Artificial Intelligence in Education: Mathematics Teachers' Perspectives, Practices and Challenges

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ABSTRACT: Efforts have been made to include artificial intelligence (AI) in teaching and learning; nevertheless, the successful deployment of new instructional technology depends on the attitudes of the teachers who conduct the lesson. Few scholars have researched teachers' perspectives on AI use due to a general lack of expertise on how it can be used in the classroom, as well as a lack of specific knowledge about what AI-adopted tools would be like. This study investigated mathematics teachers' perceptions of implemented AI systems and applications in Abu Dhabi Emirate schools. The sample study consists of 580 male and female math teachers from public and private schools across three educational regions in Abu Dhabi selected based on several qualifications and experiences. The research followed the descriptive analytical approach due to its suitability to the study's context. The results revealed that AI could be used as an educational tool to facilitate teaching and develop students' performance by including AI systems and applications in the curricula. They increased motivation for learning, encouraging challenge, competition, and suspense among students and considering their differences. The results also showed the most critical challenges that math teachers face in applying AI systems and applications, the most prominent of which are the need to exert more effort than the traditional method when using different AI systems and applications and the pressures placed on them, which prevent them from using AI in teaching. Additionally, the findings revealed no statistically significant differences in mathematics teachers' perspectives regarding the importance of using systems and applications of AI in teaching; however, statistically significant differences were found in the math teachers' challenges when applying AI systems and applications in teaching according to the educational qualifications, especially among math teachers who have masters' degrees. These results can be used as a foundation for creating guidelines for the future integration of AI education in schools since they report teachers' experiences utilizing the system and various considerations regarding its implementation.

Keywords: Artificial Intelligence, Mathematics Achievement, Elementary Students, Adaptive Learning System, Robotics.

1. INTRODUCTION

Artificial intelligence (AI) is increasingly being applied in education to enhance student learning outcomes [1, 2, 3, 4, 5]. Researchers have identified AI as a solution to the shortage of trained teachers and resources and a means of maximizing the potential of education [6, 7]. Empirical investigations have further supported these hypotheses, demonstrating the positive impact of AI on student achievement [8, 9, 10]. In addition to its impact on student outcomes, AI is also essential for the sustainable development of our society. According to UNESCO, ensuring "inclusive and equitable quality education and promoting opportunities for lifelong learning for all" is necessary for sustainable development, and AI can help achieve this [2].

In comparative education, the implementation of AI has become a necessary trend rather than a choice. This technology is widely used in various industries, including transportation, games, manufacturing, medical services, agriculture, and finance, to improve productivity and efficiency [11]. For instance, AI technology's integration into Go play has not only facilitated learning but also stimulated human learning beyond conventional methods, as demonstrated in Deep Mind's AlphaGo match against human Go players [4]. Indeed, the incorporation of AI in education is a crucial issue in science, research, and education, as evidenced by various studies [3, 6, 7, 12]. Consequently, governments, organizations, and businesses have invested significant resources to facilitate the integration of AI in education, with the World Bank estimating USD 1047 billion worth of investments in AI in education between 2008 and 2019 [13]. Furthermore, many countries have updated their curricula to include AI in the classroom [2, 14].

A literature review on AI in education reveals that it has been extensively implemented in various sectors, including higher education [7], K-12 education [1], student assessment [15], robotics [16], data mining [17], and intelligent tutoring systems (ITS) [18]. However, the research on the impact of AI on mathematics instruction is limited, with few studies examining research design elements such as author institutions and countries, the type of AI used, target grade levels, and research techniques [19]. Consequently, there is insufficient synthesized data on how AI implementation affects students' math performance; regardless of the significant impact mathematics learning has on academic achievement, college admission, future careers, and social development [11, 20]. Mathematics is a "gatekeeper course," according to [21], and math achievement is linked to civil rights issues as students' opportunities are often contingent on their math performance. [11, 22] have emphasized the value of providing students with the mathematical skills and knowledge needed to effectively respond to a rapidly changing society to promote sustainable development. Therefore, additional meta-analyses are needed to determine whether AI offers new opportunities for mathematics education [3, 5, 23]. Studies examining how moderating variables impact the relationship between them are also necessary.

Despite the growing interest in artificial intelligence in education, [3] note that "the question of how AI affects education persists." To address this gap, this study utilizes meta-analysis to synthesize and examine previous empirical research on the effects of AI on student mathematical achievement. Additionally, the study investigates the impact of moderating factors such as characteristic research variables (e.g., research type and design) [5, 24] and learning opportunity factors (e.g., the subject of the mathematics lesson and the length of the intervention) [25, 26]. While earlier meta-analyses on AI have focused on secondary and post-secondary students [7, 16, 24], this meta-analysis specifically examines elementary pupils' math achievement. The study's findings could emphasize the essence of AI and recommend strategies to use it for mathematics teaching and learning. This is particularly vital since math proficiency in elementary school is considered the foundation for future mathematics learning and career choices [27, 28]

1.1 PROBLEM STATEMENT

Incorporating technology into education requires more than just orienting teachers on how to use it; it also requires them to understand how to integrate it into their curriculum effectively. To do this, educators must first recognize the value of educational technology and its potential to enhance learning outcomes. However, many teachers and school administrators may not have experience with AI-based learning support and may view it as a more advanced form of educational technology. Therefore, before implementing and evaluating an AI support system in education, teachers should personally use it to gain a deeper understanding of how it can scaffold science, technology, engineering, and mathematics (STEM) learning, particularly in scientific writing.

AI systems and applications in education have received extensive attention. Investing in the tremendous AI technological growth has benefitted educational processes, and education experts predict a prosperous future if the education system continuously uses AI systems and applications. AI, which allows the emergence of creativity and excellence in various academic fields, and based on the relentless efforts made by educational institutions at multiple levels to develop the quality of education and reach the required global standard levels, the integration of intelligent education systems and applications has become a modern necessity that must be combined with efforts to make it an essential element in education, especially after traditional teaching methods have become incompatible with the emergence of intelligent systems and applications, and to complement the process of developing school curricula and including modern teaching strategies and methods that achieve learning goals and improve the educational process. In response to what many scholars [29, 30, 31, 32, 33, 34, 35] indicated that most methods and strategies used in teaching mathematics depend on direct methods such as recitation, dialogue, and discussion, which have become useless and do not arouse the learners' passion and motivation towards learning. As a result of the significant shortcomings in the application of modern teaching strategies by mathematics teachers, especially those that rely on AI techniques, and the researchers' observations through their work as mathematics teachers for various educational levels and supervisors who train teachers, the researchers have witnessed the pressing need to employ AI systems and applications in teaching and raised relevant questions about the importance of UAE mathematics teachers using them in education and the main challenges the mathematics teachers encounter, which prevent the use of such modern technologies in the educational process?.

As a result of the widespread use of AI, the use of technology and machines has become a concern and threat to many people who have become afraid of this rapid and robust development. Hence, this study describes AI, its essence, and

its prominent role in the educational process from the mathematics teachers' perspectives according to some variables, such as gender, teachers' experience, educational qualifications, and identification of the most critical challenges. More specifically, the current study's research problem was represented in the following three questions:

1. What is the importance of using AI systems and applications in teaching from the math teachers' point of view?
2. What are the most critical challenges math teachers face when applying AI systems and applications?
3. Is there a statistically significant difference in the means of the study sample regarding the importance of using systems and applications of AI in teaching from the perspective of mathematics teachers and the challenges they face based on variables such as gender, years of experience, and educational qualifications?

1.2 STUDY OBJECTIVES

This study aims to explore the significance of utilizing AI systems and applications in education according to mathematics teachers' perspectives. Additionally, it seeks to identify the most significant obstacles they encounter when incorporating these technologies into their teaching practices and significant differences between the participants' perspectives on AI-integrated mathematics education and variables such as gender, experience, and educational qualifications. The study intends to offer recommendations and proposals that can significantly highlight the importance of AI techniques in education and address the mathematics teachers' critical challenges in teaching using AI.

1.3 STUDY SIGNIFICANCE

The study is important as it deals with essential dimensions of the educational process. Recognizing mathematics teachers' perspectives on utilizing AI-based instruction will provide a more detailed analysis of teachers' practices and difficulties, which will be the foundation for determining innovative strategies that may direct their interests toward employing AI in teaching or modifying their current instructional practices to integrate some useful AI applications. Hence, the study's objective targets improved teaching and learning and the introduction of AI-oriented mathematics education, which can eventually lead to various studies about the topic. Moreover, the paper's literature review suggests further investigations on AI education, especially in the context of its impact on learning outcomes. Various variables in studying the general frameworks of educational systems and curricula can also be developed to apply advanced educational technology.

1.4 LIMITATIONS

- **Human Limits:** The study is limited to male and female mathematics teachers in Abu Dhabi Emirate schools in the United Arab Emirates.
- **Temporal Limits:** This research was conducted in the first semester of the school year 2022–2023.
- **Spatial Limits:** This study is limited to Abu Dhabi Emirate schools.
- **Objective Limits:** This study is limited to the importance of using AI systems and applications in teaching mathematics based on mathematics teachers' perspectives and the challenges they face while employing AI systems and applications in teaching.
- This study is determined by its tools and psychometric characteristics of validity and stability acceptable for scientific research, which is directed toward achieving the research objectives.

1.5 PROCEDURAL DEFINITIONS

- **Artificial intelligence (AI)** is a branch of computer science on which various computer programs depend, which are in line with the capabilities of the human mind in multiple actions. Among its most important capabilities is the machine's ability to teach and make decisions.
- **AI systems and applications** refer to a group of software, computer hardware, educational robots, tablets, smart boards, smartphone applications, and smart educational games that possess the capacity of the human mind to act, make decisions, and work in the same way that the human mind works for educational purposes.
- **Challenges of using AI systems and applications** include mathematics teachers' difficulties, problems, and obstacles while employing artificial intelligence systems and applications, which prevent the optimal use of these systems and applications in teaching.

2. LITERATURS REVIEW

2.1 AI IN EDUCATION

[36] Initially used the term *AI* in a research session and characterized AI challenge as "making a machine behave in ways that would be termed intelligent if a person were so acting." Many scholars have offered numerous definitions of AI and the advancement of AI technology since then [37]. While there is no agreement, experts generally believe that AI is not limited to specific forms of technology. AI, on the other hand, refers to technology, software, methodologies, and computer algorithms utilized to solve human-related problems [38]. [39, 40, 41] state that AI is a "technology that

builds systems to think and act like humans with the ability to achieve goals." Similarly, [42] defined AI as "computers which perform cognitive tasks, usually associated with human minds, particularly learning and problem-solving."

Unlike traditional computer technologies, which provide a fixed sequence without considering the individual's needs and knowledge, AI interprets patterns of collected information (e.g., student understanding and errors) and makes reasonable decisions to offer the following tasks and maximize outcomes [35, 43]. Furthermore, AI examines the outcomes of previous techniques and devises new ones based on a constant learning and thinking process. Thus, AI will positively affect student achievement, creative thinking skills, and problem-solving abilities [44, 45, 46].

The positive effects of AI on mathematics learning outcomes could be explained by cognitive and affective development theories. Students are more likely to focus on mathematics learning because AI helps them create a good attitude toward mathematics and involvement in mathematics learning [46]. They are eager to commit more time and effort. Conversely, a few studies have found that AI has no substantial effect on student achievement [47]. Because students must control their learning process as active learners with little teacher help, some students may be unable to focus on their studies and lose interest in utilizing AI [16].

Among the various types of AI, the most commonly used in education are ITS, adaptive learning system (ALS), and robotics [48]. Several types of AI have been widely used in mathematics education to improve the outcomes of mathematics teaching and learning [49, 50, 51]. ITS Assesses students' mathematics knowledge and preferences and gives tailored feedback and teaching at their speed [49]. ALS, like ITS, provides tailored learning opportunities based on the pupils' needs.

Teachers might participate in student learning passes in the ALS environment while ITS and ALS provide course content, evaluate student progress, and provide tailored feedback [7]. Teachers could use the information produced by ALS to assess student learning progress and recommend appropriate learning activities. Teachers, for example, might use the data provided by ALS to develop instructional techniques to assist student teaching [44]. Furthermore, the tasks in ALS included traditional lesson-based assignments and game-based tasks [48, 52]. ITS on the other hand, offers "customized education and fast feedback without teacher intervention" [53]. As a result, several researchers have proposed distinguishing ALS from ITS [5, 7, 14].

By manipulating robotics, students can explore various mathematical concepts. They provide interactive feedback; robotics helps students develop cognitive thinking and reasoning abilities [50, 51, 52, 53, 54]. For example, [58] employed robots to help kids learn multiplication and discovered that their math achievement improved. Similar positive effects have been documented in research involving other grade levels and mathematical disciplines [55, 56, 57].

2.2 TEACHERS PERCEPTION OF USING AI

AI adoption in the classroom has not been fully implemented because many teachers still have a negative attitude toward technology and choose not to use it [58, 59, 60, 61]. Teacher anxiety in using new technologies [62] and their preference to stay in their comfort zone, using the same materials and methodologies they are already familiar with [63] are among the reasons that interfere with their usage of technology in on-site teaching setup [64]. A study of educators' overall perceptions of AI revealed that in the past, they were heavily influenced by the concept of AI disseminated through the media and science fiction, which led them to regard AI as an occupational threat that would replace their jobs rather than as a support that can enhance learning and instruction [65]. On the other hand, recent research has helped raise teachers' expectations for significant changes in the educational sphere, such as the application of AI in various educational contexts [66]. In light of this, a new term has emerged: *artificial intelligence in education* (AIED), which encompasses all aspects of AI's educational applications [67]. Teachers' impressions of AIED systems differ depending on their pedagogical beliefs, teaching experiences, prior experience with educational technology, and the effectiveness and necessity of a specific technology, which may influence their desire to accept new educational technology [10, 15]. Several studies on teachers' perceptions of AIED found that they commonly expected AI to (a) provide a more effective teaching and learning process through digitalized learning material and multimodal human-computer interactions [68] and (b) resolve various learning difficulties of students, catering to their needs despite large class sizes [64, 69].

Furthermore, research indicates that AIED can dramatically reduce instructors' administrative workload by taking over easy and repetitive duties [70]. Despite these educators' positive attitudes toward AIED, scholars have claimed that before implementing AI in the classroom, teachers must learn how to use technology properly to integrate it into their curriculum more effectively. They must also comprehend the significance of AI and its educational benefits to be open to using modern technology in their lessons. Furthermore, many instructors and school authorities have not yet encountered AI-based learning support. They may merely see it as slightly more advanced educational technology, underestimating the AI's importance in the classroom. As a result, before an AI support system can be successfully implemented in education, teachers must test it themselves to understand how it helps scaffold learning [62, 69].

2.3 IMPORTANCE, CHALLENGES, AND FUTURE DIRECTIONS OF AI

AI and its applications have a clear and vital role in improving different areas of life, through the development of computer systems, to operate with superior efficiency similar to the efficiency of an expert human being. AI, with its various uses and applications, has become an applied science, the backbone of daily life, affecting humans' present and

future. It has not only become a tangible reality but also an indispensable reality in light of the tremendous technical development that the world witnesses today [69].

Artificial intelligence is necessary since it contributes to preserving the accumulated human experiences by transferring them to smart machines, enables humans to use human language in dealing with machines instead of computer programming languages, and plays a focal part in many sensitive fields, such as in assisting in diagnosing diseases and prescribing medicines, legal and professional advice, interactive education, and security and military fields. Also, AI can conduct scientific research and provide easy access to more discoveries [39]. Truly, the use of AI systems and applications in teaching helps increase motivation and competition and challenges students to not depend on textbooks. Using AI is compatible with inclinations and directions, characterized by flexibility in content, which considers individual differences and helps make appropriate educational decisions. It is also a suitable teaching tool for converting lessons into charts and mathematical symbols and transforming images and manual text into text files that can be edited.

The issue of developing a general policy to integrate AI into education is one of the important issues related to the future of the educational process, especially in light of its strong connection to the global open labor market. However, the implementation of this policy faces many challenges that affect the process of integrating AI into education. [66] Mentioned six challenges that affect the integration process, which begin with the authorities responsible for education, adopting a sovereign decision to create a comprehensive policy with the main title "Artificial Intelligence for educational development linked to the knowledge economy," which provides all forms of support. In second place are the budgets required to establish AI research centers, recruit and prepare experts, and invest in research and advanced training. Third is the provision of equal and fair opportunities in integrating AI into education, ensuring the participation of all students, to avoid the occurrence of the so-called "digital divide," which will result in an imbalance among those deprived of education supported by artificial intelligence? He also mentioned the process of preparing teachers and leaders for an AI-supported education [62, 63, 64, 65, 66]. The fourth challenge calls for the necessity of providing a suitable environment and overcoming any difficulties that teachers and school leaders may face in the creative, social, and economic fields, as teachers must be empowered to lead the manufacture of programs that operate with AI in education, as strong and broad support by training them on clear policies, to support the efforts of the education technology industry [61, 71]. In addition, he explained that developing high-quality and comprehensive data systems is the fifth challenge that affects the integration process due to the limited or inaccurate data, which negatively affects the quality and accuracy of the outputs, obtained. Finally, considering religious and ethical factors while applying AI is a challenge, given the risks that this general application of AI may carry due to the continuous possibility of development and modernization. Using AI systems in teaching comes with many challenges, including the difficulties of using applications, which require more time and effort compared to traditional methods, the difficulties of obtaining the latest versions and anti-virus programs, the scarcity of specialists and experts, and the lack of training programs and awareness courses [67].

In the last decade, AI has developed greatly due to a technique called *deep learning*, which gives AI the ability to devise and think independently, teach itself by itself, and liberate itself from the shackles of "narrow artificial intelligence," a programming a machine to do a specific job without thinking [59]. Recent educational trends and research about AI indicate that the greater the area of education with modern applications, the more opportunities will be available to improve the education system and adjust with development, as AI has multiple crucial roles in educational institutions and the elements they contain. From this standpoint, the employment of AI and its applications in the educational process has become a necessity for all countries of the world to achieve the objectives of the teaching and learning processes and make the most of them [65].

Future directions for AI applications in teaching suggest the need to rely on self-cadres to localize AI applications, support community participation through openness to theoretic thought, and create a supportive community environment for spreading the culture of AI applications. In addition to the necessity of providing a supportive digital infrastructure, preparing smart digital content and emphasizing the significance of training programs for learners and teachers play a major role in improving the quality of education outcomes. In addition, the need for networking of knowledge, experience, and application, and the establishment of departments in universities to prepare specialists are fundamental. This is in addition to enacting laws, establishing rules and mechanisms for implementation, and following up on all processes of AI applications in education [61, 65].

AI tools or applications for learning mathematics enhance students' understanding of mathematical concepts [67]. [58] Details some examples of these tools: (1) *online learning platforms,* such as Khan Academy and Courser, offer educational courses that leverage artificial intelligence techniques to guide students and provide accurate assessments of their progress; (2) *mobile applications* use AI to provide educational games and interactive activities that help children and students better understand mathematics; (3) *lesson design tools* assist teachers in customizing educational materials and creating tailored educational experiences for students using student data analysis and automatic recommendations.

The pros of these examples are as follows: (1) *customized learning:* AI tools help personalize education and meet students' needs better by providing suitable content for each student's level; (2) *accurate feedback* can offer precise assessments of students' performance and immediate feedback, contributing to improved learning; (3) *increased*

engagement is achieved when educational games and interactive activities can capture students' interest and increase their participation. The cons of these include (1) *dependency on technology:* The educational system may heavily rely on technology, which can be problematic in areas lacking the necessary infrastructure; (2) *reduced social interaction:* Overreliance on artificial intelligence in education can lead to a decrease in social interaction between students and teachers; and (3) *privacy and security challenges*, *which* should be considered when using technology and artificial intelligence tools in education [62].

It is expected that the world's dependence on AI will increase in the next few years in many fields, including the field of education because AI technologies can improve education, which helps the education sector to develop to better benefit students and teachers. Figure (1) shows the importance of employing AI application systems in education, the most important challenges they face, and future directions for employing them in the various fields of teaching and learning.
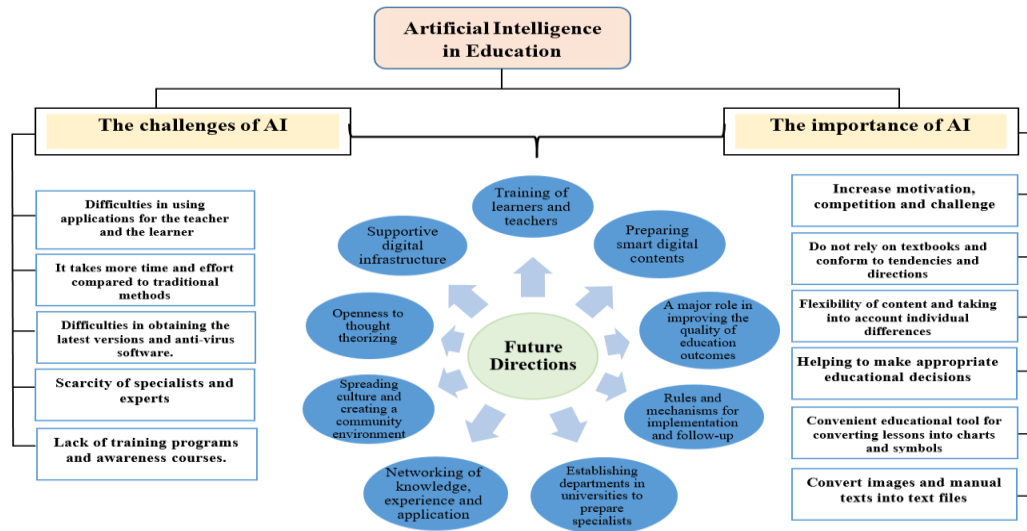

FIGURE 1. - The theoretical model of the research

2.4 PREVIOUS STUDIES

[62] Revealed the extent of using artificial intelligence applications by faculty members in Chinese university education was low. Similarly, [57] showed that the degree of primary school teachers' utilization of AI applications in teaching and application methods in a group of capital schools in Korea was low. [63] Developed an instrument to measure undergraduate students' attitudes toward the ethics of artificial intelligence (AT-EAI), verified its psychometric properties, and evaluated its validity in terms of content and concept. The study found gender differences in the characteristics of justice, privacy, and non-maleficence, and the students' different perspectives on justice were based on their prior exposure to AI coursework [72].

[64] Examined the effects of AI on elementary students' mathematics achievement, which had a negligible impact on primary kids' mathematical proficiency. He also concluded that grade level and topical characteristics related to math learning considerably reduced the impact of AI on math achievement.

[41] Used the technology acceptance model (TAM) to detect teachers' perceptions of the factors that affect the use of AI applications in science education (SE) with positive correlations to self-efficacy, ease of use, expected benefits, attitudes, and behavioral intentions. It also showed that attitude toward AI applications can predict 71.4% of future behavioral changes related to using AI applications in science teaching. Regarding teachers' behavioral intentions to employ AI in SE, this study finds no statistically significant variations depending on the factors of gender, teaching experience, and credentials. [69] Revealed challenges in the educational process, administration, teachers, learners, parents, and teacher evaluation during the Corona pandemic. By employing various applications of artificial intelligence in the educational process, these challenges can be overcome.

Many studies have found that AI applications can carry out measurement and evaluation tasks with very high levels of accuracy and efficiency, in addition to helping achieve academic excellence for learners, establishing partnerships between parents, society, and teachers, focusing on early assessment, and making the educational environment safe. AI applications can also make complex decisions, have enormous potential to solve problems, deal with contradictory data, save time and effort, and provide an alternative reality for learners as they get used to confrontation and keep up with modern technology [7, 42, 55].

3. METHODOLOGY

3.1 STUDY DESIGN

The current study followed the descriptive analytical approach due to its suitability to the nature of the study. The research describes the teachers' perspectives comprehensively and accurately by collecting, analyzing, and interpreting data to reach precise results that explain the relationship between the study variables.

3.2 STUDY SAMPLE

The study covered math teachers in the Emirate schools of Abu Dhabi during the first semester of the academic year 2022–2023, selected using random sampling. A total of (580) male and female math teacher from public and private schools across three educational regions in Abu Dhabi was included in the study. The questionnaire was distributed electronically to the selected teachers. The following table shows the distribution of the sample study.

Table 1. - Distribution of the study sample

| Demographic Information		Frequency	Percent
Gender	Male	282	48.6%
	Female	298	51.4%
	Total	**580**	**100.0%**
Qualification	Bachelor's degree	485	83.6%
	Master's degree	82	14.1%
	PhD degree	13	2.2%
	Total	**580**	**100.0%**
Experience	Less than 5 years	52	9.0%
	Between 6 to 10 years	180	31.0%
	More than 10 years	348	60.0%
	Total	**580**	**100.0%**
School Type	Private	84	14.5%
	Public	496	85.5%
	Total	**580**	**100.0%**
Region	Al Ain	320	55.5%
	Abu Dhabi	200	34.4%
	Al Dhafrah	60	10.1%
	Total	**580**	**100.0%**

3.3 INSTRUMENTS

A questionnaire was developed to measure math teachers' perspectives on using AI systems and applications in teaching based on a literature review of theoretical and research literature on related measures [62, 63, 64, 65, 73]. The questionnaire had 24 items distributed across two domains. The first domain comprised 16 items related to the importance of using AI systems and applications in teaching, while the second domain focused on the challenges faced by math teachers when implementing such systems and applications, with eight items allocated for this domain. All items were designed using a Likert scale with five response options: (Strongly Agree, Agree, Neutral, Disagree, and Strongly Disagree) where each option was given a numerical rating from one to five, respectively.

A group of arbitrators with expertise in educational psychology, measurement and evaluation, educational techniques, curricula, and teaching methods were asked to provide feedback on the research tool. Their opinions and observations were used to make necessary amendments until the final version of the tool was achieved. The tool was then applied twice to a sample of 20 male and female teachers, with a two-week interval between applications to assess its reliability. The Cronbach Alpha Coefficient was calculated for each item on the scale, as well as for the first and second domains and the scale as a whole. The coefficients ranged between 0.781 and 0.918 for each item, 0.858 for the first domain, 0.873 for the second domain, and 0.882 for the scale as a whole. These values confirm that the tool has high stability indicators, ensuring its suitability for use in the study and enhancing its accuracy in achieving the study's objectives. Furthermore, confirmatory factor analysis using structural equation modeling with AMOS, version 24, was used to confirm the validity and reliability of the scale.

3.4 CONFIRMATORY FACTOR ANALYSIS

An example of structural equation modeling (SEM) is the confirmatory factor analysis (CFA), which seeks out patterns in data (SEM). A CFA is a practical statistical method for analyzing relationships between latent constructs. An analytical technique called a CFA is used to develop measurement tools, evaluate construct validity, and classify method impacts. Throughout creating an instrument, a CFA is used to assess the latent structure of the test tool. It is

also used to verify the primary dimensions and factor loadings of the instrument [73]. The scale construct validity was verified using a CFA, where the adopted model for the relationship of the questionnaire items was drawn. Maximum likelihood method estimates were used to estimate the parameters, as shown in Figure 2.
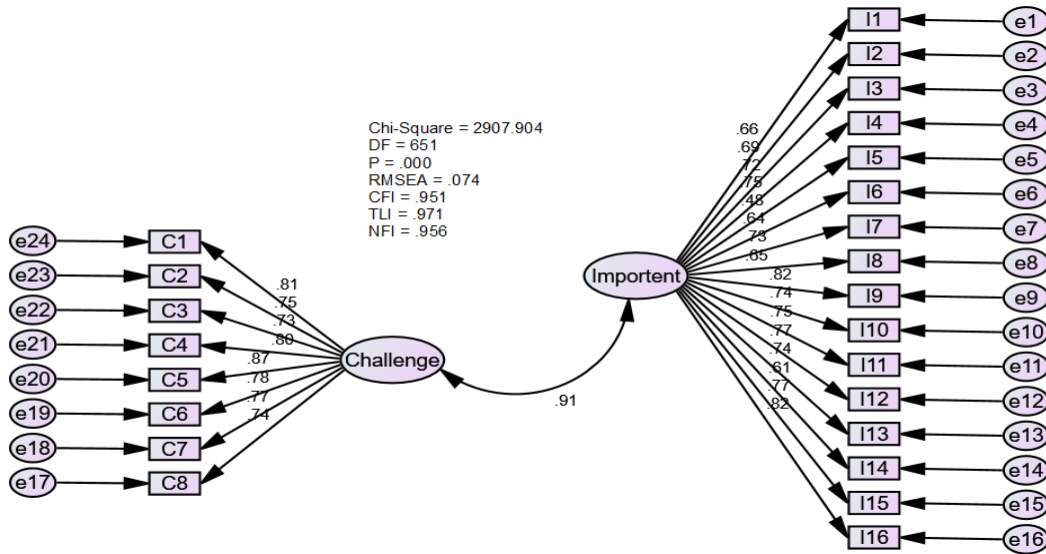
FIGURE 2. - **Results of the confirmatory factor analysis of the model adopted for the relationship of the scale items to their dimensions**

Table 2 displays the index level for a suitable goodness fit for the models' construct validity. The goodness fit indices showed a high level of goodness fit and were adequate.

Table 2. - **Results of confirmatory factor analysis of the model examining the relationship between the observation checklist items and their domains**

Category	Indicators of internal construct validity	Level of acceptance	Indexes in the proposed model
Absolute fit	χ^2	p > .05	Significant
	RMSE	RMSE < .08	0.078
	CFI	CFI > .90	0.951
Incremental fit	TLI	TLI > .90	0.971
	NFI	NFI > .90	0.956
Parsimonious fit	χ^2/df	χ^2/df < 5.0	χ^2/df = 4.47 < 5.0

3.5 PROCEDURES
Theories and research related to the study's subject were reviewed and used in preparing the study's tool. Previous international studies related to the problem of this study were reviewed. The study population and its sample were math teachers in the Abu Dhabi Emirates schools during the first semester of the academic year 2022/2023. The study instrument was developed and evaluated to ensure its validity and reliability. The instrument was then administered to both the sample selected from the study population and a separate group, with a two-week interval between the two applications. The scores for each item, domain, and overall scale were recorded for the study sample. Finally, the results were analyzed using the SPSS program to address the research questions, compare them with previous studies, and provide recommendations.

3.6 DATA ANALYSIS
The data were entered into the computer's memory and analyzed using the (SPSS) program by extracting percentages, means, and standard deviations for the scores of each item of the AI scale. The t-test and one-way analysis of variance test (One-Way ANOVA) were used to detect differences between the means in the responses of the study individuals.

4. RESULTS

4.1 Results of the first question: What is the importance of using systems and applications of AI in teaching from the point of view of math teachers?
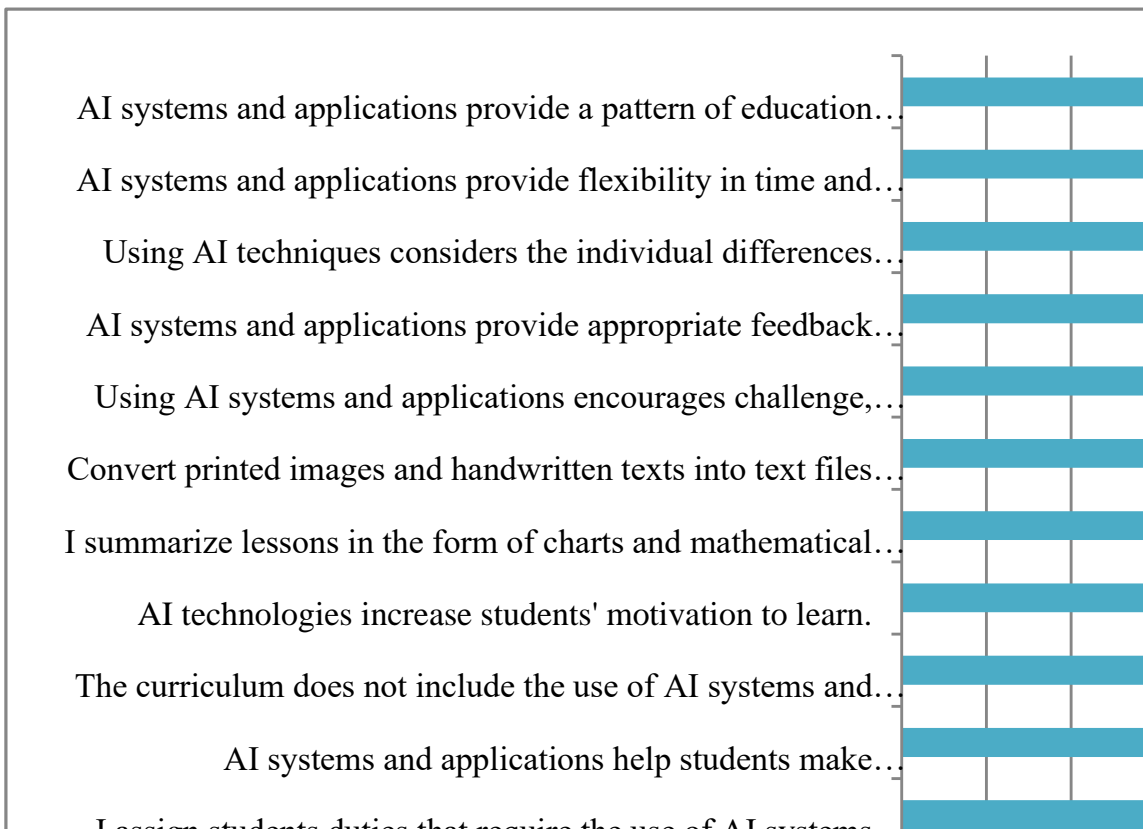
To explore mathematics teachers' views on the significance of integrating AI systems and applications in teaching, their perceptions regarding the importance of using such systems and applications were assessed using a 5-point Likert scale. The teachers were presented with various statements and asked to indicate their level of agreement. The mean and standard deviation of their responses for each perception statement are shown in Table 3.

Table 3. - The means and SD of mathematics teachers' perceptions of AI in the first domain

No.	Item	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Mean	SD
1.	I am constantly updating the systems and applications of smartphones, computers, and tablets,	28.82	39.30	23.14	7.42	1.31	3.87	1.01
2.	Systems and applications of AI reduce dependence on textbooks.	39.65	37.01	17.61	3.96	1.76	3.95	1.13
3.	Use AI systems and applications as educational tools to facilitate education and develop the educational performance of students.	25.33	26.22	26.67	16.44	5.33	4.19	1.21
4.	I convert the scientific material in the curriculum into sound and motion files through sound and image systems and applications.	28.51	42.74	18.42	7.46	2.88	3.82	0.97
5.	I assist students with little experience in using AI systems and applications.	33.77	39.54	17.11	5.70	3.88	4.01	1.26
6.	I assign students duties that require the use of AI systems and applications.	39.04	39.74	13.16	5.19	2.88	3.86	0.97
7.	AI systems and applications help students make educational decisions appropriate for them.	33.72	34.21	19.30	9.33	3.44	3.72	0.92
8.	The curriculum does not include the use of AI systems and applications in the educational process.	31.72	36.41	21.59	5.96	4.32	3.52	0.88
9.	AI technologies increase students' motivation to learn.	35.81	35.37	21.40	5.68	1.75	4.32	1.23
10.	I summarize lessons in the form of charts and mathematical symbols with extreme accuracy and an easy-to-understand manner using AI systems and applications.	30.82	37.30	22.14	10.42	3.31	4.06	1.21
11.	Convert printed images and handwritten texts into text files that can be edited using AI systems and applications.	29.52	31.48	20.36	6.04	2.60	3.93	1.15
12.	Using AI systems and applications encourages challenge, competition, and excitement among students.	31.52	36.84	21.10	9.22	5.51	4.23	1.21
13.	AI systems and applications provide appropriate feedback to the teacher.	32.74	36.51	17.42	8.89	4.45	3.79	0.91
14.	Using AI techniques considers the	31.75	34.30	20.77	8.38	4.90	4.22	1.19

No.	Item							
	individual differences between students.							
15.	AI systems and applications provide flexibility in time and place when presenting educational materials.	44.33	40.17	12.50	1.42	0.58	4.38	1.28
16.	AI systems and applications provide a pattern of education according to students' tendencies and encounters.	42.39	32.12	17.39	6.38	1.71	3.72	0.94

Table 3 details the discrepancy in the sample's responses to the first domain of the study tool. Specifically, item 15, which indicates that "AI systems and applications provide flexibility in time and place when presenting educational material," was ranked first with a mean of 4.38 and a standard deviation of 1.28, and item 8, "the school curricula include the employment of AI systems and applications in the educational process," was ranked last with a mean of 3.52 and a standard deviation of 0.88. Figure (3) shows the mean scores for each item of the first domain.

FIGURE 2. - The means of mathematics teachers' perceptions of AI in the second domain

The results from the previous analysis highlight the significance of integrating AI systems and applications in teaching as an effective educational tool. The findings suggest that such tools can facilitate teaching and improve students' performance by incorporating them into the school curricula. Furthermore, AI techniques have increased motivation for learning and encouraged challenge, competition, and suspense among students, while also considering their differences.

4.2 Results of the second question: What are the most critical challenges math teachers face when applying AI systems and applications?

Table 4 presents the percentages, means, and standard deviations of the study participants' responses to each item of the second domain, which explores the challenges that math teachers encounter when implementing AI systems and applications in their teaching practices.

Table 4. - The means and standard deviations of mathematics teachers' perceptions of AI

No.	Item	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Mean	SD
17.	The difficulty of using artificial intelligence techniques of all kinds	44.39	30.04	18.39	5.38	1.79	4.36	1.25

18.	Using artificial intelligence systems and applications requires more effort than teaching traditionally.	43.11	34.22	16.22	5.56	0.89	4.45	1.31
19.	Difficulty using artificial intelligence systems and applications by some students	41.23	32.02	18.86	4.82	3.07	3.75	0.95
20.	Difficulty obtaining the latest versions of artificial intelligence systems and applications	24.67	30.84	26.87	12.33	5.29	3.92	0.96
21.	Difficulty obtaining anti-virus software to protect intelligence systems and applications artificial	28.51	26.75	22.81	17.11	4.82	4.06	1.06
22.	Unavailability of specialists and experts in artificial intelligence technologies to turn to in times of need	34.36	36.09	21.62	5.49	2.44	3.82	1.02
23.	The many burdens placed on teachers prevent them from using the various artificial intelligence techniques	40.91	34.44	14.74	5.96	3.95	4.13	1.19
24.	Lack of availability of adequate training programs and awareness courses for using artificial intelligence in education	39.11	34.22	15.22	7.56	3.89	3.82	1.01

The results presented in Table 4 indicate a variation in the study sample's responses concerning the challenges faced by math teachers in using AI systems and applications in teaching. Item (17), which highlights the difficulty in using various AI techniques, was ranked first with a mean of (4.45) and a standard deviation of (1.31), whereas item (19), which focuses on the difficulty some students, may face in using AI systems and applications, was ranked last with a mean of (3.75) and a standard deviation of (0.95). Figure (4) shows the mean scores for each item of the second domain.
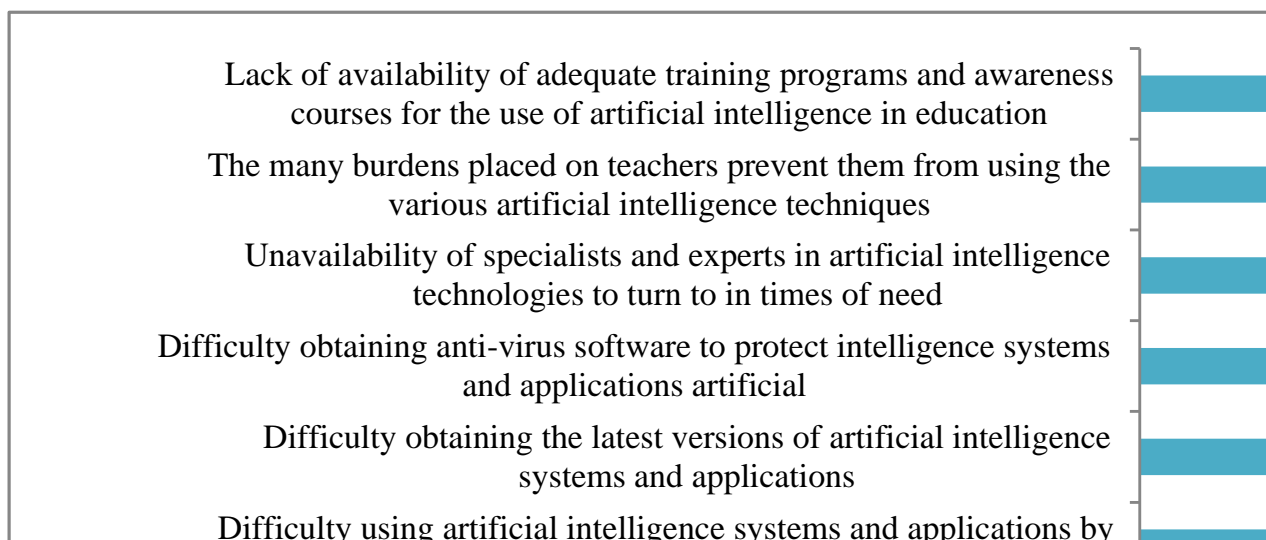
FIGURE 4. - **The means of mathematics teachers' perceptions of AI in a second domain**

The results above demonstrate the most significant challenges faced by mathematics teachers when integrating AI systems and applications. The most notable obstacle is the need for teachers to invest more effort than with traditional teaching methods when using various AI techniques. The second most significant challenge is the burden placed on teachers, which limits their ability to utilize AI techniques fully. Additionally, some male and female teachers, as well as some students, found it challenging to use these systems and applications.

4.3 Results of the third question: Is there a statistically significant difference in the means of the study sample regarding the importance of using systems and applications of AI in teaching from the perspective of math teachers, as well as the challenges they face, based on variables such as gender, years of experience, and qualification?

Statistical analyses were conducted using the t-test and one-way ANOVA to determine whether there were significant differences in the means of the study sample concerning the importance of using systems and applications of AI in teaching, as perceived by mathematics teachers, and the challenges they faced, based on the variables of gender, years of service, and academic qualifications. The significance level (α) was set at 0.05 to identify whether any observed differences were statistically significant. Table 5 lists the results of the t-test conducted to determine if there were statistically significant differences in the responses of the study participants based on their gender.

Table 5. - Mathematics teachers' perceptions of AI based on gender

Domain	Gender	Frequency	Mean	SD	df	T	Sig.
First Domain: The importance of using AI systems and applications in teaching	Male	282	54.69	6.29	579	0.43	0.088
	Female	298	55.23	5.96			
Second Domain: Challenges math teachers face when applying AI systems and applications in teaching	Male	282	48.65	5.82	579	0.95	0.015
	Female	298	52.65	6.03			

Table 5 demonstrates no significant differences between male and female math teachers in terms of the importance of using AI systems and applications in teaching. This suggests that both genders recognize the importance of incorporating these technologies into their teaching practices. However, statistically significant differences between the two genders were found in terms of the challenges they face when using AI systems, with female teachers reporting greater challenges. This could be attributed to the fact that female teachers may be more aware of and attentive to the challenges that hinder their use of AI technologies.

To determine the most critical challenges faced by math teachers when utilizing AI systems and applications based on years of experience, the ANOVA test was employed.

Table 6. - Results of the ANOVA test according to the years of experience

Experience	Frequency	Mean	SD	Variance Sources	Sum of Square	df	Mean of Square	F	Sig.
First Domain: The importance of using AI systems and applications in teaching									
Less than 5 years	**52**	52.58	6.13	**Between Groups**	626.85	2	313.42	0.041	0.025
Between 6 to 10 years	**180**	51.25	6.83	**Within Groups**	185323.36	578	320.62		
More than 10 years	**348**	48.12	7.06	**Total**	185950.21	580			
Second Domain: Challenges math teachers face when using AI systems and applications in teaching									
Less than 5 years	**52**	32.52	4.27	**Between groups**	112.4	2	56.20	1.40	0.121
Between 6 to 10 years	**180**	31.18	4.72	**Within groups**	23128.65	578	40.01		
More than 10 years	**348**	29.67	4.96	**Total**	23241.05	580			

The results in Table 6 display statistically significant differences between the means of the study sample members in the first domain of the study, which is the importance of using AI systems and applications from mathematics teachers' perspectives based on their years of experience. This may be attributed to the agreement among the study participants on the significance of utilizing AI technologies in the teaching and learning process, regardless of their level of experience. Additionally, there are significant differences between the means of the study sample in the second domain of the study, which is the challenges that math teachers face when applying AI systems and applications in teaching, based on their years of experience, particularly for novice teachers and those who have just started working in math education.

To identify the most critical challenges math teachers face when applying systems and applications of AI according to their academic qualifications, the ANOVA test was conducted.

Table 7. - Results of the ANOVA test according to educational qualifications

Qualification	Frequency	Mean	SD	Variance Sources	Sum of Square	df	Mean of Square	F	Sig.
First Domain: The importance of using AI systems and applications in teaching									
Bachelor's	**485**	50.23	5.99	**Between groups**	38.95	2	19.47	0.08	0.055
Master's	**82**	51.53	6.13	**Within groups**	130899.66	578	226.47		
PhD	**13**	50.37	6.05	**Total**	130938.61	580			
Second Domain: Challenges math teachers face when using AI systems and applications in teaching									
Bachelor's	**485**	28.92	4.06	**Between groups**	152.25	2	76.12	.088	0.008
Master's	**82**	29.86	4.29	**Within groups**	49603.96	578	85.82		
PhD	**13**	29.13	4.13	**Total**	49756.21	580			

Table 7 shows that math teachers with a Master's degree face more challenges when using AI systems and applications in teaching compared to those with Bachelor's or Doctoral degrees. This may be due to the higher expectations placed on them, as well as their advanced knowledge of the subject matter, which could lead to more complex challenges. However, despite these challenges, all teachers, regardless of their different academic qualifications, agree with the importance of using AI technologies in education, indicating the need for further support and resources to overcome the challenges they face.

5. DISCUSSION

5.1 What is the importance of using AI systems and applications in teaching from the point of view of math teachers?

The results presented highlight the significance of utilizing AI systems and applications in teaching mathematics from the teachers' perspectives. The AI-supported applications focus on teaching fundamental skills, catering to individual differences, providing teachers and students with useful feedback, and directing students toward learning styles that best suit their preferences and experiences. While the implementation of AI systems and applications in curricula was not entirely effective, employing modern teaching strategies that utilize technology and AI techniques has positively influenced student motivation and engagement. Studies have demonstrated the positive impact of AI on learning outcomes, such as increased challenge, competition, and suspense [31, 32, 33, 34].

The integration of AI systems and applications in teaching has also reduced the dependence on textbooks, with students being more inclined to use tablets and computers for studying and completing activities and homework. The flexibility provided by AI technologies enables students to access educational materials at any time and place and in ways that align with their skills and interests, thereby stimulating their critical thinking skills and interest in mathematical concepts. This could be attributed to the use of simulation systems that employ audio and kinetic systems to communicate information and summarizations in the form of charts and mathematical symbols that enhance the delivery of facts and ideas excitingly and interestingly, improving the quality of the educational process.

AI integration is an exciting field that faces numerous challenges and boasts unique advantages worth paying attention to. As for the challenges, AI integration encompasses technical and ethical issues. Among the technical challenges, dealing with data diversity and time constraints is essential, along with the development of machine learning techniques and neural networks to enhance performance. Ethical challenges, on the other hand, include matters of privacy, security, and concerns related to the impact of artificial intelligence on society and individuals. AI integration also provides significant opportunities for improvement in various domains. It can be employed in healthcare to enhance disease diagnosis and treatment and can boost productivity and efficiency in industry and business. Furthermore, it can be used to develop predictive and analytical techniques to support decision-making across fields. One of the unique advantages of AI integration is its ability to learn and adapt quickly, making it a powerful tool for innovation and the development of future technologies.

5.2 What are the most critical challenges math teachers face when using AI systems and applications?

The findings revealed that math teachers face various challenges that hinder the effective utilization of AI systems and applications in the educational process. These challenges include the difficulty of applying AI systems and applications experienced by both male and female teachers and students, and the additional effort required from teachers to utilize these technologies compared to traditional teaching methods. This may be due to a lack of experience and knowledge in

working with software, computer and tablet devices, educational games, robots, and other innovative applications. Additionally, older teachers may find it more difficult to adapt to these modern teaching approaches and strategies, as they require more time, effort, and attention than the traditional methods they have been practicing for many years. Such challenges add to the already heavy workload of teachers, including daily lesson preparation, teaching, exams, student evaluations, attendance at meetings, and other teaching responsibilities.

Furthermore, there are also challenges related to the acquisition and maintenance of up-to-date versions of AI systems and anti-virus programs. The lack of availability of AI specialists and experts to train teachers on these technologies is another obstacle, as individuals with the necessary skills and experience are currently scarce compared to other fields. This is because the development and modernization of AI systems and applications require adaptation to specific data sets and contexts, which demands a unique set of talents and expertise possessed by only a few individuals globally. The level of technical capabilities that can be attained in this field is ultimately dependent on the amount of human capital invested in the development of this software.

5.3 Is there a statistically significant difference in the means of the study sample regarding the importance of using AI systems and applications in teaching from the perspective of mathematics teachers, as well as the challenges they face, based on variables such as gender, years of experience, and educational qualifications?

The results exhibited significant differences in the perception of using AI systems and applications and the challenges faced by math teachers according to gender, years of experience, and educational qualifications. Female teachers tend to have a higher level of technical skills and knowledge, which allows them to prepare a systematic plan for employing AI systems and applications to solve technical issues. They are also more knowledgeable about modern technologies and have a broader understanding of how to use them compared to male teachers. Moreover, several educational platforms, such as School Platforms, Matvek Platforms, Nahla, and Nahil are available in the UAE, providing resources to help teachers familiarize themselves with these applications. Furthermore, many techniques and applications based on games are being used to help math teachers teach and students learn in a fun and joyful atmosphere. These techniques and applications help develop creativity self-confidence, and even academic achievement. The availability of these resources and applications provides ease and convenience for math teachers and students to use modern methods and technologies.

The current era demands new math teachers to possess more skills and experience in using technology and AI techniques than their more experienced counterparts. This requirement enables them to acquire the latest software, versions, and applications for computer and tablet devices, educational robots, smartphone applications, and educational games easily, and utilize them to achieve educational objectives. Additionally, new math teachers exhibit motivation, enthusiasm, and creativity, which allow them to manage the educational process more effectively, unlike most experienced teachers, who may be accustomed to traditional teaching methods and resistant to change [31, 32, 33, 34].

Math teachers with a master's degree possess educational training and preparation that exceeds teachers with bachelor's and doctorate degrees. By studying educational technology courses and teaching methods and strategies, they have gained knowledge of the most important and latest teaching methods and techniques, particularly those that rely on using technology and AI. Furthermore, through practical education courses, they have acquired valuable experiences in the real-world teaching environment, allowing them to understand the challenges and obstacles that prevent the use of modern teaching methods and strategies that rely on technology, AI, and its latest techniques.

6. RECOMMENDATIONS

The researchers suggest the following actions for teachers, researchers, and/or school administrators to integrate AI systems and applications in mathematics teaching more effectively:

• Work on the need to provide computers, tablets, educational robots, and smartphones that help students during their studies so that students can collect the information they study, making it an exceptional teacher for each student.

• Reconsider the curricula that should keep pace with the times by including AI systems and applications in their content interestingly to motivate students to use them to improve learning outcomes and obtain the desired learning.

• Encourage mathematics teachers to use the latest teaching methods and strategies, especially those that rely on AI systems and applications.

• Hold programs and training courses necessary to train math teachers on using AI systems and applications, which will refine their skills and increase their experience and knowledge about AI techniques in teaching

• Research developed countries' experiences in AI and establish partnerships for remote training courses for both male and female teachers, emphasizing their progress and training and providing periodic feedback.

• Explore further studies that will cover the importance of using artificial intelligence and its applications, assessing its ability to enhance the students' and teachers' performance across various samples and in different countries.

CONFLICTS OF INTEREST

The authors declare no conflict of interest

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