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Abstract

This study examines mathematics teachers' perceptions of using artificial intelligence (AI) in teaching. A survey was conducted among math teachers in Tabuk City, Saudi Arabia, encompassing three primary domains (knowledge and awareness, perceived benefits, concerns, and challenges) to ascertain mathematics teachers' views on using AI in teaching. Completed questionnaires from 149 participants were examined. Results indicate that math teachers perceive AI knowledge and awareness positively. They acknowledge AI's importance in enhancing their digital abilities, addressing students' individual needs, and benefiting student assessment and personalised learning. They exhibit a neutral stance on several factors of AI use in teaching, including time adequacy, and accessibility, and AI-based apps. They expressed a need for more financial and moral incentives to integrate AI into professional training programmes. No statistically significant differences among math teachers' perceptions of AI use in instruction were found based on gender, teaching stage, years of experience or the interaction between stage and experience.

Introduction

The adoption of artificial intelligence (AI) technologies in education has a transformative impact by altering the conventional methods of teaching and learning (Huang et al., 2021) and can enrich educational experiences and refine teaching methods. Institutions establish regulations, guidelines and standards to help educators effectively implement AI. For instance, the European Union updated its Digital Competence Framework (DigComp) to include AI-related skills and competencies (Vuorikari et al., 2022). AI literacy has been recognised by the United Nations Educational, Scientific, and Cultural Organization as essential (UNESCO, 2020). In 2019, the Organisation for Economic Co-operation and Development published an analysis of the consequences of using AI in education and provided recommendations for its appropriate utilisation (OECD, 2019). The Institute of Electrical and Electronics Engineers developed its Global Initiative on Ethics of Autonomous and Intelligent Systems (IEEE, 2019), offering ethical guidelines for AI in various fields, including education (Chatila & Havens, 2019).

The US-based AI for K-12 (AI4K12) initiative identified five areas to promote AI literacy: perception, learning, representation and reasoning, societal impact, and natural interaction (Touretzky et al., 2019). Effective integration of AI technologies into education depends on teachers' involvement and adaptability; therefore, investigating teachers' perception of AI integration is essential (Ertmer, 2005). Teachers' perspectives elucidate how AI and teaching may be integrated (Koh & Chai, 2016). Studies that explored teachers' perspectives regarding the use of AI in class revealed that teachers' digital literacy integration is linked to their attitudes toward digital literacy's usefulness in building 21st-century abilities, enhancing student engagement, and preparing students for future employment (Ayanwale et al., 2022; Sadaf & Johnson, 2017).

These factors raise issues for adopting AI technologies in education, including teachers' limited knowledge of AI (Ertmer, 2005; Luckin et al., 2016; Tay et al., 2014; Tondeur et al., 2017) and curriculum limitations. Su et al. (2023) argue that adopting AI as a teaching tool is difficult without practical instructions for developing frameworks to ensure meaningful inclusion of AI within education. According to Drent and Meelissen (2008), problems with technology implementation include insufficient time, inadequate pedagogical knowledge and institutional support, and restricted access to information and communication technologies. Targeted professional development (Laupichler et al., 2022), the development of more user-friendly AI systems, and the utilisation of time-saving features enabled by AI algorithms (Popenici & Kerr, 2017) can be employed to overcome teachers' reservation of AI being time-consuming. Creating cooperative support networks to assist users in implementing advanced procedures and tools, such as AI in Education (AIEd) systems, are also effective.

Luckin et al. (2016) and Alammari (2024) opine that AI shows promise in personalising instruction and analysing complex student data. The National Council of Teachers of Mathematics (2014) and the International Society for Technology in Education (2016) recognised the necessity of integrating appropriate technologies, such as AI, to support mathematics education (Fuller, 2022). STEM education advocates for the incorporation of AI-based tools and techniques to cultivate problem-solving abilities, critical thinking and computational proficiency (Jang, 2016; Mubin et al., 2013).

Literature Review

Studies on AI in education highlight the potential and circumspection pertaining to AI in education: applications must be suitably implemented, utilised correctly within the curriculum, and systematically evaluated to ensure its use is effective and ethical (Alfredo et al., 2024; Chiu, 2024; Chiu et al., 2023; Laupichler et al., 2022; Volungeviciene et al., 2014). Further research is needed on AI literacy, pedagogical applications and organisational contexts to inform the responsible and effective use of AI in schools.

As AI applications and tools improve, AI will revolutionise teaching and learning processes (Alammari, 2024; Al Darayseh, 2023; Alshumaimeri & Alshememry, 2023; Mudawy, 2024; NMC, 2018). Peres et al. (2023) expressed concern about educators and AI theorists' views of future advancement. Teachers' views on using AI are critical for integrating AI into teaching. Sanusi et al. (2024) examine how opinions, subjective standards and behavioural control affect teachers' AI classroom planning – teachers will shape the future of education.

Research on teachers' perceptions of using AI yielded mixed results; most studies indicated positive attitudes among teachers although they may not perceive a need for AI integration (Alfredo et al., 2024; Alghamdi et al., 2023; Al-Zahrani & Rajab, 2017; Chiu, 2024; Chiu et al., 2023; Lee & Kwon, 2024; Lee et al., 2024; Lin, 2022;

Mohamed, 2023; Ng et al., 2022). Therefore, teacher training needs to provide clear direction on how to effectively incorporate AI into their teaching and deal with future tasks (Alamri, 2021; Alshumaimeri & Alshememry, 2023; Inan & Lowther, 2010). Some studies reported neutral or negative perceptions, often stemming from a lack of knowledge about AI (Alnasib, 2023; Alotaibi & Alshehri, 2023; Alshurideh et al., 2019; Huang et al., 2021; Inan & Lowther, 2010; Laupichler et al., 2022; Volungeviciene et al., 2014). Most studies discuss how AI can improve students' adaptive learning by providing personalised access to instructional content based on their needs and output preferences (Alfredo et al., 2024; Chiu et al., 2023; Fisher, 2014).

Further research on the advantages and disadvantages of AI in education is required (Alammari, 2024; Alotaibi & Alshehri, 2023), such as effective teaching methods, best practices for AI integration and AI's impact on student learning (Lee & Kwon, 2024). The ethical and social ramifications of employing AI in education, personalised learning, institutional guidelines for using AI, self-assessment and accountability in AI systems must be investigated (Adams et al., 2023; Alammari, 2024; Alenezi, 2023; Velander et al., 2024; Volungeviciene et al., 2014; Zhang & Aslan, 2021). Volungeviciene et al. (2014) and Lee and Kwon (2024) propose two main study topics: a framework for improving organisations and results-based learning, and AI-enhanced learning.

Concerns and challenges about AI integration into education include limited understanding of AI's capabilities, impairing its effectiveness. Enhancing teachers and students' AI literacy is urgently required (Laupichler et al., 2022; Su et al., 2023; Yeter, 2023). Many studies recorded concerns regarding data privacy, safety, algorithmic bias and teacher replacement (Abdelaal & Al Sawy, 2024; Chiu et al., 2023; McGrath et al., 2023; Zhang & Aslan, 2021).

AI applications have moral, ethical and social issues that must be addressed if AI is to benefit schools (Al Darayseh, 2023; Alotaibi & Alshehri, 2023; Chiu, 2024; Velander et al., 2024; Zhang & Aslan, 2021). Some schools teach in online AI communities; a peer-learning community for AI teachers is therefore recommended (Habibi et al., 2018). Teachers can share experiences, develop higher education AI pedagogies and integrate AI into curricula (Chiu, 2024; Chou et al., 2022; Laupichler et al., 2022; Moorhouse, 2024; Zhang & Aslan, 2021). These include fostering AI literacy among teachers and students, guidelines and policies for AI integration, a clear instructional pedagogical framework, ongoing support, a collaborative environment, professional development programmes, special training on AI skills and applications, AI communities, peer knowledge exchanges, and prioritising stakeholder financial and technical support (Chiu, 2024; Chou et al., 2022; Laupichler et al., 2022; Moorhouse, 2024; Zhang & Aslan, 2021).

Teachers' experience and professional level influence their eagerness to implement AI-based educational technologies. Rotter (1966) developed a framework using the locus of control theory. Internally focused teachers may be susceptible to AI, but those with an external locus of control may experience a rebound effect because they attribute it to their circumstances (EdTech, 2021; Ely, 1999; Ertmer & Ottenbreit-Leftwich, 2010; Teo & Zhou, 2017). The mindset of veteran teachers with external loci may constrain the integration of technological innovation into their pedagogical practices, as opposed to novices who may be amenable to new technologies (Ertmer & Ottenbreit-Leftwich, 2010; Teo & Zhou, 2017).

Further investigation is required regarding cultural, institutional and pedagogical elements affecting teachers' receptivity to AI-driven technologies. This study presents preliminary research on how teachers in Saudi Arabia perceive AI and how this relates to their experience and level of teaching. The findings guide well-informed decisions to address the Saudi education system's unique challenges, needs and opportunities (Sayed Al Mnhrawi & Alreshidi, 2023).

Definitions and Research Hypotheses

Perception

'The process or result of becoming aware of objects, relationships, and events through the senses, including recognising, observing, and discriminating. These activities enable organisms to organise and interpret stimuli into meaningful knowledge and act coordinatedly' (American Psychological Association, 2018). In this study, perception refers to how mathematics teachers interpret, understand and make sense of AI in educational contexts, encompassing their beliefs, attitudes and opinions regarding benefits, challenges and implications of incorporating AI-based tools and applications into mathematics teaching.

Stage

This refers to the school level (elementary, intermediate, or high school) at which mathematics teachers teach.

Problem Statement

The Saudi Arabian government is committed to AI integration nationwide through initiatives such as the 'Artificial Intelligence in Education' programme and the 'Tatweer,' (Almutairi & Rizk, 2021; Alshammari et al., 2017; Tatweer, 2021). Saudi Arabia's Education & Training Evaluation Commission has aligned the mathematics curriculum with computational thinking and Vision 2030's knowledge-based, digital economic goals by endorsing emerging technologies such as AI (Kingdom of Saudi Arabia, 2016).

As per Saudi Vision 2030, the Ministry of Education established the Madrasati platform during the COVID-19 pandemic to facilitate distance learning. Madrasati utilises personalised learning methods to encourage AI adoption. However, the platform's usability was insufficient, hindering teachers' adoption (Shishah, 2021). Teachers' adoption of the Madrasati platform was influenced by criteria such as perceived utility, ease of use, supportive conditions, teacher self-efficacy and users' level of satisfaction (Alharbi et al., 2022).

Previous research in Saudi Arabia focused on the effects and contributing factors of using AI in education but neglecting its adoption by teachers. Most studies found that while teachers acknowledge AI's academic potential and benefits, they have concerns regarding teachers' roles, ethics, privacy concerns and dehumanising effects (Alshumaimeri & Alshememry, 2023; AL-Zahrani & Rajab, 2017). Alghamdi et al. (2023) highlight the significance of offering professional development programmes and support systems to improve teachers' preparedness and self-assurance when integrating AI into education.

Investigating the effectiveness and acceptance of AI in the Saudi education system is essential as Vision 2030 acknowledges AI's role in driving development.

Research Questions

1. What are mathematics teachers' perceptions toward using AI in their teaching?
2. What concerns and challenges do mathematics teachers associate with integrating AI into mathematics education?

Research Hypotheses

To answer the research questions, the following research hypotheses were formulated:

Hypothesis 1: There is no significant difference ($\alpha \leq 0.05$) in mathematics teachers' perceptions of using AI in their teaching in terms of gender.

Hypothesis 2: There are no significant differences ($\alpha \leq 0.05$) in mathematics teachers' perceptions of using AI in their teaching in terms of the level of school stages in which the participants teach (elementary, intermediate, or high school), their experience (< 5 years, 5–10 years, > 10 years), and the interaction between teaching stage and experience.

Purpose and Significance of the Study

This study investigated how Saudi Arabian mathematics teachers perceive AI as a teaching tool through teachers' AI awareness, perceptions of AI benefits, and related concerns and challenges. Differences in mathematics teachers' perceptions in terms of gender, teaching stage level, experience, and the interaction between teaching stage and experience were examined.

This study is unique as it is the first to examine the levels of perceived AI use among Saudi mathematics teachers in Tabuk City. The findings offer significant insights for researchers, policymakers, educators and the Training Evaluation Committee for establishing mathematics standards aligned with recommended teaching approaches. It makes a meaningful contribution by laying the groundwork for informed decision-making and the development of AI programmes that address teachers' needs and concerns.

Methods

Theoretical Framework and Survey Design

This study is based on a theoretical framework that incorporates three well-known models: the Technological Pedagogical Content Knowledge (TPACK) framework, the Technology Acceptance Model (TAM), and the Unified Theory of Acceptance and Use of Technology (UTAUT) (Davis, 1989; Koehler & Mishra, 2009; Venkatesh et al., 2003). TPACK framework investigates teachers' comprehension and awareness of AI (Koehler & Mishra, 2009). It highlights the interaction of technological, pedagogical, and content-related factors, allowing a survey to explore teachers' awareness of AI tools, comprehension of AI applications in education, and ability to use these technologies effectively. Studies in this area relate to the effective use of TPACK on teachers' knowledge and commitment to professional development (Willermark, 2017). TPACK was employed for the 'Knowledge and Awareness of AI' domain of this study's survey. The TAM is used to gain valuable information on how teachers perceive the benefits of AI (Davis, 1989). This study's 'Perceived Benefits of AI in Mathematics Education' domain is consistent with the TAM.

Venkatesh et al. (2003) opine that social influence and enabling environments affect technology adoption. The UTAUT framework was thus used to strengthen this study by examining the various contextual factors that affect teachers' perception and comprehension of integrating AI in class. The 'Challenges and Concerns' section adheres to UTAUT. Using a synthesis of well-established theoretical models (TPACK, TAM, UTAUT), this study sought to understand mathematics teachers' perspectives on AI-integrated teaching, allowing stakeholders vital insights into how AI technologies can be ethically and effectively integrated into mathematics education.

Survey Development Process

Item Generation

This study used quantitative methods through an analytical survey designed as a combination of TAM, UTAUT and TPACK. It comprised three domains: Knowledge and Awareness of AI, Perceived Benefits of AI, and Concerns and Challenges Associated with using AI. Survey items were built to measure each construct using the operational definitions of UTAUT, TAM and TPACK in these domains. The items were intended to be succinct and transparent regarding the targeted domains (and indicators within each domain). The survey included 40 items: knowledge and awareness of AI (13 items), perceived benefits of AI (14 items), and challenges and concerns (13 items). A 5-point Likert scale was used (strongly agree, agree, neutral, disagree, and strongly disagree).

Validity and Reliability

Expert Review

The draft survey was evaluated by experts in mathematics education, educational technology and AI, whose feedback was incorporated in the revised questionnaire. A pilot study was conducted with 46 mathematics teachers to determine the survey's internal consistency and reliability. Cronbach's alpha coefficients were 0.86 (knowledge and awareness of AI), 0.90 (perceived benefits of AI), and 0.89 (challenges and concerns). Cronbach's alpha for the entire survey for the three domains was 0.89, demonstrating excellent reliability.

Item–domain Correlations

The table in the Appendix presents Pearson's correlation coefficients for each item and its corresponding domain, showing that the items are significantly related to their constructed domains and are consistent with the others, with the highest correlation of 0.897.

The Final Survey

The final survey, which included 40 items that integrated the maximum potential variables of TAM, UTAUT and TPACK, was developed into a refined framework comprising three domains.

Participants

The study population comprised mathematics teachers in Tabuk, Saudi Arabia. The General Administration of Education in Tabuk District (GATED) provided a list of 531 teachers who taught mathematics at public schools during the third semester of 2023–2024 in Tabuk City, all of whom were invited to participate in the online survey. The survey was completed by 149 teachers (28% response rate), indicating a reasonable sample size to provide good insights and sufficient power for the analysis (see Figure 1).

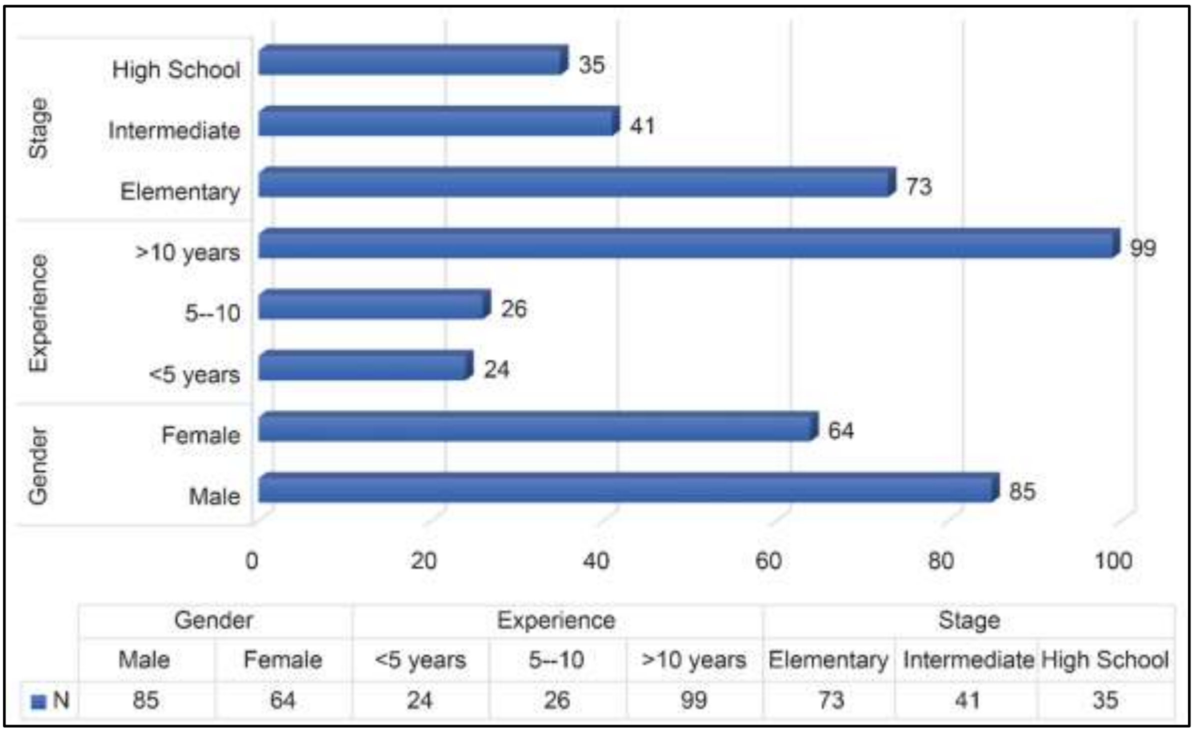

Figure 1. Study's Sample classified by the Study Variables

Informed Consent and Data Collection Methods

The research protocol was approved by GAETD before the survey was administered. Participants received an online questionnaire, informed consent form, and information on possible risks and benefits of participation and confidentiality. A priori consent was obtained from all participants. A secure online survey platform was used in alignment with GAETD instructions. Participants received the link https://shorturl.at/Tx8jy. All responses were collected anonymously and securely without access to the collected information, except for the researcher, and saved in a password-protected online website via Google Forms.

Data Analysis and Reporting

Data collection was carefully executed. The researcher then captured and analysed the data using SPSS® software. To ensure participants' anonymity, results were shared in a generalized and coded manner without any details about the respondents.

Results

Results for Domain 1: Knowledge and Awareness of AI (Question 1)

To answer the research questions, the means and standard deviations were calculated for all items within each domain. The researcher used the means of participants' perceptions on the suggested scale to interpret their responses in all domains (Figure 2). The five response levels were classified into intervals of 0.80 for each domain. The aggregate status of mathematics teachers' knowledge and awareness of AI had a positive mean score (mean = 3.64, SD = 0.588), indicating a notable level of comprehension and awareness among teachers.

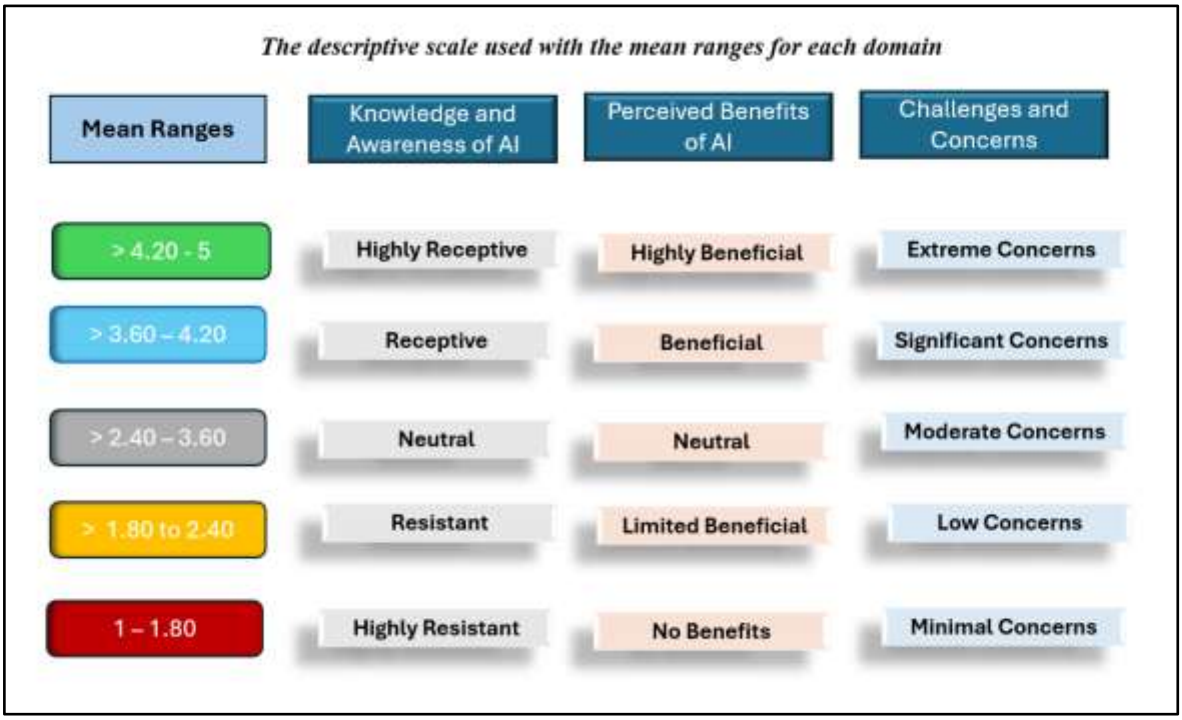

Figure 2. The Descriptive Scale used with the Mean Ranges for Each Domain

Item 13 had the highest score with a mean of 3.99 (SD = 0.784). This value indicates that mathematics teachers extensively use AI to enhance their digital teaching competencies. Item 4 had the lowest score with a mean of 3.06 (SD = 1.13), indicating a neutral status. This lack of polarization at the perception level means that AI-based platforms are either unavailable on a large scale or not adopted by all teachers. Since most means were located in the 'receptive' category, except for three items (3, 4, 6), which were classified as 'neutral,' mathematics teachers generally favoured the 'Knowledge and Awareness about AI' domain.

Table 1. The Means and Standard Deviations for Items of Domain 1: Knowledge and Awareness of AI

Items	N	Mean	SD	Degree of Teachers' Responses	Ranking
1) I know AI and its potential uses in the classroom.	149	3.55	0.97	Receptive	6
2) I know how to use AI to improve how I teach mathematics.	149	3.87	0.88	Receptive	4
3) I can comfortably discuss the advantages and drawbacks of AI with colleagues and students.	149	3.39	0.97	Neutral	11
4) In my work, I have applied AI-based tools and programmes.	149	3.06	1.1	Neutral	13
5) I am confident in using AI and its applications in teaching mathematics.	149	3.60	0.96	Receptive	7
	149	3.38	1.1	Neutral	12
6) I have sufficient time to integrate AI applications into my teaching practice.					
7) AI complements my current and future roles in the educational process.	149	3.79	0.97	Receptive	6
8) I am aware of AI techniques' potential biases and limitations.	149	3.59	0.99	Receptive	8
9) I can address privacy and information security concerns using AI applications.	149	3.48	1.04	Receptive	10
10) AI applications can help students develop a deeper conceptual understanding of mathematical concepts.	149	3.86	0.93	Receptive	5
11) I believe that AI applications can facilitate the implementation of mathematical applications in my teaching.	149	3.91	0.94	Receptive	2
12) AI applications can help cater to the diverse learning needs of students, including underachievers and slow learners.	149	3.88	0.9	Receptive	3
13) AI contributes to the development and use of my digital skills in different situations.	149	3.99	0.78	Receptive	1
Knowledge and Awareness of AI	149	3.64	0.59	Receptive	-

Results for Domain 2: Perceived Benefits of AI (Question 1)

All items in the 'perceived benefits of AI' domain were in the 'beneficial' area (see the table in the Appendix).

All items were perceived as valuable by the mathematics teachers. The total domain's mean was 3.78 (SD = 0.86), indicating that most respondents viewed AI as beneficial.

Item 14 scored the highest – the mean of 3.97 indicates that teachers had positive opinions on AI and its utility in test assessment and feedback. The next ranked item was Item 12, illustrating that mathematics teachers benefit from matching instructional methods with students' learning styles. Item 7 had the lowest mean score (3.66, SD = 0.90). However, this item still fell within the 'beneficial' area of teachers' perceptions. Overall, the opinions of mathematics teachers, irrespective of their agreement with the statements in this domain, should be implemented in the courseware.

Table 2. The Means and Standard Deviations for All Items of Domain 2: perceived Benefits of AI in Mathematics Education

Items	N	Mean	SD	Teacher Intellectual Picture	Ranking
1) AI applications have the potential to greatly enhance the accuracy and objectivity of mathematics assessment.	149	3.85	0.88	Beneficial	04
2) AI can enhance personalised learning experiences for my students, specifically in mathematics.	149	3.78	0.86	Beneficial	07
3) AI applications can potentially improve students' engagement and motivation in learning mathematics.	149	3.74	0.90	Beneficial	10
4) AI applications can effectively identify each student's learning gaps in mathematics.	149	3.70	0.84	Beneficial	12
5) AI-powered analytics and visualizations offer crucial insights into my students' proficiencies and weaknesses with respect to mathematical concepts.	149	3.70	0.90	Beneficial	11
6) AI applications provide prompt feedback to students, boosting their learning experience in mathematics.	149	3.79	0.90	Beneficial	06
7) AI applications have the potential to enhance the development of critical thinking and problem-solving skills in my mathematics students.	149	3.66	0.92	Beneficial	14
8) AI applications can create an interactive and collaborative environment for my students and me.	149	3.67	0.94	Beneficial	13
9) AI applications assist in the representation and delivery of complex mathematical concepts in my teaching.	149	3.74	0.89	Beneficial	09

Items	N	Mean	SD	Teacher Intellectual Picture	Ranking
10) The variety of exciting AI applications helps my students choose the appropriate tools to support their learning.	149	3.85	0.90	Beneficial	03
11) AI enhances students' motivation and increases their learning.	149	3.80	0.92	Beneficial	05
12) AI provides personalised learning experiences tailored to the individual learning styles of my students.	149	3.87	0.92	Beneficial	02
13) AI enables the personalisation of instruction to meet the unique needs of students in my mathematics classrooms.	149	3.77	0.88	Beneficial	08
14) AI applications can accurately and efficiently grade and provide feedback on my students' mathematical assignments and assessments.	149	3.97	0.86	Beneficial	01
Domain 2: Perceived benefits of AI	149	3.78	0.59	Beneficial	

Results for Domain 3: Challenges and Concerns of AI Integration (Question 2)

Table 3 demonstrates the results of the second research question. Participants reported that Item 9 represented the most significant challenge, with a mean of 4.04 (SD = 0.87). This indicates a lack of financial support for schools, highlighting the need for incentives for AI in education. Despite funding and encouragement provided by projects such as Tatweer and Saudi Vision 2030, these results indicate that incorporating AI literacy into educational practices will require more time. In Table 3, Item 12 had the second-highest score with a mean of 3.87 (SD = 0.93), indicating that continuous professional development programmes are insufficient to quickly adapt to developments in AI for mathematics education and revealing the need for training on integrating AI into education.

Item 10 had the third-highest score (M = 3.80, SD = 1.00). This finding implies that the main barriers to integrating AI in education are students' lack of skills to utilize AI and the cost of devices for extensive AI use. Item 13 had the lowest average value (M = 3.26; SD = 0.95). Item 4 showed a neutral perception with a mean of 3.39, a medium-level concern. Item 5 recorded a neutral perception because AI must still be officially incorporated.

Table 3. The Means and Standard Deviations for All Items of Domain 3: Challenges and Concerns

Items	N	Mean	SD	Existing	Ranking
1) I am concerned about student data privacy and security when using AI in mathematics education.	149	3.54	0.98	Significant	06
2) I am concerned about potential bias in AI algorithms, which could affect fairness and equality in mathematics education.	149	3.35	0.90	Neutral	12

Items	N	Mean	SD	Existing	Ranking
3) I have reservations about the reliability and accuracy of AI-based assessments compared with traditional teacher-led assessments.	149	3.57	0.81	Significant	04
4) I am concerned about the potential loss of job opportunities or the diminishing role of teachers in mathematics education due to AI.	149	3.39	1.18	Neutral	11
5) I am concerned about the ethical implications of using AI in mathematics education.	149	3.43	1.03	Significant	10
6) I am concerned about over-reliance on AI and its impact on students' independent thinking and problem-solving abilities.	149	3.57	0.96	Significant	05
7) I have concerns about the accessibility and inclusiveness of AI tools for students with special needs in mathematics.	149	3.52	0.84	Significant	07
8) I fear using AI will distract students from learning mathematics.	149	3.35	0.99	Neutral	12
9) There needs to be more financial and moral incentives to use AI in education.	149	4.04	0.87	Significant	01
10) Varying levels of students' digital knowledge and skills hinder the continuity of using AI.	149	3.80	1.00	Significant	03
11) I am concerned about the reliability of the learning resources used in AI applications.	149	3.54	0.86	Significant	06
12) Continuous professional development programs need to be improved to keep up with the developments and changes in AI technology for mathematics education.	149	3.87	0.93	Significant	02
13) I am concerned about the difficulty of controlling lesson time when AI applications are used in teaching.	149	3.26	0.95	Neutral	13
Challenges and Concerns	46	3.60	0.67	Significant	

Tests of Research Hypotheses

Testing the First Hypothesis

The first research hypothesis was then tested. The 'Knowledge and Awareness' domain had mean scores of 3.57 (male) and 3.74 (female), with standard deviations of 0.60 and 0.56, respectively (Figure 3). In 'Perceived Benefits,' mean scores were 3.73 for male teachers and 3.84 for female teachers, with standard deviations of 0.62 and 0.54, respectively. Average scores for the 'Challenges and Concerns' domain were 3.69 (SD = 0.62) for male teachers and 3.71 (SD = 0.65) for female teachers. The means of the total perception of AI were 3.72 for male teachers and 3.75 for female teachers, with standard deviations of 0.46 and 0.60, respectively, across all domains. An independent t-test was then conducted to compare male and female respondents in terms of their perceptions of using AI for all domains (Table 4). The findings reflect no significant differences across any domain between mathematics teachers' responses by gender. For awareness and knowledge, perceived benefits, and challenges and concerns, the t-values were -1.826, -1.89, and -0.292, with p-values of 0.07, 0.067, and 0.772, respectively.

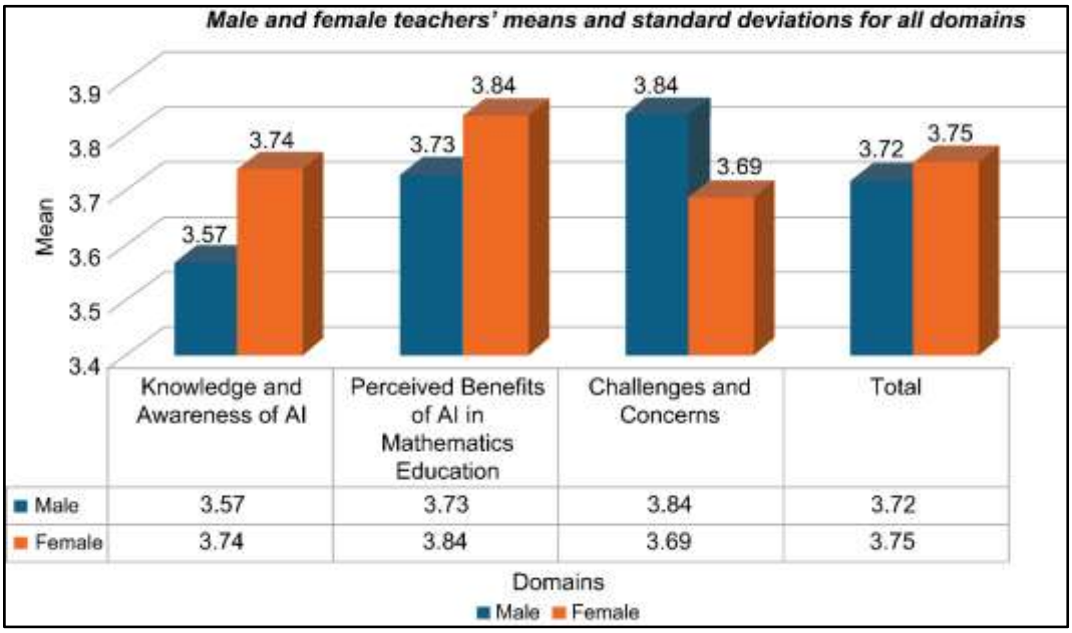

Figure 3. Mathematics Teachers' Perceptions of Using AI in Education for All Domains classified by Gender

Table 4. Independent t-test Results for Differences between Teachers in terms of Gender

Domains	df	T	Sig. (2-tailed)
Awareness	147	-1.826	0.07
Perceived Benefits	147	-1.89	0.067
Challenges and Concerns	147	-0.292	0.772
Total	147	-1.221	0.224

Testing the Second Hypothesis

To test the second hypothesis, the means of each variable and their interactions were calculated (Table 5). High school teachers with less than five years' experience reported the highest mean (M = 4.01, SD = 0.51), whereas teachers at intermediate schools with 5–10 years of experience recorded the lowest mean (M = 3.37, SD = 0.35). Mathematics teachers with more than 10 years of experience at intermediate schools scored a mean of 3.93, which was the highest mean among expert teachers at the intermediate level. This indicates teachers' belief in the benefits of integrating AI into their teaching methods. Expert teachers with more than ten years of service had means of 3.70, 3.73, and 3.60, respectively, according to the stage variable (elementary, intermediate, and high schools) in the 'Knowledge and Awareness' domain. In the 'Perceived Benefits' domain, expert mathematics teachers reported means of 3.68, 3.93, and 3.90, respectively. In the 'Challenges and Concerns' domain, their means were 3.75, 3.66, and 3.61, respectively. To determine whether there were any differences among these variables, the appropriate test for the hypothesis was the two-way ANOVA.

The two-way ANOVA was conducted to obtain information on teachers' perceptions of using AI in terms of teaching stage and experience level. It was first necessary to check whether the homogeneity of variance was justified for Levene's statistics. The homogeneity of variance assumption across the groups was tested using Levene's test (Table 6). The necessity of this assumption was tested and met according to the conditions and assumptions of the two-way ANOVA. The F-statistic was calculated for all domains, including knowledge and awareness, perceived benefits, and challenges and concerns: $F(8,140) = 1.29$ with $p = 0.254$, $F(8,140) = 1.59$ with $p = 0.132$, and $F(8,140) = 1.59$ with $p = 0.94$ for knowledge and awareness, perceived benefits, and challenges and concerns, respectively. The p-values indicated that ANOVA could be conducted regarding the heterogeneity of variances.

Table 5. The Sample Means and Standard Deviations for All Domains

Domains	Variables	Experience (years)								
	Stages	< 5 years			5–10 years			> 10 years		
		N	Mean	SD	N	Mean	SD	N	Mean	SD
Knowledge and Awareness	Elementary	8	3.67	0.31	8	3.54	0.63	57	3.70	0.61
	Intermediate	9	3.61	0.87	11	3.37	0.37	21	3.73	0.56
	High school	7	3.58	0.67	7	3.69	0.51	21	3.60	0.60
Perceived Benefits	Elementary	8	3.64	0.39	8	3.69	0.43	57	3.68	0.70
	Intermediate	9	3.79	0.68	11	3.58	0.47	21	3.93	0.55
	High school	7	4.01	0.51	7	3.77	0.36	21	3.90	0.47
Challenges and Concerns	Elementary	8	3.41	0.57	8	3.90	0.49	57	3.75	0.67
	Intermediate	9	3.74	0.61	11	3.77	0.47	21	3.66	0.68
	High school	7	3.34	0.54	7	3.89	0.65	21	3.61	0.67

Table 6. Levene's Test of Equality of Error Variance for All Domains

Variable	F	df1	df2	p
Awareness	1.29	8	140	0.25
Perceived Benefits	1.59	8	140	0.13
Challenges and Concerns	0.37	8	140	0.94

Tables 7–9 provide the results of two-way ANOVA tests on the means of the two variables (teaching stage and experience) and their interactions with nine levels (3*3), consisting of nine squares of relationships for all domains. The results are discussed for each domain.

Knowledge and Awareness of AI

The two-way ANOVA for the Knowledge and Awareness domain found no significant difference between teachers' means related to teaching stage, experience, or the interaction between them (Table 4). The F-statistic was reported as ($F(2,140) = 0.131$; $p = 0.878$ / partial $\eta^2 = 0.008$) for stage and ($F(2,140) = 0.532$; $p = 0.588$ / partial $\eta^2 = 0.008$) for experience. These results revealed no significant differences in teachers' perceptions of using AI related to stage, experience, or the interaction between them.

Table 7. The Results of a Two-way ANOVA Test for Domain 1: Knowledge and Awareness of AI

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	η^2
Stage	0.093	2	0.046	0.131	0.878	0.002
Experience	0.379	2	0.189	0.532	0.588	0.008
Stage * Experience	0.625	4	0.156	0.439	0.780	0.012
Error	49.801	140	0.356			
Total	2027.734	149				

Perceived Benefits of AI

Table 8 lists the results of the two-way ANOVA for the Perceived Benefits domain. No significant differences were found in stage ($F(2, 140) = 0.47$, $p = 0.62$) or experience ($F(2, 140) = 0.098$, $p = 0.91$). Additionally, no significant interaction between stage and experience was found ($F(4, 140) = 1.14$, $p = 0.34$), and the effect size according to partial η^2 was 0.031.

Table 8. The Results of a Two-way ANOVA Test for Domain 2: Perceived Benefits

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	η^2
Stage	0.327	2	0.16	0.47	0.62	0.007
Experience	0.068	2	0.03	0.098	0.91	0.001
Stage * Experience	1.569	4	0.39	1.14	0.34	0.031
Error	48.350	140	0.35			
Total	2177.648	149				

Challenges and Concerns

Table 9 presents the results of the two-way ANOVA for the Challenges and Concerns domain. No significant differences were found in terms of stage ($F(2, 140) = 0.25$, $p = 0.78$) or experience ($F(2, 140) = 1.91$, $p = 0.15$). Moreover, no significant interaction between stage and experience was found ($F(4, 140) = 0.55$, $p = 0.70$), and the effect size according to partial η^2 was 0.016.

Table 9. The Results of a Two-way ANOVA Test for Domain 3: Challenges and Concerns

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	η^2
Stage	0.198	2	0.099	0.25	0.78	0.003
Experience	1.541	2	0.770	1.91	0.15	0.027
Stage * Experience	0.895	4	0.224	0.55	0.70	0.016
Error	56.569	140	0.404			
Total	2095.018	149				

Discussion

Findings related to Question 1

The findings of this study are consistent with recent research showing that teachers typically hold a positive perspective on AI, demonstrate a solid understanding of AI technologies, and acknowledge its advantages. Participants recognized the potential benefits of AI, such as enhanced teaching quality, readily available feedback, and personalized learning experiences (Domain 1 and 2). In alignment with previous research, AI has the potential to improve learning outcomes, offer tailored educational experiences, and assist teachers (Luckin et al., 2016). Participants seen the contribution of AI in facilitating grading, providing feedback, selecting adaptive tools, ensuring accurate assessments, and enhancing student motivation.

Popenici and Kerr (2017) contend that these advantages improve the teacher's digital competencies, enabling them to concentrate on developing digital materials such as multimedia lessons. The findings align with earlier research on AI-driven systems, indicating that AI effectively addresses learning requirements promptly and precisely as learners participate in self-directed educational activities (Drijvers, 2015; Inan & Lowther, 2010; Zawacki-Richter et al., 2019). Nonetheless, there remain mixed or negative perceptions regarding AI in education, arising from worries about localized education, the possible displacement of teachers, and issues related to privacy or ethics (Baran, 2014; Tsai et al., 2020).

Findings related to Question 2

Most participants supported employing AI in math instruction but cited substantial problems and concerns. Lack of incentives to use AI in schools was a key issue, requiring institutional support and legislation. Another was insufficient professional development for instructors to stay abreast with AI advancements. Students' digital skills were another obstacle to the widespread use of AI. Participants worried about the implications of AI-based assessments compared with traditional techniques. Some were concerned about AI overuse affecting students' problem-solving and independent thinking. These results indicate the necessity of an effective implementation strategy. Some studies showed that costs constrain the adoption of AI in schools (Inan & Lowther, 2010; Volungeviciene et al., 2014). Teachers must be trained to close the digital divide and assist students with technology competencies (Baran, 2014; Drijvers, 2015; Tsai et al., 2020). According to Volungeviciene et al. 2014), AI can be successfully integrated into teaching with good support and training.

Results for Hypothesis 1

Consistent with the first hypothesis, the results revealed no significant gender-related differences among mathematics teachers' perceptions of using AI in teaching. The results prove that gender does not affect how teachers perceive AI integration. Congruent with earlier research, this study found that male and female mathematics teachers had similar perceptions of the challenges encountered when using AI in class. Teachers frequently face challenges while integrating mobile learning, including concerns about students' privacy and lack of technical knowledge (Baran, 2014; Inan & Lowther, 2010; Tsai et al., 2020). These challenges seem to affect teachers' attitudes equally, regardless of gender (Baran, 2014; Volungeviciene et al., 2020). However, this study's results do not necessarily indicate a more extensive set of challenges or concerns that most studies should have included. To better understand these contextual elements, additional research is needed to supplement the current findings (Baran, 2014; Volungeviciene et al., 2020).

Results for Hypothesis 2

Rotter's personality theory includes educational technology programmes. Some previous studies, such as Ely (1999) and Hall and Hord (2015), suggest that teachers' attitudes differ based on teaching stage and experience. However, the results of the current study do not support this claim – they show that math teachers' perceptions of using AI in teaching at the elementary, middle, and high school levels did not differ significantly. These findings are congruent with Alammari's (20204), who found that teachers have tolerant attitudes toward the adoption of new technologies regardless of the number of years they have been teaching or their educational context. Instead, resource availability, schools' input, and professional development opportunities have a more significant influence on teachers' attitudes under different circumstances (Kebritchi et al., 2017; Rogers, 2003; Venkatesh & Morris, 2000). Tondeur et al. (2007) concluded that school factors, such as technical support and the scope for professional growth, are more critical than individual teacher characteristics to successfully integrate educational technologies. This finding is consistent with those of other studies (Adams et al., 2023; Alenezi, 2023). Hence, adopting AI technologies to aid mathematical learning is the responsibility of both tutors and institutions (Rogers, 2003).

Caution must be exercised with this finding, though, as the non-significant variations in the scores for mathematics teachers' perceptions toward integrating AI according to stage and years of teaching give rise to issues that require further inquiry – further studies are required in this regard.

Conclusion

This study's findings on mathematics teachers' perceptions of integrating AI into their teaching reveal a generally favourable perspective among participants. Respondents demonstrated awareness, knowledge and familiarity with AI's potential benefits and applications in class. However, their perception of several factors of AI use in teaching was neutral, including time adequacy, the implementation of AI applications in their teaching plans, discussing the advantages and disadvantages of AI with peers and students, and accessibility of using AI-based apps in their teaching.

Although participants acknowledged the benefits of AI in teaching, such as automating the grading system, they expressed several key concerns that must be addressed, including financial and moral incentives, ethical consequences, professional development, and digital disparities. No significant differences were found among mathematics teachers' perceptions in any of the three domains related to gender, teaching stage, experience, or the interaction between stage and experience. This study's findings provide in-depth understanding of teachers' acceptance and challenges, which can inform tailored educational policies, interventions, and support systems.

Suggestions for Future Research

The related literature review and the study's findings reveal that further research should focus on developing an instructional framework for integrating AI into teaching, personalised AI adaptive-based learning, and professional development programmes to enhance teachers' knowledge and awareness of using AI in teaching. First, an instructional framework is needed to integrate AI into the teaching process, align tools and technology with pedagogical best practices, and guarantee the uniformity and expandability of using AI in education. Second, personalised AI adaptive-based learning, including student assessment using AI, is required to promote enthusiasm for learning through AI applications and for the development of students' computational thinking. Third, teachers' knowledge and skills are the most critical factors for effectively integrating AI into teaching. Thus, teachers need professional training programmes in various AI subjects to facilitate its use in classrooms in addition to institutional support and the formation of collaborative communities for experience exchange.

Recommendations

The research contributes to informed decision-making by establishing a foundation for developing AI programs that cater to teachers' needs and concerns.

- Policymakers should consider creating an instructional framework aligning AI tools with pedagogical best practices while addressing ethical and digital disparities.
- Educational institutions should establish support systems that offer financial and moral incentives to promote AI integration in mathematics teaching.
- Professional development programs need to address teachers' needs in AI implementation, focusing on practical classroom applications.
- There is a need for AI literacy, as teachers' opinions on AI use in math education remain consistent across gender, teaching stage, and experience levels.
- Collaboration between AI developers and educators can result in more efficient solutions tailored to the requirements of mathematics instructors.

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Appendix. Additional Statistics of the Research

Table A. Pearson's Correlation Coefficients for All Survey Items

Teacher Awareness Items	Correlation Coefficients	Perceived Benefits of AI	Correlation Coefficients	Challenges and Concerns Items	Correlation Coefficients
01	.778**	01	.852**	01	.771**
02	.613**	02	.894**	02	.759**
03	.722**	03	.866**	03	.778**
04	.667**	04	.881**	04	.611**
05	.701**	05	.776**	05	.696**
06	.637**	06	.897**	06	.757**
07	.755**	07	.908**	07	.875**
08	.675**	08	.873**	08	.806**
09	.669**	09	.894**	09	.752**
10	.719**	10	.886**	10	.604**
11	.613**	11	.836**	11	.682**
12	.759**	12	.784**	12	.540**
13	.737**	13	.822**	13	.554**
-		14	.842**		

Table B. Sample Classifications by the Study Variables

Variables	Classifications	N	%	Total
Gender	Male	85	57	149
	Female	64	43	
Experience	< 5 years	24	16.11	149
	5–10 years	26	17.45	
	> 10 years	99	66.44	
Stage	Elementary	73	49	149
	Intermediate	41	27.50	
	High School	35	23.50	

Table C. Male and Female Teachers' Means and Standard Deviations for All Domains

Domain	Gender	N	Mean	STD
Knowledge and Awareness of AI	Male	85	3.57	0.60
	Female	64	3.74	0.56
Perceived Benefits of AI in Mathematics Education	Male	85	3.73	0.62
	Female	64	3.84	0.54
Challenges and Concerns	Male	85	3.69	0.62
	Female	64	3.71	0.65
Total	Male	85	3.72	0.46
	Female	64	3.75	0.60

Table D. The Sample Means and Standard Deviations for All Domains

Domains	Variables	Experience (years)								
	Stages	< 5 years			5–10 years			> 10 years		
		N	Mean	SD	N	Mean	SD	N	Mean	SD
Knowledge and Awareness	Elementary	8	3.67	0.31	8	3.54	0.63	57	3.70	0.61
	Intermediate	9	3.61	0.87	11	3.37	0.37	21	3.73	0.56
	High school	7	3.58	0.67	7	3.69	0.51	21	3.60	0.60
Perceived Benefits	Elementary	8	3.64	0.39	8	3.69	0.43	57	3.68	0.70
	Intermediate	9	3.79	0.68	11	3.58	0.47	21	3.93	0.55
	High school	7	4.01	0.51	7	3.77	0.36	21	3.90	0.47
Challenges and Concerns	Elementary	8	3.41	0.57	8	3.90	0.49	57	3.75	0.67
	Intermediate	9	3.74	0.61	11	3.77	0.47	21	3.66	0.68
	High school	7	3.34	0.54	7	3.89	0.65	21	3.61	0.67