Kurdish Studies
Feb 2024
Volume: 12, No: 2, pp.2537-2548
ISSN: 2051-4883 (Print) | ISSN 2051-4891 (Online)
www.KurdishStudies.net

Received: December 2023 Accepted: January 2024
DOI: https://doi.org/10.58262/ks.v12i2.185

Coding the Equation: Unraveling the Dynamics between AI-Driven Mathematics Instruction and Student Anxiety in High Schools

Essa A. Alibraheim[1], Maram A. Al-Dhafeeri[2]

Abstract

The study aimed to investigate the relationship between the level of female mathematics teachers' use of artificial intelligence applications and their students' mathematics anxiety. A descriptive approach was employed, where a questionnaire was distributed to 76 mathematics teachers in secondary education in Kuwait, and a mathematics anxiety scale was administered to 361 female students at the secondary level. The results indicated that the level of mathematics teachers' use of artificial intelligence applications was moderate (Mean = 1.994). Similarly, students' mathematics anxiety was also at a moderate level (Mean = 2.836). The study's findings suggested no significant relationship between teachers' use of artificial intelligence applications and their students' mathematics anxiety. The study recommends providing mathematics teachers with a guide for using artificial intelligence applications and intensifying training courses in the field of artificial intelligence in mathematics education, enabling teachers to better incorporate these applications into their lessons.

Keywords: *Artificial Intelligence Applications, Mathematics Anxiety, Secondary Education, Mathematics Female Teacher, Kuwait.*

Introduction

Modern technology plays a crucial role in enhancing and refining the educational process by preparing 21st-century students to face future challenges, increasing their motivation for learning, and developing self-learning skills. Accordingly, teachers must use technology in their teaching practices effectively and creatively, aligning with modern educational theories and making the student the focal point of the educational process. In this context, the role of the teacher has evolved from being a mere information provider to a designer of an interactive and collaborative learning environment that enables students to acquire skills in researching, gathering, analyzing, and critiquing information. Consequently, teachers now play modern roles such as guides, facilitators, enablers, and mentors, responsible for assessing each student's level, selecting appropriate educational materials, monitoring progress, and guiding them to achieve desired goals (Oyaid & Alshaya, 2020).

The latest trends and research in the field of artificial intelligence (AI) in education emphasize that the broader the application of modern technologies, the more opportunities there are to improve the education system and keep up with advancements. AI plays various crucial roles in educational institutions, contributing significantly to decision-making processes, enhancing the quality of education, developing life skills, and improving students' cognitive achievement,

[1] Assisstant professor, College of Education, Imam Abdulrahman Bin Faisal University, Email: ealibraheim@iau.edu.sa
[2] Graduate student, College of Education, Imam Abdulrahman Bin Faisal University

all of which greatly contribute to the competitiveness of the educational process and the production of a generation capable of facing contemporary challenges (Mahmoud, 2020). AI applications in education, such as intelligent teaching systems, teaching robots, and adaptive learning systems, are widely used by students and teachers today (Chen et al., 2020).

The significance of artificial intelligence in education is immense, as highlighted by Fryer et al. (2019), who predict a complete transformation of traditional classroom frameworks into a blend of robots and designed artificial intelligence, benefiting a large and increasing percentage of students. This transformation will free up classroom teachers from administrative tasks, allowing them to focus more on students. Teachers often struggle with administrative tasks such as grading exams and assessing assignments, which AI applications can handle, thereby reducing the time required for correction and administrative work and enabling them to dedicate more time to students.

Several educational fields integrate artificial intelligence as revolutionary applications, such as speech recognition, letter recognition, natural language processing, games, robotics, and pattern and shape recognition (Al-Yagazi, 2019). Intelligent chatbots, like Chabot, are essential AI applications, serving as software that enables learners to engage in electronic chats with smart machines (Okonkwo & Ade-Ibijola, 2021). These interactive tools add a new dimension to teaching.

Kariri (2011) emphasizes that mathematics is one of the most abstract and anxiety-inducing core subjects. Mathematics anxiety is a serious problem for students during the learning process. Mathematics is often perceived as a difficult and intimidating subject for many students worldwide. Consequently, mathematics anxiety has garnered the attention of scholars, leading researchers to develop various measures to assess mathematics anxiety. Initiatives have been taken to integrate digital technology into mathematics learning, as it has the potential to enhance mathematics learning, creating positive attitudes towards mathematics and helping students overcome mathematics anxiety (Saha et al., 2020).

Many studies highlight the necessity of using technology to reduce mathematics anxiety, as demonstrated by Al-Abed and Salha (2014), and Kariri (2011). These studies emphasize the positive impact of artificial intelligence applications in alleviating mathematics anxiety.

Mathematics teachers, as integral components of the educational process, must be knowledgeable and aware of the use of artificial intelligence applications in teaching mathematics. Therefore, the current research aims to assess the level of mathematics teachers' use of artificial intelligence applications and its relationship with the level of mathematics anxiety among their students.

Research Problem and Questions

The integration of technological innovations in the classroom environment and their impact on the teaching process requires teachers to be trained in utilizing these innovations effectively. This training influences teachers' performance and how they present scientific content within the classroom, subsequently affecting their students' performance. Among these technological innovations, artificial intelligence (AI) techniques stand out due to their distinct advantages in educational settings. The use of AI applications in the educational process is a contemporary research trend recommended by various scientific conferences, such as the 17th Conference of the Ministry of Higher Education in the Arab World (2019), the 11th Annual Conference

of the Arab Organization for Quality Assurance in Education (2019), and the Global Virtual Conference to Support Innovation, Entrepreneurship, and Artificial Intelligence (2021). These conferences highlight the importance of employing artificial intelligence in the educational process to enhance the quality of education.

In light of the above, the current research aims to assess the level of mathematics teachers' use of artificial intelligence applications in teaching mathematics to secondary school female students and its correlation with their mathematics anxiety. The primary research question emerging from this problem is:

"What is the level of mathematics teachers' use of artificial intelligence applications and its relationship with mathematics anxiety among secondary school female students?"

Subsequently, the following subsidiary questions are derived from the main question:

1. What is the level of mathematics teachers' use of artificial intelligence applications in teaching mathematics to secondary school female students?
2. What is the level of mathematics anxiety among secondary school female students?
3. What is the correlational relationship between mathematics teachers' use of artificial intelligence applications and the mathematics anxiety of female students in secondary school?

Theoretical Framework

TPACK Model

With the advent of the Fourth Industrial Revolution, the use of technology-enhanced education has become imperative for teachers. This approach provides them with a range of methods that align with various learning styles within the educational context. Additionally, integrating technology into mathematics classrooms proves beneficial in delivering scientific content, encompassing the use of computers, web technology, the internet, and information and communication technology. As technology serves as a tool in educational curricula, teachers' knowledge, discussions, and engagement are crucial to ensure the appropriate use of technological tools (Naidoo & Singh-Pillay, 2020).

Technology in mathematics education can transform the classroom, present mathematical content innovatively, and offer additional learning opportunities for students. The National Council of Teachers of Mathematics (NCTM) emphasizes that the introduction of technology use does not replace the need for instruction in traditional calculation methods but provides students with free opportunities for more in-depth exploration and precise analysis, relying on visual representations and technology in mathematics education (Wan & Ivy, 2018).

In response to the growing recommendations for technology integration in teaching, scholars such as Mishra and Koehler recognized the need to expand Shulman's original model. They introduced the Technological Pedagogical Content Knowledge (TPACK) model, aiming to empower teachers with sufficient skills to integrate technology into education through a deep understanding of subject matter expertise and modern technologies to achieve educational goals (Mohamed, 2023).

TPACK is a crucial element in today's education system due to the increasing demand for technology use in classrooms. It focuses on both education and students' preparation for the future. Teachers must be fully aware and updated on the curriculum to effectively integrate

technology into their teaching methods (Mohamed, 2023). The integration of technology in education allows teachers to develop learning environments that stimulate students, make teaching more effective, and provide a better understanding of scientific concepts compared to traditional teaching methods (Yildirim & Sensoy, 2018).

Components of TPACK Model

According to Santos and Castro (2021), the TPACK model describes several teacher-related knowledge domains related to teaching and learning.

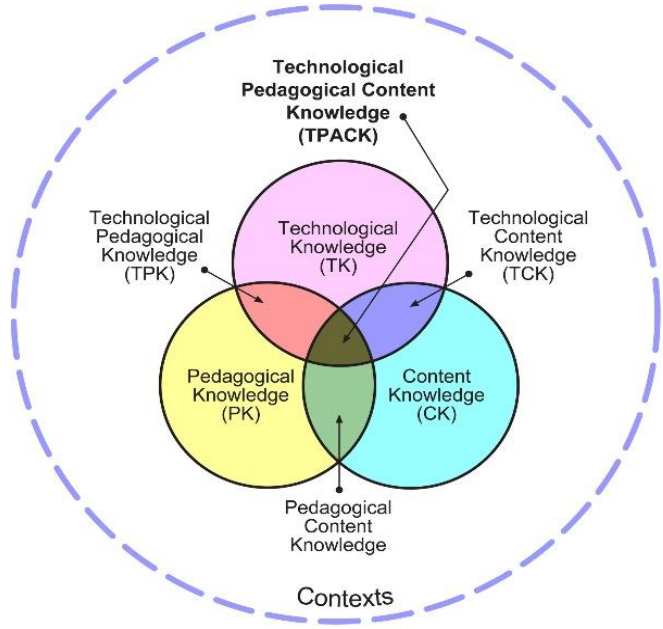

Figure 1: TPACK Framework (Graphic from http://Tpack.Org).

1. Content Knowledge (CK): Teachers' academic knowledge in the subject, including concepts, theories, evidence, and organizational frameworks within a specific topic.
2. Pedagogical Knowledge (PK): Teachers' knowledge of practices, processes, and methods related to teaching and learning, including the purposes, values, and goals of education, understanding student learning methods, classroom management skills, lesson planning, and assessments.
3. Technological Knowledge (TK): Teachers' knowledge of technology, their ability to use various technologies, technological tools, and associated resources. Technological knowledge involves understanding teaching with technology, evaluating its potential for a specific field or classroom, and learning to recognize when assistance or technology impedes learning.
4. Pedagogical Content Knowledge (PCK): Teachers' knowledge of the fundamental domains of education and learning, including curriculum development, student assessment, result reporting, and focusing on enhancing learning in the area of mathematics.
5. Technological Content Knowledge (TCK): Understanding how technology affects both itself and content, including how to deliver subject matter through various educational technologies and considering specific educational technology tools that may be most suitable for specific subjects or classrooms.
6. Technological Pedagogical Knowledge (TPK): Understanding how technology changes the

teaching and learning experience by introducing new educational possibilities and limitations through the use of specific technologies. It relates to understanding how these tools can be used in conjunction with pedagogical knowledge for specialization and lesson development.

7. Technological Pedagogical Content Knowledge (TPACK): The culmination of these groups and various concerns, derived from the three major domains of content, education, and technology. It creates an effective foundation for teaching using educational technology, ensuring teachers benefit efficiently from the TPACK framework. Teachers should be open to key ideas from these different areas.

Literature Review

The study conducted by Istikomah and Wahyuni (2018) aimed to identify the level of mathematics anxiety among students who took the technology-based mathematics course at the Islamic University of Riau in Indonesia. Their sample consisted of 40 second-year students in the mathematics education program. The prominent result was a high level of mathematics anxiety among students, with a specific concern about problem-solving related to the use of technology. The researchers attributed their findings to the students' lack of preparedness, insufficient knowledge about software applications, and fear of not understanding mathematical concepts.

Ambaranti and Retnowati's study (2019) sought to explore mathematics anxiety among 215 high school students in Indonesia. The results indicated a moderate level of mathematics anxiety among students, with male students showing less anxiety about mathematics compared to females.

The study by Shin and Shin (2020) aimed to assess the awareness of primary school science teachers in the Republic of Korea regarding artificial intelligence and its applications in teaching. Their sample included 95 teachers, and a questionnaire was used to collect data. One of their key findings was a low level of teacher awareness of artificial intelligence applications.

Wang's investigation (2020) aimed to determine the extent of 178 faculty members' use of artificial intelligence applications in education in China. The results pointed to a low level of faculty members' utilization of artificial intelligence applications in teaching.

Yaftian and Barghamadi's research (2022) examined the impact of using multimedia on mathematics anxiety and motivation in teaching mathematics. The sample consisted of 57 seventh-grade students in Iran. The researchers used anxiety and motivation scales and a multimedia-based program for teaching mathematical concepts to collect data in a quasi-experimental design. The notable result was that the use of technology in teaching mathematics had a positive impact on motivation, reduced mathematics anxiety, and enhanced understanding of mathematical concepts.

Based on the foregoing, previous studies indicate that teachers' awareness of artificial intelligence applications was low (Shin & Shin, 2020), and their utilization of such applications in teaching was also low (Wang, 2020). However, the use of technology in mathematics education can have a positive impact on motivation and reduce students' mathematics anxiety (Yaftian & Barghamadi, 2022). Additionally, there is variability in the results of educational studies regarding the level of mathematics anxiety among students. Istikomah and Wahyuni's study (2018) showed that students experienced a high level of mathematics anxiety, while

Ambaranti and Retnowati's study (2019) indicated a moderate level of anxiety among students. Therefore, the current study aims to investigate the level of mathematics anxiety among secondary school female students in Kuwait and its correlation with the teachers' utilization of artificial intelligence applications.

Methodology

The current research employs a descriptive correlational methodology to identify the relationship between mathematics teachers' use of artificial intelligence applications and the mathematics anxiety of their female students.

Population & Sample

The study population comprises all mathematics teachers and their female students in secondary schools in Kuwait during the second semester of the academic year 2023/2024. A stratified random sample was used to select the study sample, consisting of 76 mathematics female teachers and 361 female students from secondary schools.

Instruments

The study's instruments include a questionnaire on teachers' use of artificial intelligence applications, and the Mathematics Anxiety Scale (Alibraheim, 2021).

I. Teachers' Questionnaire on the Use of Artificial Intelligence Applications

The questionnaire consists of 10 Likert-type items (Always, Sometimes, Never) to measure the level of teachers' use of artificial intelligence applications.

Face Validity (Content Validity) for Teachers' Questionnaires: To ensure the face validity of the questionnaire items, they were initially presented to 16 experts in curriculum, teaching methods, and educational technology. Experts were asked to provide their opinions on the appropriateness of the items, their linguistic clarity, and any other comments. All comments and adjustments were duly considered.

Pilot Study: The questionnaire was administered to a pilot sample of 33 mathematics teachers from all educational levels (elementary, middle, high school) outside the study sample to ensure the clarity of the tool's expressions and determine its psychometric properties.

Verification of Item Discrimination: To verify the item discrimination, the correlation coefficient between the item score and the total score for the dimension is calculated (refer to Table 1).

Table 1: Correlation Coefficients for the Questionnaires.

Items	Correlation coefficient	Items	Correlation coefficient
1	0.611**	6	0.622**
2	0.564**	7	0.757**
3	0.904**	8	0.725**
4	0.855**	9	0.784**
5	0.846**	10	0.673**

Note. ** Significant at the 0.01 Level.

Table 1 shows that most correlation coefficients were significant at the level of (0.01) with

correlation coefficients ranging from (0.564-0.904). This indicates a strong relationship between the items and the total score (Pallant, 2020).

Reliability: To verify the reliability of the teachers' instrument, the Cronbach's alpha coefficient, Spearman-Brown coefficient, and Guttman Split Half coefficient were calculated (see Table 2). The Cronbach's alpha coefficient was used to calculate the reliability of the questionnaires, and the result was (0.904), indicating high reliability coefficients (Abu Nahiah, 1994). It is evident from Table 2 that the Spearman-Brown coefficient (r = 0.916) and Guttman Split Half coefficients (r = 0.916) for the questionnaire are all high (Abu Nahiah, 1994).

Table 2: Results of Reliability Tests.

No of items	Cronbach's alpha coefficient	Spearman-Brown coefficient	Guttman Split Half coefficient
10	0.904	0.916	0.916

Based on the reliability results for questionnaire using the three methods (Cronbach's alpha, Spearman-Brown, Guttman Split Half), we can say that the reliability coefficient is appropriate (Hasan, 2006). The questionnaire is stable, trustworthy, and can be relied upon and applied in research.

ii. Mathematics Anxiety Scale

The scale was developed by Alibraheim (2021). It consists of 11 items using a five-point Likert scale (Strongly Agree, Agree, Not Sure, Disagree, Strongly Disagree) to measure the level of mathematics anxiety among female students. According to Alibraheim (2021), the scale's validity was confirmed through confirmatory factor analysis, and its suitability for use in the Arabic environment was verified.

Pilot Study: The scale was applied to a random sample of 30 female high school students outside the research sample to ensure the clarity of the scale items and determine psychometric properties.

Verification of Item Discrimination*:* Item discrimination was verified by calculating Pearson correlation coefficients between each scale item and the total score on the scale (Mahmoud, 2019).

Table 3: Pearson Correlation Coefficients.

Items	Correlation coefficient	Items	Correlation coefficient
1	0.715**	7	0.636**
2	0.656**	8	0.506**
3	0.577**	9	0.660**
4	0.572**	10	0.833**
5	0.635**	11	0.778**
6	0.655**		

Note. ** Significant at the 0.01 Level.

Table 3 illustrates that the majority of correlation coefficients were significant at the level of (0.01), ranging between (0.506-0.833). This range indicates the strength of the relationship between the items (Pallant, 2020).

Reliability: The reliability coefficient was calculated using Cronbach's alpha, and the reliability

coefficient of the scale reached (0.869), indicating a high level of reliability (Abu Nahiah, 1994). It can be relied upon when applied to secondary school students.

Statistical Analysis Methods

Statistical Package for the Social Sciences (SPSS) was used to analyze the data, employing the following statistical methods:

Descriptive Statistics: This involved frequencies and percentages to describe the characteristics of the research sample, as well as means and standard deviations to understand the level of utilization by mathematics teachers of artificial intelligence applications and determine the level of mathematics anxiety among their students.

Pearson Correlation Coefficient: Used to calculate the relationship between research variables.

Cronbach's Alpha Test: Utilized to ensure the reliability of the tools and their dimensions.

Results & Discussion

Result Related to the First Question

The first research question addresses *" What is the level of mathematics teachers' use of artificial intelligence applications in teaching mathematics to secondary school female students?"*

Table 4 illustrates that the level of mathematics teachers' utilization of artificial intelligence applications in secondary education was moderate (*Mean* = 1.994, *Standard Deviation* = 0.404).

Table 4: Descriptive Statistics for the Level of Teachers' Utilization of AI Applications.

N	Mean	Standard Deviation
76	1.994	0.404

This result aligns with the findings of Al-Amri (2022) and Al-Habib (2022), which indicated that the use of artificial intelligence applications is at a moderate level. This contrasts with the results of Shin and Shin (2020), and Wang (2020), which pointed to a lower level of participation in using artificial intelligence applications in education. The reason behind the moderate use of artificial intelligence applications by teachers may be attributed to their adherence to traditional teaching approaches. Teachers often focus on delivering subject matter content in a traditional manner, adhering to predefined timelines. Moreover, the actual number of instructional days often does not align with the curriculum schedule, leading to the continued use of traditional teaching methods to cover the remaining curriculum. Additionally, most teachers are only trained in traditional teaching methods in teacher preparation colleges. Furthermore, the majority of training courses provided by the Ministry of Education are specialized only in scientific subjects, with a shortage of courses aimed at integrating artificial intelligence into mathematics education. Artificial intelligence is a modern technology in education that requires more training courses, workshops, awareness programs, and educational initiatives for its effective implementation in teaching.

Result Related to the Second Question

The second research question explores *"What is the level of mathematics anxiety among secondary school female students?"*

Table 5: Descriptive Statistics for the Mathematics Anxiety Scale.

N	Mean	Standard Deviation
361	2.836	1.088

Table 5 indicates the level of mathematics anxiety among secondary school female students, which is reported at a moderate level (*Mean* = 2.836, *Standard Deviation* = 1.088). This result suggests that students have a normal level of anxiety about mathematics. This finding is consistent with the results of Ambaranti and Retnowati (2019), and Alghamdi and Alghamdi (2019), which indicated a moderate level of anxiety among students about mathematics. However, it differs from the findings of Fares (2017), Mas (2021), and Al-Khezy and Al-Khezy (2021), which reported a high level of mathematics anxiety among students. The reason for this difference might be that secondary school female students are aware of the benefits and importance of mathematics for their university studies. Therefore, having some anxiety about mathematics is considered a natural concern experienced by any student whose academic fate and university major selection are influenced by their performance in mathematics during secondary school.

Result Related to the Third Question

The third research question explores "What is the correlation between the use of mathematics teachers for artificial intelligence applications and the mathematics anxiety level among secondary school female students?"

Table 6: The Results of the Correlation.

Variables	N	Mean	Standard Deviation	Correlation coefficient	p
Teachers' Utilization of AI Applications	76	1.994	0.404	0.057	0.623
Mathematics Anxiety among Female Students	361	2.836	1.088		

Table 6 indicates that the mean of mathematics teachers' use of artificial intelligence applications was (1.994) with a standard deviation of (0.404), while the mean of mathematics anxiety among secondary school female students was (2.836) with a standard deviation of (1.088). According to the Pearson correlation coefficient to assess the relationship between the variables, the results showed no statistically significant relationship between the variables (0.057) at a significance level of (0.05). In other words, there is no statistically significant relationship between teachers' use of artificial intelligence applications and the level of mathematics anxiety among secondary school female students in Kuwait. This result contrasts with the study by Yaftian and Barghamadi (2022), which indicated that the use of digital technology in mathematics education has an impact on reducing students' mathematics anxiety. It also differs from the study by Atoyebi and Atoyebi (2022), which analyzed previous studies and explained that technology-based methods in teaching mathematics encourage students to have a positive attitude and thereby reduce mathematics anxiety. The reason for the difference in the results of the current study from other studies may be that most previous studies did not address the relationship between the level of teachers' use of artificial intelligence applications and mathematics anxiety among female students. The focus of those studies was to uncover

the impact of technology on female students' mathematics anxiety. As for studying the relationship between the level of use and mathematics anxiety, the researchers found no similar study within their scope, giving the current study an advantage over others.

Conclusion

The current study aimed to assess the level of mathematics teachers' use of artificial intelligence applications in secondary education and its relationship with the anxiety levels of female students towards mathematics. The results indicated that secondary school mathematics teachers in Kuwait utilize mathematics applications to a moderate extent, and the mathematics anxiety levels among their female students were also moderate. The findings did not suggest a statistically significant relationship between the teachers' level of using artificial intelligence applications and the mathematics anxiety levels of their students. The study underlines the importance of providing mathematics teachers with a guide for using artificial intelligence applications, along with training them on its implementation during mathematics classes, as it plays a significant role in achieving various educational objectives efficiently. Furthermore, it suggests incorporating enrichment activities based on artificial intelligence applications into the mathematics curriculum to encourage teachers to utilize them in classroom sessions. Additionally, the study advises universities and colleges involved in teacher preparation to emphasize the training of future educators in employing artificial intelligence applications for teaching mathematics, including the integration of such applications in teaching methods courses within teacher preparation programs. The study also proposes conducting qualitative research to explore the apprehensions related to mathematics assessments in secondary education. Moreover, it suggests replicating the current research in other regions of Kuwait to verify the extent of teachers' use of artificial intelligence applications and their impact on the educational process.

Ethics Approval and Consent to Participate

The research was approved by the Ethics Committee of the Imam Abdulrahman Bin Faisal University (IRB Number: IRB-2023-15-615). The research was conducted in accordance with the Declaration of Helsinki.

References

Al-Abed, A., & Salha, S. (2014). The effect of using geogebra software on mathematical problem solving and mathematical anxiety among high basic stage students. *An-Najah University Journal for Research-Humanities*, *28*(11), 2473–2492.

Al-Amri, Z. (2022). The extent of the use of artificial intelligence applications in al-namas education schools from the point of view of female teachers. *Journal of the Faculty of Education - Tanta University*, *86*(2), 67-100. https://doi.org/10.21608/mkmgt.2022.121035.1168

Alghamdi, A., & Alghamdi, M. (2019). Mathematics anxiety and its relationship to the level of achievements of the students and their gpa in secondary school. *Journal of Scientific Research in Education*, *13*(20), 455–478. https://dx.doi.org/10.21608/jsre.2019.71286

Al-Habib, M. (2022). Employing artificial intelligence applications in training faculty members in saudi universities from the point of view of education experts. *The Journal of the Islamic University of Educational and Social Sciences*, (9), 277-317.

Alibraheim, E. (2021, January 22-26). *Attitudes towards mathematics: Confirmatory factor analysis for an arabic version of the short measurement instrument* [Paper presentation]. The (virtual) International Conference on Education in the Arab World: Problems and Solutions, Saudi Arabia.

Al-Khezy, F., & Al-Khezy, Y. (2021). Comparing the effectiveness of educational games and

gamification in reducing the level of anxiety and raising the level of motivation towards mathematics: an experimental study on fifth grade students in the state of kuwait. *Arab Journal for Educational and Social Studies,* (16), 5–43.

Al-Yagazi, F. (2019). Using artificial intelligence applications to support university education in saudi arabia. *Arab studies in education and psychology*, *113*(113), 259–282. https://doi.org/10.21608/saep.2019.54126

Ambaranti, F., & Retnowati, E. (2019). Exploring mathematics anxiety among senior high school students. *Journal of Physics: Conference Series*, *1200*, 1-6. http://dx.doi.org/10.1088/1742-6596/1200/1/012004

Atoyebi, O., & Atoyebi, S. (2022). Do technology-based approaches reduce mathematics anxiety? A systematic literature review. *International Journal of Research and Innovation in Social Science, VI*(X), 502-509. http://dx.doi.org/10.47772/IJRISS.2022.61027

Chen, X., Xie, H., Zou, D., & Hwang, G. (2020). Application and theory gaps during the rise of artificial intelligence in education. *Computers and Education: Artificial Intelligence*, *1*, 1-20. https://doi.org/10.1016/j.caeai.2020.100002

Fares, A. (2017). The relationship between mathematics anxiety and mathematics achievement for middle school students. *Journal of psychological and educational studies, 4*(16), 35-61.

Fryer, L., Nakao, K., & Thompson, A. (2019). Chatbot learning partners: Connecting learning experiences, interest and competence. *Jou Computers in Human Behavior*, *93*, 279–289. https://doi.org/10.1016/j.chb.2018.12.023

Hasan, A. (2006). *Psychometric properties of measurement tools in psychological and educational research using spss*. Educational Research Center.

Istikomah, E., & Wahyuni, A. (2018). Student's mathematics anxiety on the use of technology in mathematics learning. *Journal of Research and Advances in Mathematics Education, 3*(2), 69-77. https://journals.ums.ac.id/index.php/jramathedu/article/view/6364

Kariri, I. (2011). *The effectiveness of a proposed computer program of teaching mathematics in fourth graders achievement and mathematics anxiety reduction* [Master's thesis, King Khalid University]. Almandumah database.

Mahmoud, A. (2020). Artificial intelligence applications: An introduction to education development in the light of corona virus pandemic (covid-19) challenges. *International Journal of Research in Educational Sciences*, *3*(4), 171–224. http://dx.doi.org/10.29009/ijres.3.4.4

Mahmoud, S. (2019). Common mistakes in the procedures for verifying the reliability and validity of the measurement tools used in arab educational researche. *Journal of Faculty of Education, 35*(7), 671–695. https://mfes.journals.ekb.eg/article_103756.html

Mas, A. (2021). Level of mathematics anxiety at secondary school students in radfan destruct and its relationship with educational attainment on the light of gender and level of schooling. *Saudi Journal of Psychological Sciences*, (5), 63–76.

Mohamed, S. (2023). The effect of a program based on the dimensions of the technological cognitive framework "tpack" on developing the teaching competencies of the student teacher at the college of physical education. *Scientific Journal of Physical Education and Sport Sciences*, *31*(3), 1-27. https://doi.org/10.21608/sjes.2023.183989.1860

Naidoo, J., & Singh-Pillay, A. (2020). Exploring mathematics teachers' professional development: Embracing the fourth industrial revolution. *Universal Journal of Educational Research, 8*(6), 2501–2508. https://doi.org/10.13189/ujer.2020.080634

Okonkwo, C., & Ade-Ibijola, A. (2021). Chatbots applications in education: A systematic review. *Computers and Education: Artificial Intelligence*, *2*, 1-10. https://doi.org/10.1016/j.caeai.2021.100033

Oyaid, A., & Alshaya, H. (2020). *Educational technology foundations and applications* (3rd ed.). Rushd

Bookstore.

Pallant, J. (2020). *Spss survival manual: A step by step guide to data analysis using ibm spss* (7th ed.). Open University Press.

Saha, J., Ahmmed, S., Ali, M., Tamal, M., & Rezaul, K. (2020). ICT based mathematics skill development program: An initiative to overcome mathematics anxiety. *International Journal of Emerging Technologies in Learning (iJET), 15*(14), 252–261. https://doi.org/10.3991/ijet.v15i14.14149

Santos, J., & Castro, R. (2021). Technological pedagogical content knowledge (tpack) in action: Application of learning in the classroom by pre-service teachers (pst). *Social Sciences & Humanities Open, 3*(1), 1-8. https://doi.org/10.1016/j.ssaho.2021.100110

Shin, W., & Shin, D. (2020). A study on the application of artificial intelligence in elementary science education. *Journal of Korean Elementary Science Education, 39*(1), 117-132. https://doi.org/10.15267/keses.2020.39.1.117

Wan, A., & Ivy, J. (2018). Adding a new dimension of teaching mathematics educators. *Handbook of Research on TPACK in the Digital Age,* 390-412. https://aquila.usm.edu/fac_pubs/15770

Wang, L. (2020). Artificial intelligence and career development of college teachers: Challenge and countermeasures. *Journal of Physics Conference Series*, *1550*(2), 1-4. https://doi.org/10.1088/1742-6596/1550/2/022030

Yaftian, N., & Barghamadi, S. (2022). The effect of teaching using multimedia on mathematical anxiety and motivation. *Journal of Research and Advances in Mathematics Education*, *7*(2), 55-63. https://journals.ums.ac.id/index.php/jramathedu/article/view/16141

Yildirim, H., & Sensoy, O. (2018). The effect of science teaching enriched with technological applications on the science achievements of 7th grade students. *Journal of Education and Training Studies, 6*(9), 53–68. https://doi.org/10.11114/jets.v6i9.3363