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EFFECTIVENESS OF AI POWERED TOOLS IN TEACHING AND LEARNING MATHEMATICS: BASIS FOR AN INTERVENTION PLAN

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Abstract

This study examined the use of AI Mathematics tools to improve teaching and learning in solving parallelograms, trapezoids, and kites of Grade 9 students at Minabel Integrated School in Calayan East District, Cagayan. The main objective was to determine if the use of AI tools would enhance students' performance and classroom engagement. The study used a mixed-method design incorporating surveys, interviews, pre-tests, post-tests and classroom observations. The respondents included both teachers and their students who were purposively sampled. Descriptive and inferential statistical methods were used in the analysis. The results showed that the use of tools like Cici, Photomath, and ChatGPT enhanced students' problem-solving skills, motivation and conceptual understanding. Further, teachers observed an increase in student engagement and ability to use AI tools to improve their instruction but needed a training in AI technology. Lastly, the use of AI tools can improve math instruction if used correctly. Thus, implementing a professional development focusing on practice with AI tools to reduce knowledge and skills gaps, training students on the responsible use of it, investing infrastructure and ethical policy development must be created. Moreover, the findings proposed project A.I.M. which promotes equity access to support AI practice for digital literacy in the curriculum.

Keywords: *AI Powered Tools, Mathematics Education, Mathematics AI tools, Intervention plan*

INTRODUCTION

A major issue in mathematics education is students' weak foundational skills, which hinder academic success and everyday problem-solving. Even when students grasp mathematical concepts, they often struggle with applying them effectively. Incorporating visuals and technology has been shown to boost motivation and engagement, making learning more enjoyable. Additionally, AI-based tools enhance both teaching and learning by providing personalized feedback and support.

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Although the advantages of AI in learning are well-evidenced, there are as yet unknowns about its ultimate effect on learning outcomes for students. There is uncertainty about the extent to which AI can really respond to differences in learning style and pace and whether it will be able to fundamentally change the way students see mathematics. Further, the possibility of technology dividing and data security issues must be confronted to maintain access equity and successful implementation. According to Ahuja (2023) and Memon & Memon (2024) stated that the digital divide significantly affects educational opportunities, necessitating investments in infrastructure and digital literacy to promote equity in learning environments. Thus, effective collaboration between public and private sectors hinges on secure data sharing practices, which are essential for addressing public health and financial challenges and the design of digital surveillance technologies must prioritize fairness and inclusivity to avoid exacerbating existing inequities as what Devineni (2023) and Pratt et al. (2022) elaborated.

At Minabel Integrated School, students struggle with complex mathematical concepts such as solving problems involving parallelograms, trapezoids, and kites—often reflected in poor test performance. Limited access to modern technology on the island poses challenges for both teaching and learning. However, with Starlink providing internet connectivity, integrating AI-enabled tools can help bridge educational gaps. These tools offer visual aids, real-time feedback, automatic grading, and lesson planning support—resources that educators previously lacked. This allows teachers to focus more on engaging, interactive instruction. In a setting with scarce traditional resources, AI-facilitated tools present a vital opportunity to enhance students' understanding and improve overall math instruction.

Teachers at Minabel Integrated School observed that students struggle with solving problems involving parallelograms, trapezoids, and kites. They believe that AI tools—such as interactive simulations and game-based platforms—can make these complex topics more engaging and accessible. AI can also handle routine tasks like grading, allowing teachers to focus on personalized instruction. With in-depth analytics, AI identifies students' learning gaps, enabling targeted interventions. Mane & Jagtap (2024) found that AI platforms support collaborative learning, allowing students to work together on problem-solving activities and share insights. By adapting content to individual learning styles, AI enhances both student engagement and comprehension, fostering a more effective and supportive learning environment.

Students report greater fascination and engagement when math is taught using visual and technology-enhanced methods. They appreciate the immediate support from AI-enabled tools, which helps them learn and retain math more effectively. Marikyan (2023) highlights that visuals increase engagement and motivation, making learning enjoyable. AI chatbots and virtual mentors offer 24/7 assistance, benefiting students with irregular schedules, as noted by Abernathy (2024). This continuous, personalized support helps overcome limited access to in-person tutoring, addressing learning gaps and enhancing math skills. AI tools thus improve teaching and learning, making math more accessible and engaging at Minabel Integrated School.

By integrating these identified predicaments, this study aims to assess the effectiveness of AI-powered mathematics tools in enhancing the teaching and learning of Grade 9 students at Minabel Integrated School, particularly in solving problems involving parallelograms, trapezoids, and kites. By incorporating the experiences of both teachers and students, it seeks to provide a comprehensive understanding of AI's impact in the classroom. The research also aims to address existing gaps and uncertainties, offering insights that could inform strategies and interventions to improve mathematical proficiency and academic performance, especially in tackling complex geometric concepts.

Generally, this study sought to evaluate the effectiveness of AI-powered mathematics tools in teaching and learning mathematics at Minabel Integrated School.

Specifically, it sought to answer the following questions:

1. What are the AI tools used by mathematics teachers according to:
   a. symbolic computation tool
   b. numerical computation tool
   c. machine learning-based mathematics tool
   d. geometric and visualization tool
   e. research and discovery
   f. natural language processing
2. How do teachers and learners assess the effectiveness of the AI tools?
3. What is the attitude of teachers and learners towards the use of AI tools in mathematics?
4. What are the challenges of the students and teachers in using AI tools in mathematics?
5. Is there a significant difference in the pre-test, post-test and gain scores of experimental and control groups?
6. What intervention plan can be proposed for students and teachers to effectively use AI tools in mathematics?

Conceptual Framework

This study explores the impact of AI-powered tools in mathematics on students' academic performance and their potential to enhance 21st-century skills for both teachers and learners. While technology use in education has shown positive outcomes, research on AI tools remains limited and sometimes conflicting, especially in the context of Calayan, Cagayan. Thus, further investigation is needed to clarify their effectiveness and inform education policies. Grounded in Constructivist Theory, which emphasizes learning through active engagement and experience, AI tools like GeoGebra and Desmos promote interactive exploration and visualization of mathematical concepts. These platforms foster deeper understanding, critical thinking, and real-world problem-solving—making them powerful supports for meaningful, student-centered learning in mathematics.

The Technology Acceptance Model (TAM), developed by Davis (1989), emphasizes that the perceived usefulness and ease of use of technology significantly influence its acceptance and utilization. AI-powered tools in mathematics, such as Photomath and ALEKS, are designed to be user-friendly and highly beneficial, thus encouraging both students and teachers to integrate them into their learning and teaching processes. The ease of access to instant feedback and personalized learning paths provided by these tools enhances students' motivation and engagement, leading to improved academic outcomes. TAM stresses the need for designing AI tools that are intuitive and effective so that they can be widely adopted in educational environments.

The Unified Theory of Acceptance and Use of Technology (UTAUT) supports AI tool adoption by highlighting factors such

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as performance and effort expectancy, social influence, and facilitating conditions. In math education, AI enhances student-centered learning and improves performance. Support from colleagues and proper infrastructure further strengthens effective implementation. Integrating AI also aligns with UNESCO's SDG 4 by promoting inclusive, equitable, and quality education. Adaptive AI technologies tailor learning to individual needs, bridging gaps and enabling lifelong learning. Thus, AI in education not only improves teaching and learning outcomes but also advances global goals for accessible and continuous education for all.

These AI tools further improve the process of teaching as they give the teachers some insights about their students' performances and learning trends. It can look through enormous amounts of data and provide some patterns or trends on the places that may need additional support so the teachers could personalize the instruction more. AI tools free up teachers' time by automating administrative tasks such as grading and lesson planning, allowing them to focus more on direct student interaction and personalized instruction. This improves teaching efficiency and enhances the overall learning experience for students.

AI-powered tools are strongly supported by educational theories like Constructivism, TAM, UTAUT, and global frameworks such as UNESCO's SDG 4, promoting personalized, adaptive, and engaging learning in mathematics. National policies, including DepEd Orders No. 78 (2010), No. 50 (2009), No. 46 (2011), the MATATAG Agenda, RA 10533, and RA 10929, also advocate for technology integration to ensure inclusive and quality education. AI not only enhances student achievement but also supports teachers by providing performance insights and automating tasks. As technology evolves, AI's role in reshaping education continues to grow, advancing the goal of accessible, high-quality learning for all.

METHODOLOGY

This study employed a quasi-experimental design integrating both qualitative and quantitative approaches to assess the effectiveness of AI-powered mathematics tools at Minabel Integrated School, Calayan, Cagayan. The participants included 305 students and 15 Mathematics teachers, divided into experimental and control groups. Total enumeration sampling was used for identifying all Grade 9 students officially enrolled during SY 2024–2025, along with current Mathematics 9 teachers.

Data collection methods included pre-tests, post-tests, surveys, questionnaires, interviews, observations, and focus group discussions. Descriptive statistics (frequency, percentage, mean, standard deviation) were used to describe AI tools used, their perceived effectiveness, and user attitudes. Inferential statistics—including paired sample t-tests, independent sample t-tests, ANOVA, and chi-square tests—analyzed significant differences in scores and relationships between variables.

Survey instruments were adapted and modified from Dabingaya (2022), Mohamed et al. (2022), and Yi et al. (2024). The tools included 30 items evaluating AI tool effectiveness (15 for teaching, 15 for learning) and 40 items assessing attitudes toward AI (20 for teachers, 20 for students). A semi-structured interview captured challenges experienced, and responses were analyzed thematically. Triangulation was ensured through focus group discussions for data validation.

Written permission from the Schools Division Office of Cagayan was secured. The researcher personally administered and collected the data, which was encoded and cleaned in Excel for accuracy. Findings informed the development of an intervention plan to enhance AI integration in mathematics education.

Frequency count and percentage distribution were used for the data on the respondents' profile and the AI powered tools used in teaching and learning mathematics. In assessing the effectiveness of AI powered tools in the teaching and learning mathematics, weighted mean was applied using the 4-point Likert Scale. The interval and interpretation of the scale are as follows:

Scale	Range	Response	Interpretation
4	3.25 – 4.00	Strongly Agree	Highly Effective
3	2.50 – 3.24	Agree	Effective
2	1.75 – 2.49	Disagree	Not Effective
1	1.00 – 1.74	Strongly Disagree	Highly Not Effective

Likewise, in assessing the attitude of teachers and students on the use of AI powered tools in teaching and learning mathematics, weighted mean was applied using the 4-point Likert Scale. The interval and interpretation of the scale are as follows:

Scale	Range	Response	Interpretation
4	3.25 – 4.00	Strongly Agree	Very Positive Attitude
3	2.50 – 3.24	Agree	Positive Attitude
2	1.75 – 2.49	Disagree	Negative Attitude
1	1.00 – 1.74	Strongly Disagree	Very Negative Attitude

Further, a semi-structured interview was used to determine the challenges encountered by the teachers and students on using AI powered tools in teaching and learning mathematics. Likewise, a thematic analysis was used to code and transcribe the identified key themes and patterns based on the identified challenges. Further, triangulation through focus group discussion was utilized.

Likewise, a paired sample t-test was used to determine the significant difference in the pre-test, post-test and gain scores of experimental and control groups. Moreover, through analysis of the data collected on this study, an effective intervention plan was crafted and proposed.

RESULTS AND DISCUSSION

This study discusses the effectiveness, perceptions, and challenges of using AI-powered tools in mathematics education at Minabel Integrated School, while exploring differences in student performance and proposing an intervention plan to enhance AI tool integration for both teachers and learners.

AI tools used by Mathematics Teachers

Table 1 reveals that Cici is the most versatile AI tool, used across all six categories, while Photomath focuses on symbolic, numerical, and machine learning tasks, and ChatGPT supports research and natural language processing. This suggests teachers select tools based on their strengths. However, Roshan et al. (2024) found 70% of teachers lack AI-related professional development. Ruslim & Khalid (2024) and Magat & Sangalang (2024)

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emphasize the urgent need for targeted training, as many educators are unfamiliar with AI tools like ChatGPT. Schools must provide ongoing training and resources to boost teacher confidence and enhance student learning.

Table 1. Summary of AI Tools used by Teachers according to Categories

Categories on AI Usage	AI Tools Use
a. symbolic computation tool	Photomath, Cici
b. numerical computation tool	Photomath, Cici
c. machine learning-based mathematics tool	Cici, Photomath
d. geometric and visualization tool	Cici
e. research and discovery	ChatGPT, Cici
f. natural language processing	ChatGPT, Cici

Teachers' and learners' assessment on the effectiveness of the AI tools

Table 2a shows teachers rate AI tools as very effective in teaching math (mean = 3.73), praising their role in explaining concepts, engaging lessons, saving time, and improving student performance (all rated 4.00). Some areas, like feedback precision and tailored learning, scored slightly lower (3.00), indicating room for improvement. Torres-Peña et al. (2024) noted AI tools enhance understanding of complex topics, while Matere (2024) emphasized the need for professional development due to educator unfamiliarity. Mustafa (2024) and Noakes et al. (2024) stress ongoing research and strategic investment to optimize AI's educational impact.

Table 2a. Teachers' assessment of the effectiveness of the AI tools

Statement	Weighted Mean	Descriptive Interpretation
1. AI-powered tools help me explain complex mathematical concepts to students.	**4.00**	Highly Effective
2. The use of AI tools makes my mathematics lessons more engaging.	**4.00**	Highly Effective
3. AI tools provide accurate and reliable solutions to mathematical problems.	**3.00**	Effective
4. I feel more confident in my teaching abilities when using AI tools.	**3.00**	Effective
5. AI-powered tools save time in preparing and delivering mathematics lessons.	**4.00**	Highly Effective
6. The feedback provided by AI tools is helpful and constructive for students.	**3.00**	Effective
7. AI tools enhance students' problem-solving skills in mathematics.	**4.00**	Highly Effective
8. I find AI-powered tools easy to integrate into my teaching practices.	**4.00**	Highly Effective
9. AI tools help students visualize mathematical concepts better.	**4.00**	Highly Effective
10. The use of AI tools improves students' overall performance in mathematics.	**4.00**	Highly Effective
11. AI-powered tools are effective in providing personalized learning experiences for students.	**3.00**	Effective
12. Students are more motivated to learn mathematics when using AI tools.	**4.00**	Highly Effective
13. AI tools help students identify and correct their mistakes in mathematics.	**4.00**	Highly Effective
14. The integration of AI tools in mathematics classes is beneficial for both teachers and students.	**4.00**	Highly Effective
15. I would recommend the use of AI-powered tools to other teachers and educators.	**4.00**	Highly Effective
Overall weighted mean	**3.73**	Highly Effective

Table 2b shows students rate AI tools as highly effective in learning math (mean = 3.40), highlighting benefits in understanding concepts (3.60), engagement (3.28), and confidence (3.28). They appreciate time-saving, helpful feedback, ease of use, and personalized learning. However, problem-solving (3.20), visualization (3.16), and overall performance (3.16) scored slightly lower, suggesting room for deeper learning improvements. Sari et al. (2024) and Senanayake et al. (2024) found AI tools improve performance and engagement but often focus more on gamification than critical thinking, sometimes leading to surface-level understanding rather than deep conceptual grasp.

Table 2b. Students' assessment on the effectiveness of the AI tools

Statement	Weighted Mean	Descriptive Interpretation
1. AI-powered tools help me understand complex mathematical concepts.	**3.60**	Highly Effective
2. The use of AI tools makes learning mathematics more engaging.	**3.28**	Highly Effective
3. AI tools provide accurate and reliable solutions to mathematical problems.	**3.56**	Highly Effective

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4. I feel more confident in my mathematical abilities when using AI tools.	**3.28**	Highly Effective
5. AI-powered tools save time in solving mathematical problems.	**3.60**	Highly Effective
6. The feedback provided by AI tools is helpful and constructive.	**3.48**	Highly Effective
7. AI tools enhance my problem-solving skills in mathematics.	**3.20**	Effective
8. I find AI-powered tools easy to use and navigate.	**3.40**	Highly Effective
9. AI tools help me visualize mathematical concepts better.	**3.16**	Effective
10. The use of AI tools improves my overall performance in mathematics.	**3.16**	Effective
11. AI-powered tools are effective in providing personalized learning experiences.	**3.40**	Highly Effective
12. I am motivated to learn mathematics when using AI tools.	**3.32**	Highly Effective
13. AI tools help me identify and correct my mistakes in mathematics.	**3.40**	Highly Effective
14. The integration of AI tools in mathematics classes is beneficial.	**3.56**	Highly Effective
15. I would recommend the use of AI-powered tools to other students and teachers.	**3.60**	Highly Effective
Overall weighted mean	**3.40**	**Highly Effective**

Attitude of teachers and learners towards the use of AI tools in Mathematics

Table 3a shows teachers generally have a positive attitude toward AI in mathematics (mean = 3.15), valuing its role in teaching, administration, and personalized learning (all 4.00). They support AI education and professional development but express concerns about privacy, equity, and AI's impact on jobs (3.00). Some teachers remain skeptical about AI's classroom use and formative assessment (as low as 1.00). Tilepbergenovna (2024) highlights AI's potential to boost engagement and clarify concepts, while Kotsis (2024) warns of privacy risks and inequality. Effective training and ethical guidelines are essential for successful AI integration.

Table 3a. Attitude of teachers towards the use of AI tools in Mathematics

Statement	Weighted Mean	Descriptive Interpretation
1. I look forward to using AI-tools in my teaching	**4.00**	Very Positive Attitude
2. AI gives me hope for the future	**4.00**	Very Positive Attitude
3. The use of AI worries me and makes me scared	**3.00**	Positive Attitude
4. There is a risk that AI will increase inequality in the classroom	**3.00**	Positive Attitude
5. AI can make future teachers unemployed	**4.00**	Very Positive Attitude
6. I think that a good student could get new challenges from using AI-tools	**1.00**	Very Negative Attitude
7. I consider all this talk of how AI will change society is exaggerated	**2.00**	Negative Attitude
8. AI will in the future support and make a teacher's work easier	**4.00**	Very Positive Attitude
9. Adaptive and individualizing teaching material will be a valuable resource in the classroom	**4.00**	Very Positive Attitude
10. AI-tools are not suitable for the formative assessment of student learning	**2.00**	Negative Attitude
11. It is important for students in school to come into contact with and learn about AI	**4.00**	Very Positive Attitude
12. AI and the gathering of data will intrude on the personal integrity of the student	**3.00**	Positive Attitude
13. I do not follow the discussions concerning AI in society or school	**1.00**	Very Negative Attitude
14. I would like to participate in continuing education and projects focusing on AI in school	**4.00**	Very Positive Attitude
15. I would not use a social robot in my classroom	**1.00**	Very Negative Attitude
16. Students would quickly adapt to a social robot	**4.00**	Very Positive Attitude
17. I regularly use AI-tools outside of school (ex. Siri, Google translate...)	**3.00**	Positive Attitude
18. It is hard for me to see that I would start using AI-tools in	**4.00**	Very Positive

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my teaching		Attitude
19. An AI can be used to offer differentiated and individualized learning	**4.00**	Very Positive Attitude
20. I look forward to using AI-tools in my administrative workloads.	**4.00**	Very Positive Attitude
Overall weighted mean	**3.15**	**Positive Attitude**

Table 3b reveals students' generally positive attitude toward AI tools in mathematics (mean = 3.04), showing enthusiasm for using AI in learning and homework (3.58, 3.74) and appreciating its role in personalized and adaptive learning (3.36–3.44). However, some students expressed anxiety (2.36), concerns about privacy (2.74), inequality (2.76), and uncertainty about AI's impact and use (2.82–2.84). Kohnke & Zaugg (2025) and Maulida et al. (2024) highlight AI's potential to improve accessibility, especially for underrepresented groups, but emphasize the need to address uneven access, privacy, and ethical issues through collaboration among educators, developers, and policymakers.

Table 3b. Attitude of learners towards the use of AI tools in Mathematics

Statement	**Weighted Mean**	**Descriptive Interpretation**
1. I look forward to using AI tools in my math studies.	**3.58**	Very Positive Attitude
2. AI tools make learning math more interesting and engaging.	**3.28**	Very Positive Attitude
3. The use of AI tools in math worries me and makes me anxious.	**2.36**	Negative Attitude
4. There is a risk that AI tools will increase inequality among students.	**2.76**	Positive Attitude
5. AI tools can replace traditional math teaching methods.	**2.82**	Positive Attitude
6. I think that AI tools can provide new challenges for good students.	**3.26**	Very Positive Attitude
7. I consider the impact of AI on education to be exaggerated.	**2.84**	Positive Attitude
8. AI tools will support and make learning math easier in the future.	**3.42**	Very Positive Attitude
9. Adaptive and individualized learning materials are valuable resources.	**3.36**	Very Positive Attitude
10. AI tools are not suitable for assessing my learning progress.	**2.54**	Positive Attitude
11. It is important for students to learn about and use AI tools.	**3.52**	Positive Attitude
12. AI tools and data collection intrude on my personal privacy.	**2.74**	Positive Attitude
13. I do not follow discussions about AI in education or society.	**2.48**	Negative Attitude
14. I would like to participate in projects focusing on AI in education.	**3.26**	Very Positive Attitude
15. I would not feel comfortable using a social robot in my studies.	**2.40**	Negative Attitude
16. Students would quickly adapt to using a social robot.	**3.18**	Positive Attitude
17. I regularly use AI tools outside of school (e.g., Siri, Google Translate).	**3.40**	Very Positive Attitude
18. It is hard for me to see how I would start using AI tools in my studies.	**2.42**	Negative Attitude
19. AI can be used to offer differentiated and individualized learning.	**3.44**	Very Positive Attitude
20. I look forward to using AI tools to help with my math homework.	**3.74**	Very Positive Attitude
Overall weighted mean	**3.04**	**Positive Attitude**

Challenges of the teachers in using AI tools in mathematics

The use of artificial intelligence (AI) tools in mathematics instruction offers both exciting possibilities and significant challenges to teachers and students alike. While AI can potentially revolutionize traditional instruction, increase student interest, and tailor learning experiences to individual needs, its use comes with challenges. Teachers and students are faced with a fast-changing technology landscape that requires not just technical skills but also critical thinking and flexibility. These issues are typically framed by differing degrees of digital literacy, resource access, and institutional backing. Several key themes regarding the challenges teachers face in using AI tools in mathematics instruction emerged.

Theme 1. Experience and Familiarity

The first theme is **experience and familiarity**. With the changing education scenario, a teacher's comfort level with digital technologies, particularly AI, is a determining factor for effective classroom adoption. Teachers who are comfortable and skilled in employing AI are likely to investigate its complete potential and urge students to follow suit. It is useful to know how teachers view and manage AI tools as it indicates their preparedness and flexibility in an AI-driven learning environment.

Participant: "I have been using AI even before it became popular, navigating AI tools were became easy in my part. We can't deny the fact that most of the students hated mathematics because they find it boring."

Participant: "I use AI tools every in every group activity of my students in order for them to familiarized not just the tools but the topic as well."

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The teacher's early and consistent use of AI tools has enhanced their confidence and ease in integrating them into instruction, particularly in group activities to support math learning and digital fluency. This aligns with Roshan et al. (2024), who noted that initial exposure significantly impacts teacher confidence, as only 5% report feeling highly capable with AI. Similarly, Aga et al. (2024) and Moorhouse & Kohnke (2024) emphasized that regular AI use fosters comfort and deeper understanding, enabling more effective pedagogical integration. Continuous engagement with AI tools thus strengthens instructional strategies and promotes more meaningful learning experiences.

Theme 2. Training and Support

The second theme is **training and support**. Successful integration of AI in education largely relies on training quality and availability for teachers. Professional development must prepare educators with technical competences as well as pedagogical approaches to harness AI effectively. Investigating teachers' experiences during training indicates whether existing support structures are adequate or need enhancement.

Participant: "Our SDO has its group called ICT on WHEELS, this group of IT expert teachers provides a relevant training on integrating AI on education especially in the classroom setting."

Participant: "Since I already have backgrounds on some of their topic, I can say that it was sufficient."

The teacher credited the "ICT on Wheels" training for enhancing their AI proficiency, though its effectiveness was amplified by prior experience. This highlights the need for differentiated professional development. Generic training may not suit all, especially those with limited AI exposure. Roshan et al. (2024) and Kitcharoen et al. (2024) noted that 70% of teachers lacked AI-related training, correlating with low confidence levels. Targeted programs like AIoT-PD significantly improved competencies, showing that modular, tiered training can bridge gaps. Continuous support and follow-up sessions are essential for reinforcing learning and addressing emerging challenges across varying skill levels.

Theme 3. Implementation Challenges

The third theme centers on **implementation challenges**. While AI has kept a promise in learning, its use in the classroom comes with challenges. Teachers face technical constraints, content errors, or student misunderstandings when applying AI tools. Recognizing these difficulties aids in honing both the tools and the teaching methods that accompany them.

Participant: "The only challenge I found hard in in integrating AI tools in my math class is that some of the answers provided by the AI was a bit confusing and inaccurate. And it is pretty handle. Because if this happened, my students immediately ask me to say that there is something on the provided answer."

Participant: "I am more confident that they are even more engaging in learning because they are not just using the AI tools to provide answer, but they are using it in checking their answers if it is correct or not. There are using AI to verify their answers."

The teacher viewed occasional AI inaccuracies not as setbacks but as opportunities to foster critical thinking. Students were encouraged to validate AI responses, deepening their understanding and promoting active engagement. This strategy transformed AI errors into valuable teaching tools. Oh & Ahn (2024) noted that AI's inability to grasp emotional nuance can spark reflective discussions, while Folmeg et al. (2024) emphasized using AI mistakes to drive collaborative problem-solving. Thus, integrating critical assessment of AI outputs into classroom strategies helps build analytical skills and encourages students to question, evaluate, and refine their understanding rather than passively consume information.

Theme 4. Ethical Bias Concerns

The fourth theme involves **ethical and bias concerns**. As AI continues to become more integrated into education, ethical issues such as data privacy, algorithmic bias, and proper use grow in significance. Teachers are largely responsible for educating students on ethical AI practices and ensuring technology enhances learning, not facilitates its erosion. A look at how teachers manage these issues provides insight into the measures required for effective AI integration.

Participant: "Potential biases is always there, so what I always did was to remind my students that AI should be just a checker and not the giver of answer."

Participant: "I always give guidelines like in every problem I only give them 2 minutes or less and emphasize the responsible use of it."

The teacher addressed AI bias by promoting ethical use, setting time limits, and emphasizing AI as a supportive tool rather than a solution provider. Clear classroom protocols fostered responsible use, reflecting the need for ethical AI integration. Leta & Vancea (2023) stressed ethical frameworks to ensure fairness, while Mubofu & Kitali (2024) emphasized teacher training in data privacy and transparency. Meylani (2024) advocated AI literacy among educators. These findings suggest that embedding digital citizenship and ethics into teacher preparation and student instruction is essential to harness AI's benefits while safeguarding educational integrity.

Comparison test results in the pre-test, post-test, and gain scores of the experimental and control groups

The results in Table 5a reveal that the control group, which did not use AI tools, showed a statistically significant improvement from pre-test (M = 14.24, SD = 2.98) to post-test (M = 16.00, SD = 3.49), with a t-value of 2.971 and a p-value of 0.00665 ($p < 0.05$). This suggests that even without AI integration, conventional teaching methods enhanced students' performance in solving problems involving parallelograms, trapezoids, and kites. This aligns with Şan & Kış (2018), who found traditional geometry instruction significantly boosts achievement (effect size = 0.83, $p < 0.001$), and Fitriana & Waswa (2024), who confirmed that conventional methods improve problem-solving skills.

Table 5.a. Comparison test results between the pretest and posttest scores of the respondents on control group

Variables	Mean	SD	t-value	p-value	Inference
Pretest	14.24	2.98	2.971	0.00665	Significant
Posttest	16.00	3.49			

**tested at 0.05 level of significance*

Table 5b reveals a substantial improvement in the experimental group's scores, with a pre-test mean of 14.24 (SD = 2.42) and a

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post-test mean of 25.28 (SD = 5.75). The t-value of 10.551 and p-value of 0.00000000017084 indicate a highly significant difference ($p < 0.05$), affirming the effectiveness of AI integration in mathematics instruction. This aligns with Dabingaya (2022), who found AI tools significantly improved mathematical competency, and Tulak et al. (2024), who emphasized that personalized learning and tailored feedback through AI enhance understanding and outcomes in mathematics.

Table 5.b. Comparison test results between the pretest and posttest scores of the respondents on experimental group

Variables	Mean	SD	t-value	p-value	Inference
Pretest	14.24	2.42	10.551	0.0000000 0017084	Significant
Posttest	25.28	5.75			

**tested at 0.05 level of significance*

Table 5c shows a significant gain score difference between the control (M = 1.76, SD = 2.96) and experimental group (M = 11.04, SD = 5.23), with a t-value of 8.430 and a highly significant p-value of 0.000000012331. This confirms the superior effectiveness of AI-integrated instruction in teaching problems on parallelograms, trapezoids, and kites. As supported by Dabingaya (2022) and Alhalafi et al. (2024), AI enhances mathematical competency through personalized learning. Likewise, Sidhu & Srinivasan (2018) and Zhang (2023) noted that AI-supported active learning environments significantly improve student understanding and achievement in mathematics.

Table 5.c. Comparison test results of the gain scores of the respondents between control group and experimental group

Variables	Mean	SD	t-value	p-value	Inference
Control group	1.76	2.96	8.430	0.000000 012331	Significant
Experimental group	11.04	5.23			

**tested at 0.05 level of significance*

The Intervention plan

To effectively implement AI tools in mathematics teaching at Minabel Integrated School, the intervention plan should address local needs and resources. Professional development workshops tailored to the school's context must be conducted to equip teachers with practical skills in using AI tools, focusing on common challenges like limited training and digital literacy. Student orientations should emphasize how to responsibly use AI for learning, fostering critical thinking while considering local technological access. Given potential limitations in devices and internet connectivity in the area, the school should prioritize equitable access by providing shared resources or offline AI applications. Establishing a local support system—such as peer mentoring among students and teacher collaboration groups—can help troubleshoot issues quickly. Continuous feedback from the Minabel community will guide improvements. Collaboration among school leaders, educators, parents, and local tech experts will ensure that AI integration is relevant, sustainable, and sensitive to the school's unique environment.

CONCLUSIONS

Based on the findings of this study, it can be concluded that AI-powered tools such as Cici, Photomath, and ChatGPT significantly enhance the teaching and learning of mathematics among Grade 9 students at Minabel Integrated School, particularly in solving problems involving parallelograms, trapezoids, and kites. The AI tools supported improvements in the students' problem solving, motivation, and conceptual understanding, most significantly Cici across the three different AI categories. The teachers reported that the AI content engaging the students supported students' learning of complex concepts and extended instruction time on concepts. The survey results revealed that 70% of teachers want more professional development specific to AI integration. Students recently faced the current challenge - limited access to the Internet, bias towards language, and technical difficulties that were highlighted in the survey and interview. Teachers and students should face difficulties with Internet access, language bias, and technical issues. The results need documentation and training to hold teachers accountable for integrating social, local and engagement in AI learning collaboratively and successfully reality in equity.

RECOMMENDATIONS

Based on the findings, it is recommended that teachers undergo professional development on AI tools like Cici, Photomath, and ChatGPT, while schools conduct student orientations on responsible AI use and problem-solving. Students should receive localized guidance to enhance critical thinking and digital literacy. The local education board must invest in infrastructure, policies, and ethical guidelines for AI integration. Professional organizations should promote AI literacy through training and research, and ICT experts must ensure inclusive, culturally sensitive, and bias-free AI tools, collaborating with educators to create safe, equitable digital learning environments.

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The author hereby states that this article is his original and sole work and that there were no conflicts of interest.

References

1. Abernathy, J. (2024). AI tools in education: Tailoring lessons and feedback. Journal of Educational Technology, 15(2), 123-135.
2. Adetoun, A., Oyelude. (2024). Artificial intelligence (AI) tools for academic research. Library Hi Tech News, doi: 10.1108/lhtn-08-2024-0131
3. Aga, Z. G., Sawyer, A. G., & Wolfe, M. L. (2024). More confidence more critical: Investigating secondary mathematics preservice teachers' use of an Artificial Intelligence chatbot as a curriculum development tool. American Journal of Creative Education, 7(2), 63–78. https://doi.org/10.55284/ajce.v7i2.1278
4. Ahuja, V. (2023). Equity and Access in Digital Education (pp. 45–59). IGI Global. https://doi.org/10.4018/979-8-3693-1826-3.ch005
5. Ajda, Fošner. (2024). University Students' Attitudes and Perceptions towards AI Tools: Implications for Sustainable Educational Practices. Sustainability, doi: 10.3390/su16198668

DOI: 10.5281/zenodo.15645955

6. Ajuwon, A., Smith, J., & Lee, K. (2024). Interactive simulations and gamified learning environments in mathematics education. Journal of Educational Technology, 18(2), 145-160.

7. Akintande, O. J. (2024). *Artificial versus natural intelligence: Overcoming students' cheating likelihood with artificial intelligence tools during virtual assessment*. https://doi.org/10.1002/fer3.33

8. Alex, Oesterling., Usha, Bhalla., Suresh, Venkatasubramanian., Himabindu, Lakkaraju. (2024). Operationalizing the Blueprint for an AI Bill of Rights: Recommendations

9. Alhalafi, H. M., Al-shammari, W. S., & Mehregan, F. (2024). Effectiveness of Artificial Intelligence in Mathematics Teaching by Protus 2.1. Mağallaẗ Abḥāṯ Al-Baṣraẗ. Al-'ilmiyyāt, 50(2), 1–8. https://doi.org/10.56714/bjrs.50.2.1

10. Ali, H. Y., & Okon, O. E. (2024). Balancing innovation and ethics: educators' perspectives on the role of ai in education. *The American Journal of Social Science and Education Innovations*, *6*(9), 128–139. https://doi.org/10.37547/tajssei/volume06issue09-14

11. Aljemely, Y. (2024). Challenges and best practices in training teachers to utilize artificial intelligence: A systematic review. Frontiers in Education. https://doi.org/10.3389/feduc.2024.1470853

12. Allan, M., Canonigo. (2024). Levering <scp>AI</scp> to enhance students' conceptual understanding and confidence in mathematics. Journal of Computer Assisted Learning, doi: 10.1111/jcal.13065

13. Amalu, Kattunilam. (2024). Mathematics And Technology – An Introduction. doi: 10.59646/mt/218

14. Babalwa, Ceki. (2024). New audit reporting tools with AI-based implementation in the public sector. doi: 10.1201/9781003382706-7

15. Baisova, G. (2024). Integration of Artificial Intelligence into Educational Programs to Develop Scientific Analysis Skills in a Multidisciplinary Environment. *Бюллетень Науки и Практики*, *10*(11), 410–416. https://doi.org/10.33619/2414-2948/108/54

16. Bekdemir, Y. (2024). *The Urgency of AI Integration in Teacher Training: Shaping the Future of Education*. *3*(1), 3. https://doi.org/10.51853/jorids/15485

17. Bhardwaj, R. (2024). *AI Integrated Model Design for Education System for Analytical Computation (Mathematics)*. *8*, 1412–1417. https://doi.org/10.1109/icacite60783.2024.10616503

18. Bodonhelyi, A., Thaqi, E., Özdel, S., Bozkir, E., & Kasneci, E. (2024). *From Passive Watching to Active Learning: Empowering Proactive Participation in Digital Classrooms with AI Video Assistant*. https://doi.org/10.48550/arxiv.2409.15843

19. Campanilla, N. S. (2024). Exploratory analysis of learners' motivation on learning Mathematics in Philippines. Journal of Social, Humanity, and Education, 5(1), 37–59. https://doi.org/10.35912/jshe.v5i1.2115

20. Campanilla, N. S., & Mendoza, C. R. (2024). Error pattern analysis of the Mathematics problem solving of grade 10 learners. Journal of Social, Humanity, and Education, 4(4), 245–262. https://doi.org/10.35912/jshe.v4i4.2125

21. Canonigo, A. M. (2024). Levering <scp>AI</scp> to enhance students' conceptual understanding and confidence in mathematics. *Journal of Computer Assisted Learning*. https://doi.org/10.1111/jcal.13065

22. Celina, Aparecida, Almeida, Pereira, Abar., José, Manuel, Dos, Santos, Dos, Santos., Marcio, Vieira, de, Almeida. (2024). Contributes of the Integration Between Computational Thinking and Artificial Intelligence for Mathematics Education. doi: 10.1007/978-3-031-54256-5_27

23. Chung, J., Henderson, M., Pepperell, N., Slade, C., Liang, Y., & Yu, S. (2024). *Student use of Generative AI*.https://doi.org/10.14742/apubs.2024.1153

24. ClassPoint. (2025). A guide to navigate the challenges of using AI in education. ClassPoint Blog. https://www.classpoint.io/blog/challenges-of-using-ai-in-education

25. Dabingaya, M. (2022). Analyzing the Effectiveness of AI-Powered Adaptive Learning Platforms in Mathematics Education. Interdisciplinary Journal Papier Human Review, 3(1), 1–7. https://doi.org/10.47667/ijphr.v3i1.226

26. Dulundu, A. (2024). *AI in Education: Benefits and Concerns*. *8*(1), 81. https://doi.org/10.62802/3fr4f412

27. Efendi, M., Panglipur, I. R., & Murtinasari, F. (2024). Identifying the use of artificial intelligence in math learning based on learning outcomes. At-Ta`lim: Jurnal Pendidikan, 10(2), 53-59. https://doi.org/10.55210/attalim.v10i2.1689

28. Entschew, E. M. (2024). *Discriminatory data yields discriminatory systems: when AI biases harm human beings*. 37–65. https://doi.org/10.4337/9781803928241.00009

29. Fawns, T., Henderson, M., Matthews, K., Oberg, G., Liang, Y., Walton, J. K., Corbin, T. A., Bearman, M., Shum, S. B., McCluskey, T., McLean, J., Shibani, A., Bakharia, A., Lim, L.-A. Y. L., Pepperell, N., Slade, C., Chung, J., & Seligmann, A. (2024). *Gen AI and student perspectives of use and ambiguity*. https://doi.org/10.14742/apubs.2024.1218

30. Fitriana, H., & Waswa, A. (2024). The Influence of a Realistic Mathematics Education Approach on Students' Mathematical Problem Solving Ability. Interval, 2(1), 28–33. https://doi.org/10.37251/ijome.v2i1.979

31. Folmeg, M., Fekete, I., & Mészárosné Kóris, R. (2024). Enhancing Student Engagement using Artificial Intelligence (AI) and chatbots like ChatGPT. Journal of University Teaching and Learning Practice. https://doi.org/10.53761/wzyrwj33

DOI: 10.5281/zenodo.15645955

32. Ge, L. (2024). Automating administrative tasks with AI in education. Educational Management and Administration, 18(1), 112-125.

33. Gökçearslan, Ş., Tosun, C., & Erdemir, Z. G. (2024). Benefits, challenges, and methods of artificial intelligence (AI) chatbots in education: A systematic literature review. International Journal of Technology in Education, 7(1), 19-39. https://doi.org/10.46328/ijte.600

34. Gómez Cano, C. A., & Colala Troya, A. L. (2023). Artificial Intelligence applied to teaching and learning processes. 1, 2. https://doi.org/10.62486/latia20232

35. H., Richard, Milner., F., Blake, Tenore. (2010). Curriculum planning and development. Educational research and innovation, doi: 10.1787/9789264079731-10-EN

36. Henkel, O., Horne-Robinson, H., Kozhakhmetova, N., & Lee, A. (2024). Effective and Scalable Math Support: Evidence on the Impact of an AI- Tutor on Math Achievement in Ghana. *arXiv.Org*, *abs/2402.09809*. https://doi.org/10.48550/arxiv.2402.09809

37. James, Hutson., Daniel, Robert, Plate. (2023). Enhancing Institutional Assessment and Reporting Through Conversational Technologies: Exploring the Potential of AI-Powered Tools and Natural Language Processing. doi: 10.59232/air-v1i1p102

38. Jeremy, Norton. (2024). Navigating the AI Policy Landscape. Advances in library and information science (ALIS) book series, doi: 10.4018/979-8-3693-3053-1.ch006

39. Johnson, L. (2022). Teachers' attitudes towards AI in the classroom. *Educational Research Review*, 38, 45-58.

40. Karmakar, S., & Das, T. K. (2024). *Effect of artificial intelligence on education*. 198–211. https://doi.org/10.1201/9781003536796-8

41. Kenan, Baltaci., Monika, Herrmann., Ahmet, Turkmen. (2024). Integrating Artificial Intelligence into Electrical Engineering Education: A Paradigm Shift in Teaching and Learning. doi: 10.18260/1-2—47644

42. Kitcharoen, P., Howimanporn, S., & Chookaew, S. (2024). Enhancing Teachers' AI Competencies through Artificial Intelligence of Things Professional Development Training. https://doi.org/10.3991/ijim.v18i02.46613

43. Kohnke, S., & Zaugg, T. (2025). Artificial Intelligence: An Untapped Opportunity for Equity and Access in STEM Education. Education Sciences, 15(1), 68. https://doi.org/10.3390/educsci15010068

44. Kotsis, K. T. (2024). Integrating Artificial Intelligence in Science Education: Benefits and Challenges. International Journal of Educational Innovation, 6(3), 39–49. https://doi.org/10.69685/icas1772

45. Krishna, Kashyap, Yakkala. (2024). AI-powered assessment tools for E-learning: Enhancing feedback and grading systems. World Journal of Advanced Engineering Technology and Sciences, doi: 10.30574/wjaets.2024.13.1.0497

46. Kujundziski, A. P., & Bojadjiev, J. (2024). Artificial Intelligence in Education. *Advances in Educational Technologies and Instructional Design Book Series*, 1–54. https://doi.org/10.4018/979-8-3693-4310-4.ch001

47. Lars, Mehnen., Birgit, Pohn. (2024). Supporting Academic Teaching with Integrating AI in Learning Management Systems: Introducing a Toolchain for Students and Lecturers. doi: 10.23919/softcom62040.2024.10722016

48. Leta, F. M., & Vancea, D.-P. (2023). Ethics in Education: Exploring the Ethical Implications of Artificial Intelligence Implementation. Ovidius University Annals: Economic Sciences Series. https://doi.org/10.61801/ouaess.2023.1.54

49. Leyda, Marìa, Cedeño, Carranza., Tereza, Jazmín, Urquizo, Miranda., Jipson, Lenin, Vera, Pazmiño., Michel, Leonor, Veloz, Estrada., Jonathan, Luis, Monserrate, Sarmiento. (2024). Planificación Curricular: Elemento Fundamental en el Proceso Enseñanza-Aprendizaje en la Educación Ecuatoriana. Ciencia latina, doi: 10.37811/cl_rcm.v8i2.11082

50. Lima, L. A. de O., Gomes, L. P., Silva, P. H. da S. e S., Oliveira, E. L., Nascimento, M. do P. S. C. B. do, Tourem, R. V., Gonçalves, J. N. de A., Lima, A. da S., Sobral, R., & Santos, I. O. (2024). *Artificial intelligence and its use in the educational process*. Seven Editora. https://doi.org/10.56238/sevened2024.002-043

51. Lockwood, A. (2024). *Mitigating AI Bias in School Psychology: Toward Equitable and Ethical Implementation*. https://doi.org/10.31234/osf.io/mh4rj

52. Louly, N.M. (2024). Application of AI Tools in Education- A Conceptual Framework. Recent trends in Management and Commerce.

53. MacDowell, P., Moskalyk, K., Korchinski, K., & Morrison, D. (2024). Preparing Educators to Teach and Create With Generative Artificial Intelligence. *Canadian Journal of Learning and Technology*, *50*(4), 1–23. https://doi.org/10.21432/cjlt28606

54. Magat, R. J., & Sangalang, E. M. (2024). Teachers' Familiarity, Perceptions, and Training Needs on the Use of ChatGPT in Mathematics Instruction. International Journal of Education in Mathematics, Science and Technology, 1471–1487. https://doi.org/10.46328/ijemst.4332

55. Marikyan, G. (2023). Teaching mathematics with visuals. Athens Journal of Sciences, 10(4), 245-262. https://www.athensjournals.gr/sciences/2023-10-4-3-Marikyan.pdf

56. Matere, A. (2024). Effectiveness of Artificial Intelligence Tools in Teaching and Learning in Higher Education Institutions in Kenya. Journal of the Kenya National Commission for UNESCO, 5(1). https://doi.org/10.62049/jkncu.v5i1.177

DOI: 10.5281/zenodo.15645955

57. Maulida, L., Nurossobah, P., Aura, B. A., Nengsih, E. D., & Rasilah, R. (2024). Improving The Effectiveness of Mathematics Learning Through Artificial Intelligence: Literature Review. Journal of General Education and Humanities, 3(4), 323–338. https://doi.org/10.58421/gehu.v3i4.267

58. Memon, F. N., & Memon, S. N. (2024). Digital Divide and Equity in Education. Advances in Educational Technologies and Instructional Design Book Series, 107–130. https://doi.org/10.4018/979-8-3693-1854-6.ch004

59. Merve, Hickok., Nestor, Maslej. (2023). A policy primer and roadmap on AI worker surveillance and productivity scoring tools. AI and ethics, doi: 10.1007/s43681-023-00275-8

60. Meylani, R. (2024). Artificial Intelligence in the Education of Teachers: A Qualitative Synthesis of the Cutting-Edge Research Literature. Journal of Computer and Education Research, 12(24), 600–637. https://doi.org/10.18009/jcer.1477709

61. Mishra, S. (2024). Revolutionizing Education: The Impact of AI-Enhanced Teaching Strategies. *International Journal For Science Technology And Engineering*, *12*(9), 9–32. https://doi.org/10.22214/ijraset.2024.64127

62. Mohamed, M. Z. b., Hidayat, R., Suhaizi, N. N. b., Sabri, N. b. M., Mahmud, M. K. H. b., & Baharuddin, S. N. b. (2022). Artificial intelligence in mathematics education: A systematic literature review. International Electronic Journal of Mathematics Education, 17(3), em0694. https://doi.org/10.29333/iejme/12132

63. Moorhouse, B. L., & Kohnke, L. M. A. (2024). The effects of generative AI on initial language teacher education: The perceptions of teacher educators. System. https://doi.org/10.1016/j.system.2024.103290

64. Moussawi, S., & Joshi, K. D. (2024). *AI and Discrimination: Sources of Algorithmic Biases*. https://doi.org/10.1145/3701613.3701615

65. Mubofu, C., & Kitali, L. (2024). Artificial Intelligence In Education: Ethics & Responsible Implementation. Journal of Interdisciplinary Studies in Education, 13(2). https://doi.org/10.32674/9rjyjp52

66. Mustafa, A. N. (2024). The future of mathematics education: Adaptive learning technologies and artificial intelligence. International Journal of Science and Research Archive, 12(1), 2594–2599. https://doi.org/10.30574/ijsra.2024.12.1.1134

67. Nathim, K., Hameed, N. A., Salih, S. A., Taher, N. A., Salman, H. M., & Chornomordenko, D. (2024). *Ethical AI with Balancing Bias Mitigation and Fairness in Machine Learning Models*. 797–807. https://doi.org/10.23919/fruct64283.2024.10749873

68. Noakes, S., Shell, A., Van Nostrand, P., Murillo, A. M., Ruiz, P., & Liberman, B. (2024). AI-Powered Innovations in Mathematics Teaching & Learning: Initial Findings. https://doi.org/10.51388/20.500.12265/229

69. Norveen S. Campanilla. (2024). NAVIGATING THE ACADEMIC JOURNEY: EXPERIENCES, CHALLENGES, AND COPING STRATEGIES OF EDUCATORS PURSUING A MASTER'S DEGREE. ISRG Journal of Arts Humanities & Social Sciences (ISRGJAHSS), II(VI), 25–34. https://doi.org/10.5281/zenodo.14038508

70. Oesterling, A., Bhalla, U., Venkatasubramanian, S., & Lakkaraju, H. (2024). *Operationalizing the Blueprint for an AI Bill of Rights: Recommendations for Practitioners, Researchers, and Policy Makers*. arXiv. https://doi.org/10.48550/arxiv.2407.08689

71. Oh, S. H., & Ahn, Y.-G. (2024). Exploring Teachers' Perception of Artificial Intelligence: The Socio-emotional Deficiency as Opportunities and Challenges in Human-AI Complementarity in K-12 Education. https://doi.org/10.48550/arxiv.2405.13065

72. Onesi-Ozigagun, O., Ololade, Y. J., Eyo-Udo, N. L., & Ogundipe, D. O. (2024). Revolutionizing education through ai: a comprehensive review of enhancing learning experiences. *International Journal of Applied Research in Social Sciences*. https://doi.org/10.51594/ijarss.v6i4.1011

73. Opesemowo, O. A. G., & Adewuyi, H. O. (2024). A systematic review of artificial intelligence in mathematics education: The emergence of 4IR. *Eurasia Journal of Mathematics, Science and Technology Education*, *20*(7), em2478.

https://doi.org/10.29333/ejmste/14762

74. P., Mosae, Selvakumar., Sivaraja, Muthusamy., D., Satishkumar., P., Vigneshkumar., C., Selvamurugan., Pawan, Kumar. (2024). AI-Powered Tools. Advances in computational intelligence and robotics book series, doi: 10.4018/979-8-3693-2615-2.ch002

75. Pezo, M., Gonzalez, R., & Alvarez, L. (2024). Addressing technology gaps and data privacy concerns in AI-powered mathematics education. International Journal of Educational Research, 35(1), 78-92.

76. Pramod, Kumar., Asfa, Siddiqui., Kshama, Gupta., S., P., Jain., Y., V., N., Krishna, Murthy. (2014). Capacity Building through Geospatial Education in Planning and School Curricula. ISPRS - International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, doi: 10.5194/ISPRSARCHIVES-XL-8-1253-2014

77. Radoslav, Baltezarević., Ivana, Ž., Baltezarević. (2024). Students' Attitudes on The Role of Artificial Intelligence (Ai) In Personalized Learning. International Journal of Cognitive Research in Science, Engineering and Education, doi: 10.23947/2334-8496-2024-12-2-387-397

78. Ritu, Arya., Ashish, Verma. (2024). Role of Artificial Intelligence in Education. International Journal of Advanced Research in Science, Communication and Technology, doi: 10.48175/ijarsct-19461

DOI: 10.5281/zenodo.15645955

79. Roberto, Torres-Peña., Darwin, Peña-González., Ellery, Chacuto-López., Edwan, Anderson, Ariza., Diego, Antonio, Vergara. (2024). Updating Calculus Teaching with AI: A Classroom Experience. Neveléstudomány, doi: 10.3390/educsci14091019

80. Robinson Joel, M., Lakshmi, N. T., Shanthakumar, P., Jevremov, T., Siva, A. N., & Rajasekaran R., T. (2024). Evaluating the Impact of AI Tools on Teaching Effectiveness and Student Outcomes. Advances in Educational Technologies and Instructional Design Book Series, 273–300. https://doi.org/10.4018/979-8-3693-6170-2.ch010

81. Roshan, S., Iqbal, S. Z., & Qing, Z. (2024). Teacher Training and Professional Development for Implementing AI-Based Educational Tools. *Journal of Asian Development Studies*. https://doi.org/10.62345/jads.2024.13.2.154

82. Ruslim, M. I., & Khalid, F. (2024). The Use of Artificial Intelligence in Differentiated Instruction Classrooms. International Journal of Academic Research in Business & Social Sciences, 14(8). https://doi.org/10.6007/ijarbss/v14-i8/22435

83. S., C., Vetrivel., P., Vidhyapriya., V., P., Arun. (2024). The Role of AI in Transforming Assessment Practices in Education. Advances in educational marketing, administration, and leadership book series, doi: 10.4018/979-8-3693-5443-8.ch003

84. Sagin, F. G., Özkaya, A. B., Tengiz, F. İ., Geyik, Ö. G., & Geyik, C. (2023). *Current evaluation and recommendations for the use of artificial intelligence tools in education*. *0*. https://doi.org/10.1515/tjb-2023-0254

85. Şan, İ., & Kış, A. (2018). Effect of Traditional Methods in Geometry and Numbers Learning Domains on Academic Achievement: A Meta-Analysis Study. International Journal of Research in Education and Science, 4(2), 544–554. https://doi.org/10.21890/IJRES.428950

86. Sari, H., Tumanggor, B., & Efron, D. (2024). Improving Educational Outcomes Through Adaptive Learning Systems using AI. International Transactions on Artificial Intelligence, 3(1), 21–31. https://doi.org/10.33050/italic.v3i1.647

87. Senanayake, S. M. N. A., Karunanayaka, K., & Ekanayake, K. V. J. P. (2024). Review on AI Assistant Systems for Programming Language Learning in Learning Environments. 1–6. https://doi.org/10.1109/slaai-icai63667.2024.10844969

88. Siddhant, M. (2024). Revolutionizing Education: The Impact of AI-Enhanced Teaching Strategies. International Journal For Science Technology And Engineering, doi: 10.22214/ijraset.2024.64127Sidhu, G., & Srinivasan, S. (2018). An Intervention-Based Active-Learning Strategy To Enhance Student Performance in Mathematics. 2(1), 85–96. https://doi.org/10.20961/IJPTE.V2I1.19568

89. SIGNS: A Tool in Enhancing the Skills of Grade 7 Students on Operation of Integers - NORVEEN S. CAMPANILLA - IJFMR Volume 6, Issue 4, July-August 2024. DOI10.36948/ijfmr.2024.v06i04.26713

90. Siti, Yuliandi., Ahmad., Noorsakinah, Sardar, Hussain., Farah, Farzana., Ulul'Azmi., Nursyafiqah, Najwa., Binti, Ismadi., Nur, Farihin., Elyani, Mohd, Fauzi., Nurulain, Razali. (2024). Feelings, Attitudes, and Knowledge in the Learning Method Using Chatgpt among Students in Higher Education Institutions. Jurnal Audiens, doi: 10.18196/jas.v5i3.476

91. Smith, J. (2023). The impact of AI on education. *Journal of Educational Technology*, 45(2), 123-135.

92. Stavytska, O., Ivanov, P., & Petrenko, M. (2024). Real-time feedback and tailored resources in education: The role of Grammarly and Knewton. Journal of Learning Technologies, 12(4), 200-215.

93. Sukirman, Sukirman., Eko, Supriyanto., Arif, Setiawan., Ahmad, Chamsudin., Irma, Yuliana., Jan, Wantoro. (2024). Exploring Student Perceptions and Acceptance of ChatGPT in Enhanced AI-Assisted Learning. doi: 10.1109/siml61815.2024.10578145

94. T., Janaki., Msr, Mariyappan. (2024). Exploring the Influence of Ai-Powered Learning Tools on Student Understanding and Academic Performance: A Comprehensive Analysis. Shanlax international journal of management, doi: 10.34293/management.v11is1-may.7834

95. Thanuja, Rathakrishnan., Thivashini, B., Jaya, Kumar., Mung, Khie, Tsen., Mei, Kei, Leong., Aqilah, Yaacob. (2024). AI Tools. Advances in educational technologies and instructional design book series, doi: 10.4018/979-8-3693-8217-2.ch003

96. Thị, Thu, Hiền, Trần. (2024). AI Tools in Teaching and Learning English Academic Writing Skills. Proceedings of the AsiaCALL International Conference, doi: 10.54855/paic.23413

97. Torres-Peña, R., Peña-González, D., Chacuto-López, E., Anderson Ariza, E., & Vergara, D. A. (2024). Updating Calculus Teaching with AI: A Classroom Experience. *Neveléstudomány*. https://doi.org/10.3390/educsci14091019

98. Trần, N. (2024). Enhancing academic writing skills with AI-powered tools. International Journal of Educational Research, 30(1), 45-60.

99. Tulak, M., Smith, A., & Johnson, L. (2024). The impact of personalized feedback from AI systems on mathematical concept retention. Mathematics Education Review, 22(3), 78-92.

100. Tulak, T., Rubianus, R., & Maramba', S. (2024). Optimizing mathematics learning outcomes using artificial intelligence technology. Mapan, 12(1), 160–170. https://doi.org/10.24252/mapan.2024v12n1a11

101. Utepbergenova, A. T. (2024). The role of artificial intelligence in education. International Journal of

DOI: 10.5281/zenodo.15645955

Pedagogics. https://doi.org/10.37547/ijp/volume04issue10-32

102. Vahid, Garousi., N., Eneh, Joy., Alper, Buğra, Keleş. (2024). AI-powered test automation tools: A systematic review and empirical evaluation. doi: 10.48550/arxiv.2409.00411

103. Valentine, Joseph, Owan., Delight, O., Idika., Bassey, Asuquo, Bassey. (2023). Exploring the potential of artificial intelligence tools in educational measurement and assessment. Eurasia journal of mathematics, science and technology education, doi: 10.29333/ejmste/13428

104. Wan, Yi., Vanessa, Kitzie., Manar, Alsaid., A., Berkowitz., Anisah, Herdiyanti., Rebecca, Bryant, Penrose. (2024). The AI-empowered Researcher: Using AI-based Tools for Success in Ph.D. Programs. Proceedings of the Association for Library and Information Science Education Annual Conference, doi: 10.21900/j.alise.2024.1710

105. Wangdi, P. (2024). *Integrating Artificial Intelligence in Education:* https://doi.org/10.33830/ijrse.v6i2.1722

106. Xiaofang, Liao., Xuedi, Zhang., Zhifeng, Wang., Heng, Luo. (2024). Design and implementation of an AI-enabled visual report tool as formative assessment to promote learning achievement and self-regulated learning: An experimental study. British Journal of Educational Technology, doi: 10.1111/bjet.13424

107. Yamijala, Suryanarayana, Murthy., R, S, Ch, Murthy, Chodisetty., Chandresh, Chakravorty., K., Gowtham, Sai. (2024). AI-Powered Learning Revolutionizing Smart Education With Personalized Learning Styles. Advances in educational technologies and instructional design book series, doi: 10.4018/979-8-3693-8151-9.ch007

108. Yi, L., Liu, D., Jiang, T., & Xian, Y. (2024). The effectiveness of AI on K-12 students' mathematics learning: A systematic review and meta-analysis. International Journal of Science and Mathematics Education. https://doi.org/10.1007/s10763-024-10499-7

109. Zhang, X. (2023). An Innovative Model of Higher Mathematics Curriculum Education Incorporating Artificial Intelligence Technology. Applied Mathematics and Nonlinear Sciences. https://doi.org/10.2478/amns.2023.2.01524

110. Zhicheng, Lin. (2023). Towards an AI policy framework in scholarly publishing. doi: 10.31234/osf.io/jgck4

111. Zhicheng, Lin. (2024). Towards an AI policy framework in scholarly publishing. Trends in Cognitive Sciences, doi: 10.1016/j.tics.2023.12.002

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