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Integrating Artificial Intelligence in Mathematics Education: A Review of Teacher Perceptions, Student Outcomes and Ethical Considerations

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Abstract

Today, artificial intelligence (AI) is rapidly growing in the field of education. Because of this, teaching methods are changing, tests and assessments are being designed according to each student's needs and learning process has become easier and more interesting than before. AI is specially provided to be very helpful in mathematics. For example, there are systems that immediately tell students where they have made mistakes, continuously monitored their performance and provided lessons according to their level. In this way, every student can learn at their own pace and understand difficult concepts more effectively. This paper looks at how artificial intelligence (AI) is being used in Secondary School mathematics classes. It mainly explores what teachers think about AI, how it affects student learning and the ethical concerns that come with using it. Most teachers see AI has a helpful tool in the classroom. They believe it can make students more interested and involved in learning, help them solve maths problems more easily and give each student learning support based on their own needs. Teachers also feel that AI can improve students' academic performance, develop their critical thinking and increase their motivation to learn. However, there are still some challenges, many teachers do not receive enough training to use AI properly and some are not fully aware of how it works. There are also concerns about protecting students' data, possible bias in AI systems and the fact that not all schools and students have equal access to technology. Overall, the findings show that AI has great potential to

improve mathematics teaching, but its successful use depends on proper teacher training, awareness and fair access to technology. The findings highlight the need for ongoing professional development, institutional support and the alignment of AI tools with effective teaching practices. The paper concludes by offering practical recommendations for the responsible, inclusive and effective use of AI in mathematics education.

Keywords: Mathematics Education, Artificial Intelligence, Teacher, AI Integration.

1. Introduction

Artificial Intelligence (AI) continues to evolve in the field of education, bringing new instructional methods, assessments that adapt to individual student's needs, and ways to support for learning. Particularly in mathematics subject, AI technologies such as intelligent tutoring systems, automatic feedback generators, and adaptive learning platforms support to evaluate students' progress in real time, personalise learning and provide conceptual understanding to the students at their own pace. However, effective implementation of these technologies relies specially on teacher readiness, pedagogical compatibility and school support.

Several studies highlighted the evolving perspectives of mathematics teachers on using AI tools. Alhazzani (2024) used ChatGPT and developed a framework to facilitate creative teaching strategies and found moderate proficiency levels in teachers using these tools. Canonego (2024) has emphasized that student's self-efficacy and conceptual understanding have been significantly improved by using AI applications like GeoGebra. Other studies, such as by Taani and Alabidi (2024) found that for assessment design and problem explanation, teachers use ChatGPT. The other respondents also identify challenges such as accuracy and language limitations. Studies Owaba 2024 and Kim & Kin 2024 reported Limitations in teachers' preparedness and a knowledge gap in using digital mathematics textbooks along with AI. Broadly, the literatures present an increasing interest in AI- driven adaptive platforms, real-time assessment and personalised learning environments. Research by Cabero-Almenara et al. (2024) studied on the relationship in teacher beliefs and AI acceptance, revealing that constructivist beliefs strongly influence AI adoption.

Kaur et al. (2024) and Duraes et al. (2024) emphasized potential in AI's transformation but also found disparities in access and digital fluency. Melnyk (2024) and Zaman (2024) highlighted the ethical implications, while Zhunussov (2024) stressed the creation of clear AI integration policies. Artificial intelligence (AI) is a large and multidisciplinary field that creates intelligent and smart machines to do the tasks usually done by human beings (Mohamed et al., 2022). Several studies emphasized the evolving perspectives of mathematics teachers on AI tools in learning. Wardat et al. (2024) found that secondary school teachers in Abu Dhabi recognised AI's usefulness in enhancing student performance and personalizing instruction. AI is the field that develops designs, studies and develops algorithms, and also creates systems that can make choices on the basis of what they learn from their experience in their surroundings. All the various subfields apply different methods and approaches to make machines emulate or

simulate the cognitive actions of humans. An AI aims to develop smart systems that may work independently and adjust to different situations (Opesemowo & Adewuyi, 2024).

Objectives of the Study

1. To find out the research gap regarding the perspectives of mathematics teachers on the integration of AI in their teaching practices.
2. To find out the research gap regarding the potential of AI tools to enhance students' learning experiences and outcomes in mathematics education.
3. To find out the research gap regarding the ethical considerations and challenges associated with the implementation of AI in mathematics education.

Methodology

This study followed a qualitative literature review approach and examined the relevant research studies. The sources of these studies were academic data bases, institutional library archives and search engines including ResearchGate, Google Scholar, and Shodhganga. From wide range of scholarly publications, empirical studies and peer-reviewed literature findings were gathered on the use of Artificial Intelligence (AI) in Mathematics education. The main aim was to examine existing studies related to perception of teachers, students' learning outcomes and ethical issues concerning with AI adoption in Secondary School mathematics instruction. Using secondary source the data was gathered, such as conference proceedings, research papers and academic journal articles.

The literature was studied using content analysis method to find out recurring themes, trends and challenges. The reviews were objectively arranged to enable a systematic examination of the evidence under each of the stated objectives. This methodology enabled to gain a comprehensive understanding of the present state of AI in teaching mathematics subject, revealing both opportunities and limitations to its ethical and successful implementation.

4. Objective-wise Analysis of Reviews

In this section, a detailed analysis of the reviewed literature is presented, which is organised according to the three main objectives. In this way, categorising the review studies offer say clear understanding of the existing Research and addresses each is specific area of focus. These Structure Analysis keeps information about the benefits and limitations of AI in school settings, enabling decision making for future Research and practice.

4.1 (Objective 1): *To find out the research gap regarding the perspectives of mathematics teachers on the integration of AI in their teaching practices.*

Several studies are exploring mathematics teachers' perspectives on integrating AI into their teaching practices:

1. Bacilio, Pozo, Suarez, Asencio, & Campuzano (2025) Reported that teachers highlight the necessity of guiding AI used to word critical reflection and mathematical reasoning to prevent student from simply using it for automated answers. They emphasize that effective AI integration is entirely dependent on

- the teacher's ability to plan lessons that mediate between the technology and the learner.
2. Wardat, Tashtoush, & Saleh (2024) Found that teachers believe AI can enhance educating and learning and improve a student performance and the results of the study also indicated that AI can be incorporate as educational tool to enable educating and learning activities and development students' performance by incorporating AI system and its application into the curriculum.
 3. Alhazzani (2024) Proposes using the ChatGPT AI model to and secondary school mathematics teachers creative teaching competencies, this study makes Sence to promote creativity and efficacy among secondary school teachers, thereby posibally enhancing the quality of instruction and student learning in mathematics. The finding of the study pointed out the need of integrating ChatGPT' application of AI, into the classrooms.
 4. Owaba (2024) Indicates that preserve is teachers have low Awareness of AI base pedagogy in mathematics education.
 5. Ibrahim & Bello (2024) Highlight AI's potential to revolutionize mathematics teaching and learning but emphasize the need of for careful planning and a human centred design and the researchers also suggested that policy makers and ministries of education and mathematics teachers should maximize the benefits of artificial intelligence in mathematics teaching a learning process at all levels of education.
 6. Kim & Kim (2024) stated that secondary mathematics instructors recognise the need for AI digital textbooks but lack understanding and experience with core functionalities. Also, the present study submits the need for advanced teacher professional development to develop teachers' understanding also support practical implementation of AI in the classroom.
 7. Canonigo (2024) shows AI tools like GeoGebra and ChatGPT to increase conceptual understanding among the learners as well as self-efficacy in mathematics subject. The study recommends addressing these problems and challenges through other support resources and proper communication from stakeholders and emphasizes the need for thoughtful incorporation of AI in education.
 8. Panqueban & Huincahue (2024) reported that teacher notice AI as a potential tool, but many feel their existing pedagogical and content to knowledge (TPACK) is inadequate for smooth integration. According to the review, teachers often believe that their own qualitative suggestions are more nuanced and useful than those produced by AI tutors.
 9. Yousef, Tahtoush, & Jarrah (2023) Found that ChatGPT has superior mathematics capabilities. Also, the results of the investigation propose several avenues for research that should be explored specifically to guarantee the safe and conscientious integration of ChatGPT into mathematics education.
 10. Huma (2023) concluded that if the use of Artificial Intelligence increases among secondary school students, their school adjustment will also increase. that is artificial intelligence helps students in personal studies, making them

better in the school environment. AI tools improve students' learning speed and understanding, which increases their confidence and participation in school. In addition, students are more organised and motivated by collaboration with smart techniques, which positively affects their school adjustment.

11. Vankus (2024) Studied the usage of AI on mobile devices to enhance the preparation of prospective mathematics teachers and the researcher also highlights the opportunities of effective use of AI in various aspects of instructions and its temporal challenges that are likely to be mitigated by suitable technology developments.
12. Choi & Shim (2024) Suggest day incorporating AI mathematics related content into college course that is the curriculum should be divided into two subjects, Artificial Intelligence Mathematics 1 and Artificial Intelligence Mathematics 2, So that all students can choose and make the course according to their abilities and needs. This study also concludes that courses related to Artificial Intelligence and mathematics should have theory-oriented classes to understand the principles of artificial intelligence.
13. Saifi & Lal (2024) Demonstrate the digital story telling is more effective than traditional methods in teaching mathematics. students showed better understanding and engagement through story telling techniques. traditional methods were found to be less interactive and less impactful. Overall, digital storytelling enhances learning outcomes in math education.

4.2 (Objective 2): To find out the research gap regarding the potential of AI tools to enhance students' learning experiences and outcomes in mathematics education.

Several studies examine the usefulness of AI tools to improve student's learning experiences and outcomes:

1. Fernando Lara Lara (2025) discovered that in AI- integrated classrooms, the students are outperformed when compared to their peers particularly in problem-solving accuracy and participation. The research utilized intelligent tutoring systems and predictive analytics to provide a data-driven analysis of improved student achievement.
2. Joel I. Alvarez (2024) found that students using specialized AI tutors revealed notable improvements in calculus problem-solving when compared to the control group. The study highlighted that these tools support personalized learning of the students with their pace.
3. Seyum Getent (2024) stated that AI-based collaborative learning systems improve student's problem-solving abilities and promote social learning through real-time feedback, as evidenced by multiple recent trials.
4. Bin Mohamed et al. (2022) found that AI methods like robotics and intelligent tutoring system positively influence student's "critical thinking and problem-solving skills". This study also noted that AI show strong potential to improve mathematics learning, however, factors like high costs and effective integration strategies remain crucial challenges. This study recommends the need for further study in this area to gain comprehensive understanding of AI's effect on mathematics subject.

5. Lim et al. (2021) designed teaching and learning models and scenarios incorporating the AI tools to enhance the students' learning in the basic mathematical concepts. This study revealed the importance of innovative teaching methodology, particularly in elementary level education. The study pointed out, notable role of AI in developing effective teaching practices.
6. Wu (2021) found that when students were taught by using AI in teaching performed significantly better, their score (30) percent higher than those taught with the traditional methods. This suggests that the use of artificial intelligence into basic mathematics teaching is effective, which is proving important for mathematics learning and teaching the subject.
7. Orhani (2021) Mentioned that AI the improving the learning and development of students as well as the teaching work of teachers. artificial intelligence is establishing new dimensions in the field of education. students generally study mathematics in school education, consider it a difficult subject, but advancement in Computer technologies especially artificial intelligence have led to personalized diagnosis of students' learning problems and improved learning outcomes.
8. Jancarik, Novotna & Michal (2023) Designed and experimentally tested the possibility of using a series of Prepared mathematics problems of increasing difficulty for individual practice of algebraic expressions.
9. Shoufan (2023) stated that students appreciate the capabilities of ChatGPT and find it interesting, motivating and useful for study and educational work. However, this study pointed that students must be informed about its limitations. Teachers should try to use ChatGPT and lead the pupil on effective encouragement procedures and how to access the responses generated. The study give information about the “capabilities and limitations of ChatGPT” in learning and facilitates further research as well as development.
10. Melnyk (2024) Emphasizes that AI can enhance students' learning outcomes by boosting motivation, promoting self-education and offering personalized interactive learning experience.
11. Moi (2024) Says that artificial intelligence, if applied appropriately, can prove to be a game changer that provides a more engaging, simple, efficient and personalized learning experience.
12. Zhunussov (2024) Reveals that AI significantly benefited education by enhancing personalized learning, automated grading, intelligent tutoring and predictive analytics.

4.3 (Objective 3): To find out the research gap regarding the ethical considerations and challenges associated with the implementation of AI in mathematics education.

Several studies explore the ethical considerations and challenges linked with the implementation of AI in mathematics education:

1. Lara Lara (2025) work pointed out that the ethical concerns regarding data use and algorithmic transparency are paramount. Furthermore, this study brought to light a significant digital divide, where disparities are observed in AI access in

- socio-economic and geographical contexts could lead to inequitable education achievements in mathematics.
2. Canonigo (2025) Stated that the implementation of AI challenges traditional teacher authority and social connections. the paper suggests that without transparent communication and support resources, AI integration may result in difficulties related to pacing and a loss of human centric social interaction in the classroom.
 3. Yukyeong Song (2024) found that a major issue is students' over-reliance on AI, that can hamper original thought of the student and limit their social learning. The study also noted the potential for AI-generated content to include inappropriate or biased information, which could conflict with educational standards.
 4. Kaur et al. (2024) highlighted the significance of ethical considerations within the students' educational environment, especially concerning about the reduction of biases and promotion of equitable learning experience for every student. The researchers stressed that the responsible deployment of Artificial Intelligence is essential for navigating ethical dilemmas and potential difficulties in integration.
 5. Zaman (2024) pointed out the need for a careful approach when applying the AI in education, particularly concerning the risk and ethical challenges involved while using these tools. The research stresses that AI consider as a helping tool to support the teaching, not replace, human educators. Furthermore, AI integration requires careful consideration of data protection, need to check if there is any bias in AI systems, and required transparent decision-making process.
 6. Nawaz & Chain (2024) proposed a balanced approach that acknowledges the scope of generative AI, at the same time this study stressed for prioritizing ethical considerations and academic integrity. The researchers concluded that using 'generative artificial intelligence' in education represents an important change in teaching practice.
 7. de Oliveira Lima et al. (2024) Identify a lack of technical ability with resistance to change among educators as major obstacles in integrating AI into education. That is the study observed that, despite AI's benefits, overcoming these barriers requires collective efforts to Foster a culture of innovation and support technology adoption. comprehensive capacity building initiative are essential for fully realising AI's potential, leading to a more adoptable, inclusive and effective educational environment for all students.
 8. Alenezi (2024) Identify several challenges hindering the appropriate implementation of AI in educational situation, including lack of suitable educational materials, insufficient expertise in AI, and the complexity of the subject. the finding suggests that while there is optimism regarding AI role in education, more effort is needed to provide the usable resources, expertise and support to help educators integrate AI effectively.

9. Cukurova, Miao & Brooker (2023) Indicated that minimising work load, enhancing teacher ownership, establishing trust and addressing ethical concerns were essential in promoting AI engagement.
10. Mohamed and Ghazali (2023) Stated that continuous training is very important for teachers working in Secondary Schools. They believe that teachers should receive regular training so that they can improve their skills and face the educational challenges of the modern era. They also stated that future classrooms should be designed in a way that benefits not only students but also supports the professional growth of teachers.
11. Ilkka (2018) emphasized that proper planning and wise decision making are essential before integrating AI into education. According to the study, if AI is used in the right way, it can greatly help improve students' academic performance. However, at the same time, understand the challenge that may arise while using AI.

4.4 Findings

The reviewed studies suggest that mathematics subject teachers have mixed perceptions about use of AI in their classroom. While some educators are optimistic about using AI in their mathematics subject and view AI as a useful tool for make teaching more engaging, encourage creativity as well as improve student learning and bring new approaches into the teaching practices. For example, Bacilip (2025) argues that the successful AI depends on how teachers guide its use, so that it encourages and supports critical mathematical reasoning rather than simple answer copying. Wardat et al. (2024) and Alhazzani (2024) Highlight generally positive teacher attitude toward AI tools like ChatGPT for making instructions more creative. However, regarding awareness and understanding of teachers was pointed out. Owaba (2024) Notes low AI awareness among pre-service teachers, while Kim & Kin (2024) Identify teachers' lack of familiarity with digital AI tools like textbooks. There is also an expressed need for teachers training and pedagogical alignment with AI, as emphasized by Ibrahim & bello (2024). Panqueban (2023) found that while teachers see AI as promising, many feel their TPACK knowledge is insufficient and perceive their own qualitative feedback as superior to AI suggestions. Overall, while there is enthusiasm for AI, many teachers feel underprepared for its effective use.

AI tools have shown considerable promise in increasing students' participation, comprehension and academic achievement in mathematics. The examined reviews indicate that AI can facilitate personalized learning, boost learner motivation and cultivate critical thinking abilities. For example, Lara Lara (2025) discovered that classrooms integrating AI technologies, including tutoring systems and learning analytics, exhibited improved problem-solving accuracy and heightened student engagement relative to conventional methods. Likewise, Alvarez (2024) reported that AI-driven tutors, such as ChatGPT and Flexi 2.0, significantly improve calculus problem-solving skills through personalised and self-directed learning approaches. Gatenet (2024) Established that AI based collaborative systems boost problem solving skills and social learning by providing immediate, real-time feedback. Wu (2021) Found that students great improved by 30% when taught with AI based tools. Bin Mohammed

et al. 2022) and Lim et al. 2021) showed that AI methods such as robotics and intelligent tutoring systems enhance students' problem-solving skills and concept mastery. Additionally, Shoufan 2023) and Moi 2024) Found that students are more engaged and motivated when learning with tools like ChatGPT. These findings indicate that when AI is used appropriately it can make learning more personalised, interactive and useful.

The use of AI also brings some problems and concerns. The biggest issue is that many teachers are not yet fully prepared to use AI. Lara Lara (2025) pointed out that data transparency and the digital divide are still major concerns. This means that not only every student gets equal opportunities, because some have access to better internet and technology while others do not. Similarly, Canonigo (2025) mentioned, if AI is not used carefully, it can affect the teacher's role and the relationship between teachers and students. Song (2024) also explained that If students become too dependent on AI, their own thinking and creativity may decrease. In addition, AI can sometimes provide incorrect or biased information. de Oliveira Lima and other researchers (2024), Mohamed and Ghazali (2023), Kaur et al. (2024) and Zaman (2024) also stated that there are several ethical issues in the use of AI, such as the protection of students' data, bias information and unequal opportunities for everyone. Furthermore, many people hesitate to accept new technology, and in many places technical facilities are limited. Besides this, there are still no precise rules and guidelines for AI use. According to Nawaz and Chain (2024) AI should be used in a balanced way. In other words, one should certainly take advantage of AI, but at the same time one should also give importance to honesty, fairness and students' real abilities.

4.5 Summary of the Reviews

The reviewed literature collectively supports the increasing role of AI in mathematics education. Teachers responded a mix of excitement and reluctance. Reviews also revealed that the teachers' appreciation of AI in enhancing the creativity of the students, cater individual leaning needs, enhance student performance and provide understandable instructions. Several other studies revealed that the teachers' concerns are persist, especially related to inadequate training, lack of familiarity with AI tools and ethical issues such as protection of the data, possibility of potential bias also over-dependence on technology. While there is an agreement on AI's transformative potential, but the need for structured support and proper guidance remains evident.

5.0 Recommendations

It is important to focus on fostering computational thinking by guiding the students divide difficult tasks into small and manageable parts and use suitable algorithms for the successful use of AI in teaching. Teachers must carefully choose and use AI tools which may fit with pedagogical goals while carefully handle the possible bias. Student active involvement through AI based tasks such as simulation, coding and real-life problem-solving tasks is important for effective learning. Furthermore, teachers should promote the positive attitude about using AI, explaining the students to consider it as a supportive tool rather than an alternative for human abilities. Teachers should participate in Continuous Professional Development (CPD) or training programs by organising workshops and online courses to be updated with emerging AI

developments. Incorporating AI tools in the curriculum can strengthen the learning practice also prepare the students with required skills for their future. Additionally, AI has the capacity to develop required skills like ‘problem solving abilities and critical thinking’ in students for their future work place. Finally, successful AI integration in mathematics education requires collective contributions among educators, parents, stakeholders and policymakers to support useful and ethical integration of AI in teaching mathematics.

5.1 Research Gap

Although the use of AI is encouraging in mathematics teaching but, it is still restricted by several important factors. To begin with, dearth of large scale, and longitudinal studies in mathematics education, which makes it difficult to understand the lasting impact and continuity of AI-based intervention in mathematics teaching. Much of the current research depends on qualitative findings or self-reported teachers’ perceptions, which may not always provide fully accurate or complete picture. In addition, several studies are situation based which makes it difficult to apply their findings or generalize across different schooling system or cultural contexts. Some studies also lack in the empirical evidences and do not provide detailed information about the implementation of AI tools in the mathematics classrooms. Finally, the ethical concerns related to data protection, algorithmic bias and student autonomy are frequently discussed matters, they are often not thoroughly studied, this points a significant gap in the current studies which shows the need for more comprehensive research in this area.

5.2 Conclusion

Artificial Intelligence has notable possibility to transform mathematics teaching by making learning more personalized, adaptive and tailored according to the learning level of the student. This review analysis brings together various perspectives of mathematics teachers, exhibiting their enthusiasm and hesitation in using AI in their mathematics teaching. While many teachers appreciate AI’s use to improve creativity, tailor instruction to learner’s needs and reduce routine workload, others show concern about their level of preparedness or ability, ethical concerns and risk of overuse of technology. The findings confirms that AI can enhance student’s academic achievement, participation, confidence and motivation when used in interactive learning situation. It is also noted that AI is useful when given real-life problem-solving situations connected to students’ daily life activities. However, its usefulness mainly depends on how teachers effectively integrated these tools into their teaching and learning process. Successful integration of AI in mathematics teaching requires practical exposure through hands-on experience, ongoing professional development and require to update on latest developments in the technology are necessary for successful incorporation of AI in teaching process. At the same time, major challenges such as inadequate training of teachers, limited availability of empirical research and limited focus to ethical concerns need to be addressed appropriately. Meaningful use of AI in teaching needs collaborative efforts among teachers, parents, stakeholders and policymakers to support useful and ethical integration of AI in teaching mathematics. With careful planning and proper use, AI can transform mathematics teaching beyond conventional methods

toward a more interactive and student-centred approach. In doing so, it can help students develop their critical thinking, problem solving abilities and lifelong learning skills that are necessary for the 21st century.

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