or that it develops their skills in employing technological teaching techniques (13.0%). Conversely, 34.5% (30.0%) did not specify their position on

whether AI tools assist teachers in assigning student assignments or support students' learning of mathematics. While 1.6% strongly disagreed that AI tools suggest practical steps for planning daily instruction, 23.8% strongly agreed that their use enriches teaching practices.

**Table 3.** Teachers' perceptions of the use of AI in lesson planning.

| Item | SD (%) | D (%) | N (%) | A (%) | SA (%) | Mean | St. Dev. |
|---|---|---|---|---|---|---|---|
| Helps the teacher analyze the content into concepts, generalizations, skills, and problems. | 14 (4.6) | 31 (10.1) | 80 (26.1) | 132 (43.0) | 50 (16.3) | 3.56 | 1.03 |
| Suggests the practical stages of planning the class period. | 5 (1.6) | 39 (12.7) | 86 (28.0) | 125 (40.7) | 52 (16.9) | 3.59 | 0.97 |
| Suggests activities that are aligned with the learning outcomes. | 8 (2.6) | 31 (10.1) | 73 (23.8) | 126 (41.0) | 69 (22.5) | 3.71 | 1.01 |
| Provides suggestions for strategies appropriate to the topic. | 8 (2.6) | 36 (11.7) | 66 (21.5) | 139 (45.3) | 58 (18.9) | 3.66 | 1.00 |
| Provides the teacher with suggestions for educational resources appropriate to the topic. | 9 (2.9) | 39 (12.7) | 67 (21.8) | 134 (43.6) | 58 (18.9) | 3.63 | 1.02 |
| Assists the teacher in selecting homework. | 12 (3.9) | 51 (16.6) | 106 (34.5) | 93 (30.3) | 44 (14.3) | 3.36 | 1.05 |
| Provides the teacher with suggestions about the nature of the student's role. | 9 (2.9) | 39 (12.7) | 77 (25.1) | 132 (43.0) | 49 (16.0) | 3.58 | 1.02 |
| Organize and distribute teaching time based on learning outcomes. | 10 (3.3) | 42 (13.7) | 90 (29.3) | 114 (37.1) | 50 (16.3) | 3.51 | 1.06 |
| Contributes to clarifying mathematics concepts. | 8 (2.6) | 37 (12.1) | 91 (29.6) | 118 (38.4) | 52 (16.9) | 3.57 | 1.04 |
| Propose assessment criteria aligned with learning outcomes. | 9 (2.9) | 36 (11.7) | 92 (30.0) | 121 (39.4) | 48 (15.6) | 3.55 | 1.05 |
| Enriches mathematics teachers' teaching practices. | 7 (2.3) | 29 (9.4) | 69 (22.5) | 128 (41.7) | 73 (23.8) | 3.78 | 1.08 |
| Enhances mathematics teachers' teaching style. | 13 (4.2) | 32 (10.4) | 90 (29.3) | 121 (39.4) | 50 (16.3) | 3.56 | 1.13 |
| Develops the teacher's efficiency in employing technological techniques. | 9 (2.9) | 34 (11.1) | 79 (25.7) | 131 (42.7) | 53 (17.3) | 3.64 | 1.13 |
| Total | | | | | | 3.59 | 0.90 |

### *4.2. Implementation Domain*

The questionnaire included 21 items related to mathematics teachers' perceptions of using AI tools in teaching implementation. Table 3 presents these items alongside the qualitative responses of the participating teachers, the percentage of responses for each item, and the mean and standard deviation for these responses.

**Table 4.** Teachers' perceptions of the use of AI in teaching implementation.

| Item | SD. (%) | D (%) | N (%) | A (%) | SA (%) | Mean | St. Dev. |
|---|---|---|---|---|---|---|---|
| Clarifies mathematical concepts. | 8 (2.6) | 31 (10.1) | 89 (29.0) | 136 (44.3) | 42 (13.7) | 3.60 | 1.11 |
| Supports the students' learning process. | 4 (1.3) | 27 (8.8) | 87 (28.3) | 137 (44.6) | 51 (16.6) | 3.70 | 1.11 |
| Enriches mathematics teaching practices. | 9 (2.9) | 22 (7.2) | 82 (26.7) | 130 (42.3) | 63 (20.5) | 3.75 | 1.20 |
| Fosters positive student attitudes towards learning. | 10 (3.3) | 32 (10.4) | 89 (29.0) | 115 (37.5) | 60 (19.5) | 3.64 | 1.27 |
| Facilitate academic dishonesty (cheating). | 37 (12.1) | 77 (25.1) | 99 (32.2) | 70 (22.8) | 24 (7.8) | 2.89 | 1.13 |
| Analyses students' classwork in real-time. | 9 (2.9) | 36 (11.7) | 89 (29.0) | 135 (44.0) | 37 (12.1) | 3.56 | 1.30 |
| Assists in explaining and clarifying lesson elements. | 5 (1.6) | 34 (11.1) | 94 (30.6) | 133 (43.3) | 40 (13.0) | 3.61 | 1.30 |
| Encourages independent learning. | 8 (2.6) | 35 (11.4) | 78 (25.4) | 109 (35.5) | 76 (24.8) | 3.74 | 1.44 |
| Promotes collaborative learning. | 12 (3.9) | 30 (9.8) | 98 (31.9) | 102 (33.2) | 64 (20.8) | 3.64 | 1.48 |
| Establishes connections between mathematics and other subjects. | 9 (2.9) | 24 (7.8) | 85 (27.7) | 122 (39.7) | 66 (21.5) | 3.76 | 1.48 |
| Provides multiple ways to explain topics effectively. | 6 (2.0) | 26 (8.5) | 83 (27.0) | 124 (40.4) | 67 (21.8) | 3.79 | 1.51 |
| Organizes student roles in the classroom. | 9 (2.9) | 38 (12.4) | 107 (34.9) | 120 (39.1) | 32 (10.4) | 3.49 | 1.55 |
| Creates a rich and engaging learning environment for discussions. | 5 (1.6) | 33 (10.7) | 86 (28.0) | 110 (35.8) | 72 (23.5) | 3.76 | 1.62 |
| Addresses challenges that arise during lesson delivery. | 6 (2.0) | 32 (10.4) | 96 (31.3) | 115 (37.5) | 57 (18.6) | 3.68 | 1.65 |
| Increases student motivation. | 6 (2.0) | 27 (8.8) | 84 (27.4) | 123 (40.1) | 66 (21.5) | 3.79 | 1.69 |
| Negatively impacts students' writing skills. | 38 (12.4) | 79 (25.7) | 100 (32.6) | 67 (21.8) | 22 (7.2) | 3.01 | 2.86 |
| Leads to classroom disruptions. | 33 (10.8) | 69 (22.5) | 122 (39.9) | 67 (21.9) | 14 (4.6) | 2.96 | 1.86 |

| Item | SD. (%) | D (%) | N (%) | A (%) | SA (%) | Mean | St. Dev. |
|---|---|---|---|---|---|---|---|
| Encourages students to rely entirely on AI for completing homework. | 14 (4.6) | 29 (9.4) | 110 (35.8) | 95 (30.9) | 58 (18.9) | 3.59 | 1.89 |
| Increases the risk of students accessing inappropriate content online. | 16 (5.2) | 43 (14.0) | 120 (39.1) | 88 (28.7) | 39 (12.7) | 3.39 | 1.93 |
| Yields positive outcomes in mathematics teaching practices. | 7 (2.3) | 23 (7.5) | 109 (35.5) | 119 (38.8) | 48 (15.6) | 3.68 | 1.91 |
| Negative results are more than positive results. | 56 (18.2) | 62 (20.2) | 115 (37.5) | 58 (18.9) | 15 (4.6) | 2.82 | 2.10 |
| Total | | | | | | 3.52 | 1.35 |

Data analysis shows that nearly two-thirds of teachers (62.8%; 61.2%) strongly agree that AI tools enrich their teaching practices and support student learning. Sixty-three percent of teachers agree that using AI tools helps students learn independently, and nearly half (54.0%) believe they facilitate collaborative learning. Additionally, 54.4% of teachers think that using AI tools leads to positive outcomes in teaching mathematics. However, 9.8% of teachers disagreed, and a small percentage (9.8%, 10.5%, 10.8%) did not believe that using AI tools has significant positive effects in teaching mathematics, that they offer teachers diverse ways to explain topics easily, or that they engage students during lessons. Moreover, 38.1% of teachers disagreed that using AI tools negatively impacts students' writing skills, while 12.4% strongly disagreed. A limited number of teachers (33.3%) agreed that the use of AI tools creates chaos and disruption in the classroom, and 18.2% of teachers strongly disagreed that the adverse effects of using AI tools outweigh the positive ones.

A very small percentage of teachers (1.6%; 2.0%) strongly disagreed that the use of AI tools provides a rich learning environment that encourages dialogue or that their use engages students during class. However, 21.5% strongly agreed that using them in teaching mathematics engages students during class. Conversely, 39.9%; 39.1% remained neutral regarding whether the use of AI tools in teaching mathematics causes chaos and disruption in class and whether their use enables students to access inappropriate online content. Nearly a third of teachers (37.5%) did not specify whether the use of AI tools has a greater negative than positive impact on teaching mathematics.

### *4.3. Assessment Domain*

The questionnaire included 8 items related to mathematics teachers' perceptions of using AI tools in assessment. Table 4 presents these items alongside the qualitative responses of the participating teachers, the percentage of responses for each item, and the mean and standard deviation of these responses.

**Table 5.** Teachers' perceptions of the use of AI in assessment.

| Item | SD. (%) | D (%) | N (%) | A (%) | SA (%) | Mean | St. Dev. |
|---|---|---|---|---|---|---|---|
| Provide immediate feedback on student performance (Formative assessment). | 9 (2.9) | 29 (9.4) | 83 (27.0) | 137 (44.6) | 48 (15.6) | 3.71 | 2.032 |
| Analyze student work based on assessment criteria. | 7 (2.3) | 32 (10.4) | 84 (27.4) | 132 (43.0) | 51 (16.6) | 3.72 | 2.082 |
| Generate performance reports for school management. | 8 (2.6) | 33 (10.7) | 70 (22.8) | 138 (45.0) | 57 (18.6) | 3.77 | 2.142 |
| Diversify assessment methods for mathematical concepts. | 7 (2.3) | 30 (9.8) | 72 (23.5) | 139 (45.3) | 58 (18.9) | 3.80 | 2.182 |
| Evaluate students' solutions to mathematics homework. | 5 (1.6) | 35 (11.4) | 73 (23.8) | 140 (45.6) | 53 (17.3) | 3.77 | 2.229 |
| Share assessment results with students via email. | 9 (2.9) | 38 (12.4) | 79 (25.7) | 119 (38.8) | 61 (19.9) | 3.72 | 2.319 |
| Facilitate discussions about assessment criteria through digital platforms. | 8 (2.6) | 37 (12.1) | 85 (27.7) | 120 (39.1) | 56 (18.2) | 3.71 | 2.360 |
| Store student performance data securely in cloud systems. | 7 (2.3) | 31 (10.1) | 81 (26.4) | 117 (38.1) | 70 (22.8) | 3.82 | 2.406 |
| Total | | | | | | 3.75 | 2.18 |

Table 4 illustrates mathematics teachers' perceptions of the use of AI tools in the assessment process. It shows that 64.2%, 62.9%, and 60.9% agreed that using AI tools assists teachers in writing assessment reports, determining assessment criteria, and that allowing students to use AI tools for completing their assignments fosters positive attitudes toward mathematics. In contrast, 2.9% strongly disagreed that using AI tools aids teachers in choosing appropriate assessment strategies and tools.

About 22.8% of teachers strongly agreed that allowing students to utilize AI tools for completing their assignments promotes positive attitudes toward mathematics. Less than a third of students (27.0% and 27.7%) were unable to articulate their stance on whether using AI tools in assessments assists mathematics teachers in selecting appropriate assessment strategies or helps teachers diversify assessment methods. This is even though 60.2% of teachers concurred that using AI tools supports teachers in choosing appropriate assessment strategies.

### *4.4. Challenges Domain*

The questionnaire included 12 items related to mathematics teachers' perceptions of using AI tools in assessment. Table 5 presents these items alongside the qualitative responses of the participating teachers, the percentage of responses for each item, and the mean and standard deviation of these responses.

**Table 6.** Teachers' perceptions regarding the challenges of using AI.

| Item | SD. (%) | D (%) | N (%) | A (%) | SA (%) | Mean | St. dev. |
|---|---|---|---|---|---|---|---|
| Providing training programs that include various applications of artificial intelligence. | 16 (5.2) | 23 (7.5) | 64 (20.8) | 128 (41.7) | 75 (24.4) | 3.86 | 2.485 |
| Increased teacher awareness of AI's role in facilitating instruction. | 7 (2.3) | 22 (7.2) | 75 (24.4) | 121 (39.4) | 81 (26.4) | 3.94 | 2.50 |
| Development of appropriate infrastructure for AI integration. | 9 (2.9) | 28 (9.1) | 60 (19.5) | 111 (36.2) | 98 (31.9) | 3.99 | 2.58 |
| Reduction of teaching workload | 9 (2.9) | 30 (9.8) | 74 (24.1) | 119 (38.8) | 74 (24.1) | 3.85 | 2.62 |
| Reducing the administrative burdens on teachers. | 11 (3.6) | 33 (10.7) | 69 (22.5) | 119 (38.8) | 74 (24.1) | 3.83 | 2.69 |
| Stronger regulations to control academic dishonesty. | 13 (4.2) | 21 (6.8) | 71 (23.1) | 114 (37.1) | 87 (28.3) | 3.93 | 2.74 |
| Reassurance that AI does not replace teachers. | 7 (2.3) | 25 (8.1) | 65 (21.2) | 129 (42.0) | 80 (26.1) | 3.96 | 2.76 |
| Lack of incentives for teachers to use artificial intelligence applications in teaching | 10 (3.3) | 28 (9.1) | 66 (21.5) | 124 (40.4) | 78 (25.4) | 3.91 | 2.84 |
| A great deal of time and effort is required compared to regular teaching. | 19 (6.2) | 38 (12.4) | 71 (23.1) | 118 (38.4) | 60 (19.5) | 3.68 | 2.93 |
| Increased technical support for maintenance and application design | 10 (3.3) | 29 (9.4) | 74 (24.1) | 118 (38.4) | 75 (24.4) | 3.87 | 2.95 |
| Access to modern devices compatible with AIAs. | 10 (3.3) | 28 (9.1) | 55 (17.9) | 123 (40.1 | 90 (29.3) | 3.99 | 3.00 |
| Legal frameworks to ensure intellectual. | 13 (4.2) | 21 (6.8) | 74 (24.1) | 118 (38.4) | 80 (26.1) | 3.92 | 3.05 |
| Total | | | | | | 3.90 | 2.72 |

Table 5 shows that a large percentage (69.8%; 69.4%) of mathematics teachers agree that there is a need to increase knowledge of the various applications of artificial intelligence and that using these applications requires more time than regular teaching. Furthermore, 68.1% of teachers believe it is essential to raise awareness of the importance of artificial intelligence applications in facilitating the teaching process and that legislation is needed to control cheating. Many teachers (66.1%) agree that using artificial intelligence applications necessitates training programs that encompass various types of applications.

Nearly a third of teachers (31.9%) strongly agree that there is a need to enhance teachers' awareness of the importance of using applications to aid the teaching process. Less than a third of teachers (24.1%; 24.4%) strongly agree that there is a requirement for training programs to reduce the burden on teachers, provide appropriate infrastructure for application use, and offer incentives for utilizing artificial intelligence applications. Additionally, 18.6% of teachers disagreed with the notion that mathematics teachers need to be made aware that the use of AI applications does not replace their role. Moreover, 14.3% of teachers did not concur that application usage necessitates alleviating the teachers' workload. Meanwhile, 5.2% of teachers strongly disagreed that using AI applications requires training programs for teachers that include various types of applications.

Conversely, a significant percentage of teachers (24.4%; 24.1%) were unable to clearly define their stance on the challenges teachers face in using AI applications in teaching, such as the need for training on various applications, infrastructure provision, increased incentives, or technical support for the design and maintenance of applications.

### *4.5. The Impact of Experience and Educational Region*

The study collected data about the experience and the educational region in which they work. The means and standard deviations of the sample members' responses were calculated for experience and educational region, as shown in Table 6.

**Table 7.** Means and standard deviations of sample members' responses in relation to experience and educational region.

| Years of experience | Educational region | Mean | Std. Deviation |
|---|---|---|---|
| Less than 5 | The university | 3.63 | 0.69 |
| | Haifa | 3.48 | 0.78 |
| | Total | 3.58 | 0.73 |
| Five to 10 | The university | 3.58 | 0.65 |
| | Haifa | 3.93 | 0.71 |
| | Total | 3.72 | 0.69 |
| More than 10 | The university | 3.34 | 0.75 |
| | Haifa | 3.70 | 0.68 |
| | Total | 3.48 | 0.74 |
| Total | The university | 3.47 | 0.73 |
| | Haifa | 3.68 | 0.73 |
| | Total | 3.56 | 0.73 |

Table 7 indicates that there are statistically significant differences at the $\alpha = 0.05$ level in the means of responses of mathematics teachers regarding their perceptions of the use of artificial intelligence tools, attributed to the educational district. This finding favors the Haifa Educational District (3.56) over the University District Educational District (3.47). Additionally, Table 8 provides a two-way ANOVA analysis of the differences between means based on years of experience and educational region, which did not reveal any statistically significant differences at the $\alpha = 0.05$ level in teachers' perceptions of using artificial intelligence tools, attributed to teaching experience.

**Table 8.** Two-way ANOVA analysis of the significance of differences between means based on years of experience and educational region.

| Source | Type III sum of squares | df | Mean square | F | Sig. |
|---|---|---|---|---|---|
| Corrected model | 5.881 | 3 | 1.960 | 3.735 | 0.012 |
| Intercept | 3302.383 | 1 | 3302.383 | 6291.655 | 0.000 |
| Experience | 2.525 | 2 | 1.262 | 2.405 | 0.092 |
| Educational region | 3.339 | 1 | 3.339 | 6.362 | 0.012* |
| Error | 158.515 | 302 | 0.525 | | |
| Total | 4033.365 | 306 | | | |
| Corrected total | 164.396 | 305 | | | |

**Note:** *There is a statistically significant difference at (0.05).

## 5. Discussion

The data analysis of the first research question indicated that the domain of Challenges had the maximum mean. This result is attributed to teachers' awareness of the nature of the challenges associated with incorporating AI applications into the teaching and learning environments. Working in AI-enriched teaching and learning environments requires technical support, particular training, and suitable infrastructure. These factors are considered difficulties that could affect the use of AI. In addition, this result is attributed to teachers' awareness that reducing the challenges of using AI in teaching and learning environments requires mitigating teaching and administrative loads, as well as increasing incentives. This strengthens their awareness of the need to create stimulating teaching and learning environments to face the challenges. Further, the results demonstrated increasing awareness among teachers of the significance of balancing the use of AI while maintaining the teacher's instructional role. That is, teachers should keep a critical view and balance between the technical capabilities and the educational and ethical challenges. Consequently, the high score in the domain of Challenges indicates teachers' readiness to adopt AI technologies. It also reveals their awareness of the obstacles that should be overcome for the incorporation process to thrive.

The high percentages indicated that teachers agree on the need to enhance their knowledge of AI applications, reflecting an apparent lack of training and qualifications to employ those applications efficiently. Magat and Sangalang (2024) and Almethen (2024) designate that the lack of targeted training for teachers on the employment of AI applications is one of the major obstacles, arguing that teachers may struggle to incorporate these applications efficiently into their teaching practices without satisfactory training. According to Hashem et al. (2024), teachers feel overwhelmed by the additional work required to master AI applications and incorporate them into their teaching practices, especially for those who already face heavy workloads. Furthermore, the teachers indicate that employing these applications requires more time than traditional teaching, creating an additional burden that hinders their adoption in daily classroom practice.

The majority of teachers also see the need to enact legislation to curb cheating, indicating their concern about the uncontrolled use of these applications by students. Further, a few teachers expressed fears that their educational role would be marginalized, reinforcing the awareness of AI as a source of occupational threat. Although the majority of teachers agreed on the importance of training, a significant percentage did not specify their position on this matter, reflecting a lack of clarity about their future vision. Based on the above, it can be said that the predominance of challenges in teachers' perceptions reflects a pressing reality in which educational environments lack the elements of professional and technical empowerment, which limits the effective exploitation of AI's potential in mathematics teaching. Therefore, numerous studies (Zreik, 2024) and Maulida et al. (2024) have emphasized the need to develop policies that regulate and support the use of artificial intelligence in education, update curriculum designs to integrate it effectively, and establish unified guidelines for its implementation.

The results of the first question also indicated that the domain of assessment ranked second among mathematics teachers' perceptions of AI applications. Teachers expressed an apparent belief that AI tools contribute to writing more accurate and objective assessment reports and help define clear assessment criteria. This reflects an awareness of the significance of employing AI as an analytical tool that supports data-driven assessment. The majority of teachers also indicated that these applications contribute to fostering positive attitudes toward mathematics among students, especially when used to answer assignments or provide direct support, which decreases students' frustration and increases their engagement with the subject. According to Busuttil and Calleja (2025) and Magat and Sangalang (2024), AI applications are valuable for developing consistent practice questions and assessments, and can also be used effectively in formative assessment by providing direct feedback and recognizing areas where students may need extra support.

On the other hand, the results related to the domain of assessment exposed a degree of hesitation or neutrality among some teachers regarding the employment of AI in selecting assessment strategies and applications. This may be attributed to the absence of practical experience or training in these applications. Further, a minority of teachers expressed opposition to the idea of adopting AI in this context, indicating worries related to the loss of pedagogical control and questioning the consistency of smart applications in dealing with complex mathematical topics. These results reflect a rising awareness among teachers of the benefits of AI in improving assessment, as well as the need to improve their professional competencies in this area through training and designed experimentation. Slobodsky and Durcheva (2024) indicated that incorporating AI applications improves learning experiences at home and in the classroom by providing automated assessments that support student feedback, which in turn also helps teachers in assessing assignments.

The results of the first question also indicated that the domain of planning had the third-highest mean score in mathematics teachers' perceptions of the employment of AI applications, reflecting a rising awareness among teachers of the role these applications could play in supporting their teaching practices in the pre-lesson stage. The majority of teachers agreed that the employment of AI applications improves the planning process and offers a range of educational activities suitable to the subject matter, as indicated by the high percentages of items in the study instrument. This finding is consistent with the works of Durmuş (2024) and Luzano (2024) on the capability of AI applications to deliver content tailored to learning outcomes and educational contexts. Further, the results showed that a large percentage of teachers realize that these applications are capable of suggesting suitable activities to achieve learning outcomes and providing insights into student roles within the classroom, which contributes to encouraging active learning practices and assigning more flexible educational roles. According to Mwaraksurmes (2024), AI applications help teachers create higher-quality, more comprehensive lesson plans by producing diverse examples and multiple clarifications of concepts, assessments, and assessment criteria. Further, Karaman and Göksu (2024) explain that these applications enable the development of collaborative and active lesson plans, allowing mathematics teachers to modify their teaching to meet students' individual requirements.

Despite positive insights, a difference exists in teachers' attitudes toward certain planning functions supported by AI applications. Less than half of teachers indicated that these applications benefit them in assigning homework properly, while a quarter of teachers did not notice any clear advantage from them. This difference reflects challenges related to AI tools' ability to account for individual differences among students or their contextual characteristics when offering assignments. Furthermore, a percentage of teachers were unable to define their position on the extent to which these applications support task allocation or mathematics learning, which may indicate limited real employment or a lack of particular training in this

domain. However, the results displayed that more than half of teachers realize that AI applications contribute to clarifying mathematical concepts and developing their skills in employing technological teaching approaches. This highlights the potential for these applications to be employed more efficiently in teaching planning processes in the future, provided a helpful environment and suitable training chances are provided to improve teachers' digital and pedagogical capabilities.

However, the results of the first question indicated that the domain of implementation ranked last in terms of mean perceptions, indicating strong reservations among mathematics teachers about the practical employment of AI applications in the classroom. According to Sunarto et al. (2024) and Inderjeet and Bhardwaj (2024) the effective employment of AI in mathematics teaching includes analyzing student performance data and suggesting suitable learning paths, ensuring that lesson plans align with each student's development. The results of these studies are consistent with the findings of this study, which showed that the majority of teachers agreed that the employment of AI applications enriches instruction, supports student learning, and improves student independence. Despite this result, this belief was not obviously reflected in real classroom application.

Whereas there is a comparative agreement that AI could involve students during lessons and improve cooperative learning, this conviction is still evolving due to challenges related to classroom management, pedagogical oversight, and ensuring safe employment. Therefore, the low mean ratings in the domain of implementation may be due to a gap between the technology's theoretical potential and its targeted practical application. This calls for a reassessment of training programs that emphasize how to safely, systematically, and efficiently use AI in teaching and learning environments.

While Al-Shara, Karim, and El-Sayed (2024) showed that AI applications provide maximum educational benefits and permit the creation of the best learning opportunities for students. The results, in general, through participants' responses to the full instrument, showed a moderate level of awareness. This moderate level recommends that teachers have not yet fully embraced or internalized the employment of AI in all aspects of their teaching practices. Particularly, the results reflect a stronger acceptance of AI in assessment than in planning and application. This inconsistency could be clarified by multiple factors. Direct and positive experiences with AI tend to improve insights, while the absence of structured professional development limits teachers' capability to efficiently employ these applications. Further, weak official support, whether in terms of infrastructure, policies, or training, could decrease teachers' motivation to adopt AI. Educational concerns, such as students' misappropriation of technology or difficulties managing its incorporation into classrooms, also contribute to teachers' hesitancy. According to Busuttil and Calleja (2025) and Choi et al. (2022) teachers' employment of AI applications faces many challenges that prevent them from investing their educational beliefs in achieving their teaching aims. To improve teachers' perceptions and promote more active employment of AI in learning and teaching environments, a comprehensive method is needed. This comprises enhancing teachers' knowledge and skills, ensuring the necessary infrastructure is in place, providing strong official support, and applying well-designed AI incorporation models that build confidence and alleviate concerns.

The results of the second research question revealed statistically significant differences attributable to the educational district, favoring the Haifa Educational District. This result could be attributed to the Haifa Educational District's preparation and training of teaching staff, as well as their intensive completion of several training workshops, which enabled them to gain vital professional competencies and prepare them to employ these skills in the learning and teaching environments. Further, this result could be attributed to the Haifa Educational District's anticipation of international trends, which call for extensive investment in technological programs and AI in the learning and teaching processes. This could be achieved by assigning substantial finances to the Ministry of Education, allocating considerable resources for infrastructure and internet access in schools, and establishing AI rooms and modern laboratories that keep pace with developments and modernization. Furthermore, the awareness of school administrations in the Haifa Educational District of the impact of modern technologies and AI applications on the learning and teaching processes is a factor that has contributed to teachers' improved employment of AI applications. Incorporating and updating the educational system in line with technological advancements requires flexible management that is aware of and responsive to all global changes and developments across various fields. The Haifa Education District has provided free seminars, workshops, and distant meetings to clarify how to employ these applications and their practices in the learning and teaching processes. It has also established numerous social media groups for all teachers from across all directorates, which have contributed to the acceptance of AI applications.

The results of the second question also disclosed no statistically significant differences in the mean responses of mathematics teachers regarding their perceptions of the employment of AI applications, attributable to teaching experience. This result is attributed to the fact that the number of years of experience is not a conclusive factor in shaping teachers' perceptions of these applications. This pattern of results could be clarified by the fact that AI is a comparatively new technological innovation, still in its early stages of adoption within learning and teaching settings. Subsequently, all categories of teachers, regardless of years of experience, are on a similar level of knowledge and practical experience. Furthermore, interaction with these applications depends mainly on self-motivation, personal readiness, and level of digital expertise, rather than necessarily professional seniority.

The results of this study are consistent with the study of Wardat et al. (2024), which indicated that mathematics teachers have positive perceptions of AI applications used in schools to enable mathematics teaching and increase student performance. Further, the results of this study are consistent with the study of Alkramiti and Alsharidah (2024), which showed that although teachers are aware of AI's potential to advance classroom interaction and teaching efficiency, many do not incorporate AI applications into their teaching practices. Furthermore, the results of this study are also consistent with the study of Al-Ruwaished (2023), which found that teachers generally have a moderate understanding of AI applications. The study indicated that the main obstacles to the employment of AI were the irresistible curriculum and the numerous administrative burdens placed on teachers. Finally, the results revealed no statistically significant differences based on variables such as years of experience among teachers. However, the results of this study differ from those of Yoon and Jang (2025), who declared that teachers with 5 to 10 years of experience had higher confidence in the comfort of use and efficiency of AI than their more experienced colleagues.

## 6. Conclusions

The study results indicated that mathematics teachers recognize the significance of AI applications in supporting their teaching practices. However, their perceptions revealed a deep awareness of the challenges that hinder the effective integration of these applications. The domain of Challenges topped the list of all other domains, representing a dire need for appropriate infrastructure, specific training, and official support to alleviate administrative loads and enhance incentives. Despite the relatively positive perceptions of teachers regarding the use of AI in assessment and planning, the implementation domain ranked lowest, reflecting a gap between theoretical knowledge and practical application. It also highlights reservations related to classroom management, content control, and providing a safe learning environment.

Accordingly, the study recommends the development of national policies that support the use of AI in education, including practical teacher training, the development of technical infrastructure, and the establishment of ethical and pedagogical guidelines. It also calls for the design of smart educational models that take into account individual differences, support educational interaction, and enhance confidence in AI tools. These findings pave the way for future applications, including the

creation of smart learning labs, the development of AI-based assessment and analysis tools, and educational research to explore the actual impact of these tools on the educational process.

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