ISSN–2278-5655

AMIERJ Aarhat Multidisciplinary International Education Research Journal

Volume–XV, Special Issues– I(a) Jan – Feb, 2026

OPEN ACCESS Original Research Article

AI IN MATHEMATICAL EDUCATION: A DOUBLE-EDGED SWORD

** Mrs. Jyoti Sagar Waghulkar*

** Assistant Professor, Model College, Dombivli .*

Abstract:

Mathematics has always been considered a tricky subject because of its abstract concept and lack of personalization in the conventional method of instruction. The fast-paced development of Artificial Intelligence (AI) has brought innovative approaches to the instruction of mathematics through intelligent tutoring, adaptive learning, automated testing, and generative AI technology. AI technology allows for personalization of instruction, instant feedback, and increased engagement of the learner, which makes the learning process efficient and increases the level of comprehension. Nevertheless, the pervasive use of AI technology poses important pedagogical and ethical concerns, making AI a double-edged sword in the instruction of mathematics. Specific objectives are: (i) the place of AI in facilitating teaching and learning of mathematics, (ii) challenges that come with the integration of AI in mathematics education, and (iii) how managing AI use can be done to avoid over-reliance on technology and ensure that children do not lose the ability for independent thinking. The study adopts a conceptual research methodology informed by a critical review and synthesis of recent literature on AI applications, educational models, and ethical considerations. It has been determined that while it true that AI improves or enhances personalization and efficiency of assessments and engagement, over-reliance on it might hamper problem-solving skills and critical or conceptual understanding. It can thus be concluded from this paper that AI should be used as an aid in pedagogy and it should be grounded in sound pedagogy and ethical foundations so that there could be an optimum use of it.

Keywords: *Artificial Intelligence, Mathematics Education, Personalized Learning, Intelligent Tutoring Systems, Ethical Concerns.*

Introduction:

Maths is a major field of knowledge that plays a significant part in logical thinking, scientific research, and the development of technology in the modern world. Nevertheless, a number of students have been struggling because of the abstract nature of maths ideas and the usual approach in the process of teaching maths (Boaler, 2022).. The use of artificial intelligence in the teaching process has been a revolutionary approach in dealing with the aforementioned problems associated with the teaching of mathematical subject matter (Holmes et al., 2022).

AI-based technologies, for example, intelligent tutoring systems, learning analytics, and generative AI applications, are being increasingly utilized for mathematical learning. Popular applications, for example, Photomath, Microsoft Math Solver, Symbolab, and Khanmigo, help students solve problems, visualize, and explain mathematical concepts. Nevertheless, along with these advantages, the following have attracted research-based study, for example, over-dependence, decreased independence, unethical usage, and loss of interaction between the teacher and students (Selwyn, 2023).

ISSN–2278-5655

AMIERJ Aarhat Multidisciplinary International Education Research Journal

Volume–XV, Special Issues– I(a) Jan – Feb, 2026

OPEN ACCESS Original Research Article

Thus, the purpose of the current study is to explore the role of AI in mathematics education and how it may be considered a double-edged sword.

Literature Review:

Recent literature has shown the increasing prominence of AI within mathematics education. For example, it is evident from studies that intelligent tutoring systems and adaptive learning platforms enhance student achievement through the personalization of instruction to meet individual learning needs (Hwang & Tu, 2021). These systems operate on models like Bayesian Knowledge Tracing, which will anticipate the mastery levels of learners in specific areas and adjust the content given appropriately (Rahman & Watanobe, 2023).

There has also been considerable investigation into the adoption of AI tool technology by teachers and students alike using TAM and the TPACK model. The perceived ease of use, usefulness, and educational alignments have been cited as essential in AI adoption as posited by a study by Zhai et al. in 2021.

However, there is equal caution exercised by researchers to prevent misuses. For example, overdependence on AI-generated solutions can lead to surface-level learning and decrease mathematical problem-solving abilities (Alimisis & Kynigos, 2022). Issues associated with data privacy, bias in algorithms, transparency, and academic dishonesty can cause added complexity when it comes to AI integration in education (UNESCO, 2023; Mhlanga, 2023). These serve as the basis for the prudent plea regarding the ethical integration of AI into mathematical education. Thus ,we can say that,AI has great potential to improve mathematics education with personalized and adaptive learning experiences that boost student achievement. However, successful adoption relies on how teachers and students view its usefulness, ease of use, and fit with teaching methods. There are also concerns about overreliance, ethical risks, data privacy, and bias in algorithms. These issues show the importance of careful and responsible use. Therefore, AI should serve as a supportive tool that enhances deep mathematical understanding, not as a replacement for human judgment and teaching skills.

Research Methodology:

For the current research, the research methodology that will be employed is conceptual research methodology. The research is grounded on the extensive review and synthesis of the relevant literature, including articles and publications on AI in the subject of mathematics. The research will be conducted by analyzing the different themes and challenges associated with the use of AI technology in the development of mathematics education.

Applications of Artificial Intelligence in Mathematics Teaching and Learning:

AI is being used in mathematical education through various applications that are used in both teaching and learning processes of mathematics.

Photomath is one of the most widely used artificial intelligence–based mathematics applications globally. It enables students to scan handwritten or printed mathematical problems and provides step-by-step solutions, supporting procedural understanding and independent learning (Wang & Cheng, 2024; Zhai et al., 2021).

Microsoft Math Solver offers AI-powered problem solving with graphical representations, definitions, and video explanations. The platform supports classroom instruction by visualizing complex mathematical concepts and encouraging conceptual clarity (Hwang & Tu, 2021; OECD, 2021).

Symbolab is extensively used from higher secondary to higher education levels. It provides detailed step-by-step solutions in algebra, calculus, and linear algebra, enabling both teachers and learners to understand multi-step problem-solving processes and symbolic reasoning (Alimisis & Kynigos, 2022; Wang & Cheng,

ISSN–2278-5655

AMIERJ Aarhat Multidisciplinary International Education Research Journal

Volume–XV, Special Issues– I(a) Jan – Feb, 2026

OPEN ACCESS Original Research Article

2024).

QANDA integrates artificial intelligence tutoring that allows students to upload questions and receive immediate explanations. Its adaptive learning features promote personalized support and efficient doubt resolution, improving learner engagement and academic performance (Tlili et al., 2024; Zhai et al., 2021).

Socratic by Google follows an inquiry-based learning approach, offering conceptual explanations and curated learning resources instead of direct answers. This supports higher-order thinking, conceptual understanding, and learner autonomy (Boaler, 2022; Selwyn, 2023).

Khanmigo, integrated with Khan Academy, employs generative AI and Socratic questioning techniques to foster reasoning, reflection, and metacognitive skills among learners (Holmes & Tuomi, 2022; UNESCO, 2023).

GeoGebra, often integrated with AI-supported environments, facilitates visualization and exploratory learning in geometry, algebra, and calculus. It enhances students' mathematical reasoning, dynamic modeling, and conceptual discovery through interactive simulations and intelligent feedback mechanisms (Alimisis & Kynigos, 2022; Hwang & Tu, 2021; Wang & Cheng, 2024

Findings Results :

The analysis of literature has unveiled the ensuing results AI has increased substantiated literacy by offering learners instructions that can be acclimated according to their requirements.

Artificial intelligence systems produce immediate constructive feedback. This enhances learning effectiveness.

Visualization ways enhance the understanding of abstract generalities in mathematics.

Depending too much on AI coffers might hinder the development of problem- working and critical thinking chops .

The ethical issues pertaining to the use of data, integrity, and bias are still round. Inequalities regarding the use of AI technology affect the digital peak in education.

Challenges in the Use of AI in Mathematics Education:

In malignancy of the advantages, there are a number of challenges that come on with use of AI in education such as inordinate reliance on AI Tools Performing in Superficial literacy, lack of logical thinking and fine mathematical creativity ,issues of ethics in plagiarism, data protection, and translucency also overdependency on these tools hence inability to explain reasoning , teacher student interaction will get reduced , also there will be inequitable access to digital infrastructure . These challenges bring to the fore for applicable and methodical use of AI in mathematical education.

Strategies for Effective and Ethical Use of AI in Mathematics Education Strategies for Effective and Ethical Use of AI in Mathematics Education

To exclude these challenges and guarantee the effective perpetration of AI, the following strategies can be espoused AI as a Supporting Agent: In Education AI must prop and not replace mortal tutoring (Selwyn, 2023).

Stress Abstract Understanding Encourages the assessment processes like logic, explanation, and operation. schoolteacher training for digital knowledge: It's needed to train preceptors on applying AI results to tutoring in ethical ways(Karsenti et al., 2019).

Ethical fabrics and University programs: There should be strict programs on using AI in an applicable way and should promote academic integrity(UNESCO, 2023).

Methodology in Blended Learning : This aids in connecting artificial intelligence and mortal commerce

ISSN–2278-5655

AMIERJ Aarhat Multidisciplinary International Education Research Journal

Volume–XV, Special Issues– I(a) Jan – Feb, 2026

OPEN ACCESS Original Research Article

and cooperation, hence promoting balanced cognitive development.

Enabling metacognitive reflection to fight the implicit debit of dependence on the system, the learners need to be encouraged to reflect on the manner in which the AI system is aiding them. The idea is to bring forth the eventuality of mortal intelligence and overcome dependence on artificial intelligence.

Discussion:

The results have reaffirmed the immense eventuality that AI has for the metamorphosis of mathematics literacy. The TAM (Total addressable market) and SAM (Serviceable addressable market) models are veritably salutary for the conceptualization of AI perpetration still, if AI is used in the absence of tutoring and moral oversight, it may have an injurious effect on the development of cognitive chops. AI and mortal tutoring should be judiciously blended in order for learning to do.

Conclusion: Artificial Intelligence harbors an effective and complex type of invention within mathematics education. For illustration, Artificial Intelligence results have been shown to have significantly contributed towards an enhancement in learning effectiveness and increased availability still, Artificial Intelligence has been shown to have contributed towards adverse issues in autonomy and applicable literacy ethics. This confirms that Artificial Intelligence within mathematics education is a binary-whetted brand. Artificial Intelligence has been shown to have significantly contributed towards supplementing mathematics education.

References:

1. *Alimisis, D., & Kynigos, C. (2022). AI-based tools and students' mathematical reasoning. International Journal of Mathematical Education in Science and Technology, 53(7), 1754–1770.*
2. *Boaler, J. (2022). Mathematical Mindsets (Revised ed.). Jossey-Bass.*
3. *Holmes, W., Bialik, M., & Fadel, C. (2022). Artificial Intelligence in Education: Promises and Implications. OECD Publishing.*
4. *Holmes, W., & Tuomi, I. (2022). State of the art and practice in AI in education. European Journal of Education, 57(4), 542–570.*
5. *Hwang, G. J., & Tu, Y. F. (2021). Roles and research trends of artificial intelligence in mathematics education. Computers & Education: Artificial Intelligence, 2, 100009. 6. Karsenti, T. (2019). Artificial intelligence in education: Preparing teachers. Formation et Profession, 27(1), 112–116.*
6. *Mhlanga, D. (2023). Ethical considerations in artificial intelligence and education. Journal of Digital Learning in Teacher Education, 39(1), 1–10.*
7. *OECD. (2021). Artificial Intelligence, Big Data and Education. OECD Publishing. 9. Selwyn, N. (2023). Should Robots Replace Teachers? Polity Press.*
8. *Tlili, A., Huang, R., Chang, T. W., et al. (2024). AI-driven educational tools and learning outcomes. British Journal of Educational Technology, 55(1), 28–47.*
9. *UNESCO. (2023). Guidance on Generative AI in Education and Research. UNESCO Publishing.*
10. *Wang, Y., & Cheng, L. (2024). Artificial intelligence applications in mathematics education. Eurasia Journal of Mathematics, Science and Technology Education, 20(3), em2364.*
11. *Zhai, X., Chu, X., Chai, C. S., et al. (2021). A review of AI in education. Education and Information Technologies, 26, 1–23.*

Cite This Article: ***Mrs. Waghulkar J.S. (2026).*** *AI In Mathematical Education: A Double-Edged Sword.* **In Aarhat Multidisciplinary International Education Research Journal**: Vol. XV (Number I, pp. 133–136). **Doi:** https://doi.org/10.5281/zenodo.18609990