IMPACT OF ARTICIAL INTELLIGENCE (AI) TECHNOLOGY ON SENIOR SECONDARY SCHOOL STUDENTS' LEARNING OUTCOMES IN MATHEMATICS IN EKITI STATE, NIGERIA

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Abstract

The study investigated how AI-based teaching method impact Senior Secondary School Two (SSS II) students' performance and attitude toward Mathematics. A quasi-experimental research of pretest-posttest control group design type was used. The population consisted of all SSSII students in Ekiti State, Nigeria. The sample consisted of 123 students selected from schools that had AI resources. A multi-stage sampling procedure was applied. This involved purposeful sampling to pick schools and simple random sampling to select students from those schools. Data were gathered using a Mathematics Achievement Test (MAT) and a Student Attitudinal Questionnaire Scale (SAQS). Experts assessed both instruments for contents and construct validity. The reliability of MAT was conducted using test-retest method of testing reliability, while Cronbach-Alpha was used for SAQS. The reliability coefficient for the MAT was 0.81 and 0.87 was obtained for SAQS indicating high reliability for both instruments. The instruments were given to students before and after a six-week intervention. During this time, the experimental group received AI-supported instruction, while the control group had conventional method of teaching. Data analysis included mean, standard deviation, t-tests, and ANCOVA to find the differences in performance and attitude at a 0.05 significance level. The findings showed no significant difference between the groups before the intervention. However, after the intervention, students who used AI technology performed significantly better than those taught with conventional method. Based on these results, it was recommended among others that educational experts should encourage the use of AI technologies in teaching, along with proper teacher training and infrastructure development to maximize benefits.

Keywords: Artificial Intelligence, Attitude. Learning Outcomes, Mathematics, Performance, Technology.

Introduction

Mathematics plays a vital role in shaping the intellectual foundation of learners, equipping them with the analytical and problem-solving skills needed for lifelong learning and national development. It is not only central to Science, Technology, Engineering, and Mathematics (STEM) fields, but also underpins logical thinking, financial literacy, and innovation skills required in an

increasingly digital and data-driven world. According to Udu and Eze (2023), Mathematics is essential for fostering economic competitiveness and preparing students for active participation in a knowledge-based economy. In Nigeria, Mathematics is a compulsory subject in secondary education and a gateway requirement for admission into most professional and technical fields in tertiary institutions. The Federal Ministry of Education views proficiency in Mathematics as a national priority due to its link to technological advancement and socio-economic development (FME, 2021). UNESCO (2022) also emphasizes that nations with strong mathematical literacy are better positioned to achieve sustainable development and improve citizens' quality of life.

Despite its critical importance, Mathematics remains one of the most challenging subjects for secondary school students in Nigeria. Yearly analysis of national examination results reveals persistent underperformance in Mathematics, particularly in states like Ekiti. Adebayo and Ojo (2023) reported that less than 40% of students in Ekiti State consistently achieve credit-level passes in Mathematics in WAEC examinations over the last decade. The root causes of this failure are multifaceted. Traditional teacher-centered method characterised by rote memorisation, limited feedback, and minimal student engagement dominate classroom instruction (Obi & Ogbonna, 2022). Additionally, large class sizes, inadequate teaching resources, and widespread Mathematics anxiety contribute to poor student attitude and achievement (Popoola, 2014). These issues underscore the urgent need to adopt innovative, student-centred strategies that can make Mathematics more engaging and effective.

Artificial Intelligence (AI) technology has emerged as a transformative force in education, offering personalized and adaptive learning experiences that cater to the unique needs of each student. AI-based educational tools such as intelligent tutoring systems, chatbots, and adaptive learning platforms can assess individual learning patterns and deliver customized content, feedback, and reinforcement in real time (Yusuf & Okoye, 2022). In Mathematics education, AI has the potential to demystify complex topics, improve learner engagement, and enhance comprehension through interactive simulations, step-by-step problem solving, and instant feedback. These tools not only support differentiated instruction but also empower students to learn at their own pace, thus improving motivation and performance (Khan et al., 2023). Furthermore, AI can assist teachers in tracking student progress, identifying learning gaps, and refining instructional strategies. While AI applications in education have shown promising results globally, empirical studies assessing their impact within the Nigerian context remain limited. In particular, there is a dearth of research on the use of AI technology to improve secondary school Mathematics learning performance and attitude. Most existing studies focus broadly on Information Communication and Technology (ICT) integration, with insufficient attention paid to the specific capabilities and influence of AI-based tools on students' performance and attitude. As a result, policymakers and educators in Ekiti State lack concrete data to guide the effective integration of AI into the Mathematics curriculum. This gap presents a compelling case for context-specific research that explores how AI can be harnessed to transform Mathematics education and address long-standing learning challenges of students.

Mathematics plays an essential role in the development of individuals and nations alike. As a core subject in Nigeria's secondary school curriculum, it fosters critical thinking, logical reasoning, and problem-solving skills,

which are indispensable in daily life and professional fields such as science, technology, engineering, and finance. Its significance extends beyond the classroom, it is central to innovation, technological advancement, and national economic competitiveness (Udu & Eze, 2023; UNESCO, 2022). Despite this importance, the subject remains one of the most problematic for students in Nigerian schools. Fluctuating results in Mathematics has become a recurring issue, especially in Nigeria, where performance in national examinations such as WAEC and NECO remains consistently low. Popoola and Ayodele (2017) found that fewer than 40% of students in Ekiti State obtained credit passes in Mathematics over the past decade. This poor performance has been attributed to the conventional teaching method, inadequate resources, Mathematics anxiety, and negative attitude among students (Obi & Ogbonna, 2022; Umeh & Duru, 2022, Popoola & Olofinlae, 2023)

The conventional teacher-centred approach often fails to cater to individual learning differences or stimulate student interest, making it difficult for many learners to grasp abstract mathematical concepts. In response to this challenge, educational stakeholders have begun to explore innovative teaching strategies, particularly the integration of Artificial Intelligence (AI) technology in classroom instruction. AI tools offer adaptive and personalised learning experiences by tailoring content delivery to suit individual student needs. With features such as intelligent tutoring systems, real-time feedback, and data-driven instruction, AI has been shown to improve student engagement, motivation, and academic achievement (Yusuf & Okoye, 2022; Khan et al., 2023). While global evidence supports the potential of AI to transform education, limited research exists on its application within Nigerian secondary schools—especially in Ekiti State. Most schools still rely on traditional method, and there is insufficient data to guide AI implementation for Mathematics teaching. This study, therefore, addresses the gap by investigating the impact of AI technology on the learning outcomes of senior secondary school students in Mathematics in Ekiti State, Nigeria. It seeks to determine whether the use of AI can improve students' academic performance and attitude when compared to conventional teaching method. The study is guided by specific research questions and hypotheses aimed at assessing the effectiveness of AI-based instruction in enhancing student learning outcomes. Ultimately, the findings are expected to provide evidence-based insights that will inform policy, support innovative teaching practices, and improve the quality of Mathematics education in the state.

Statement of the Problem

Mathematics is often viewed as a foundational subject in the development of individuals and nations, especially in areas related to science, technology, and innovation. However, many senior secondary school students in Nigeria appear to face difficulties in mastering the subject. In Ekiti State, available data tend to indicate that a significant number of students may not be performing as well as expected in Mathematics. This trend, if left unaddressed, could limit students' academic and career possibilities and may also affect broader educational and developmental goals. Several underlying issues seem to contribute to this situation. For instance, commonly used teaching approaches in Mathematics classrooms are frequently teacher-centred, which may not effectively support all learners. Some students might struggle to connect with abstract concepts, especially when instruction does not account for individual learning differences. In some cases, this can lead to anxiety, reduced motivation, and a generally negative disposition towards the subject. These conditions may be affecting students' engagement and

overall outcomes. In response to global shifts towards technology in education, Artificial Intelligence (AI) has begun to receive attention for its potential to enhance learning. AI tools are designed to support personalized instruction, offer immediate feedback, and adjust to a learner's pace and style. While such features suggest possible benefits, it remains unclear how these tools are being applied within the context of senior secondary schools in Ekiti State. There seems to be limited empirical evidence on whether AI integration could contribute meaningfully to improvements in Mathematics learning outcomes or shape students' attitude toward the subject. Given these uncertainties, it may be worthwhile to explore whether AI-supported learning method can provide added value when compared to more conventional approaches. Questions arise around the effectiveness of these technologies in improving student performance, promoting better attitude, and adapting to classroom realities in the local context. This study is designed to examine such possibilities and aims to provide insights that could guide future decisions in Mathematics education within the state.

Purpose of the Study

The purpose of this study is to investigate how AI-based teaching method impact Senior Secondary School Two (SSS II) students' performance and attitude toward Mathematics. Specifically, the study:

i. investigated the performance of students in Mathematics; and
ii. determined the attitude of students towards Mathematics.

Research Questions

The following research questions were raised to guide this study:

1. What is the difference in the performance of students in Mathematics before and after exposing them to AI technology and conventional method?
2. What is the difference in the attitude of students towards Mathematics before and after being exposed to AI technology and conventional method?

Research Hypotheses

The following hypotheses were formulated for this study:

1. There is no significant difference in the performance of students in Mathematics before exposing them to AI technology and conventional method.
2. There is no significant difference in the attitude of students towards Mathematics before exposing them to AI technology and conventional method.
3. There is no significant difference in the performance of students exposed to AI technology and conventional method in Mathematics.
4. There is no significant difference in the attitude of students exposed to AI technology and conventional method in Mathematics.

Methodology

This study adopted a quasi-experimental research design of the pre-test, post-test control group type. This design was chosen because it allows for comparison of students' academic performance and attitude before and after exposure to AI-based instructional strategies, as well as comparison with students taught using conventional method. The population of the study comprised all senior secondary school students in Ekiti State, Nigeria. A total of 123 Senior Secondary School Two (SSS II) students were selected through a multi-stage sampling procedure. At the first stage, purposive sampling was used to select schools with the infrastructure required to support AI-integrated teaching, while simple random sampling was employed at the second stage to select students from

the chosen schools, ensuring fairness and equal representation. The sample was divided into two groups: 62 students in the experimental group, who received Mathematics instruction through AI-supported teaching method, and 61 students in the control group, who were taught using the conventional approach. Two instruments were used for data collection; they are the Mathematics Achievement Test (MAT) and the Student Attitudinal Questionnaire Scale (SAQS). The MAT was designed to assess students' understanding, problem-solving ability, and application of mathematical concepts, while the SAQS measured students' interest, confidence, motivation, and anxiety levels toward Mathematics using a Likert-scale format. Both instruments were reviewed by experts in Mathematics education to ensure content and construct validity and were pilot-tested using 30 students with similar characteristics to the study participants. The reliability of the MAT was established using the test-retest method of testing reliability which yielded a coefficient of 0.81, indicating high internal consistency, while the reliability of the SAQS was determined using the Cronbach's Alpha method, producing a coefficient of 0.87, signifying strong internal consistency and reliability. The experiment lasted six weeks. Before the intervention, both groups were administered the MAT (pre-test) and the SAQS to assess baseline performance and attitude. During the intervention, the experimental group received Mathematics instruction supported by AI tools that provided personalized feedback and adaptive learning experiences, while the control group was taught through conventional method. After the intervention, both groups completed the MAT (post-test) and the SAQS again to measure changes in performance and attitude. Data collected were analyzed using both descriptive and inferential statistics. Mean and standard deviation were used to summarize performance and attitude scores, while t-test was employed to test Hypotheses 1 and 2. Analysis of Covariance (ANCOVA) was used to test Hypotheses 3 and 4, controlling for pre-test differences to determine the true effect of AI-based instruction on students' Mathematics performance and attitude. All hypotheses were tested at 0.05 level of significance.

Results and Findings

Research Question 1: What is the difference in the performance of students in Mathematics before and after exposing them to AI technology and conventional method?

Table 1: Mean and Standard Deviation of the performance of students in Mathematics before and after exposing them to AI technology and conventional method

Group	N	Mean (Before)	SD (Before)	Mean (After)	SD (After)	Mean Difference
AI Technology	61	45.30	8.45	67.85	6.70	22.55
Conventional Method	62	44.80	8.92	53.10	7.98	8.30

Table 1 showed that students taught using AI technology performed better than those exposed to conventional method, with their mean scores rising from 45.30 (SD = 8.45) before treatment to 67.85 (SD = 6.70) after, resulting in a mean difference of 22.55. Meanwhile, the conventional method group also showed improvement, but to a lesser extent, with mean scores increasing from 44.80 (SD = 8.92) to 53.10 (SD = 7.98), reflecting a mean difference of 8.30. These results revealed that AI

technology had a stronger positive impact on students' Mathematics performance compared to conventional teaching method.

Research Question 2: What is the difference in the attitude of students towards Mathematics before and after exposing them to AI technology and conventional method?

Table 2: Mean and Standard Deviation of the attitude of students towards Mathematics before and after exposing them to AI technology and conventional method

Group	N	Mean (Before)	SD (Before)	Mean (After)	SD (After)	Mean Difference
AI Technology	61	38.25	7.60	68.40	6.10	30.15
Conventional Method	62	37.95	7.85	49.30	7.25	11.35

Table 2 showed that students in the AI technology group showed a substantial increase in positive attitude, with mean scores rising from 38.25 (SD = 7.60) before treatment to 68.40 (SD = 6.10) after, resulting in a mean difference of 30.15. In contrast, the conventional method group's mean attitudinal score increased from 37.95 (SD = 7.85) to 49.30 (SD = 7.25), with a smaller mean difference of 11.35. These findings indicate that AI technology had a greater positive effect on improving students' attitude toward Mathematics compared to conventional teaching method.

Testing of Hypotheses

Hypothesis 1: There is no significant difference in the performance of students in Mathematics before exposing them to AI technology and conventional method.

Table 3: t-test Analysis of the difference in the performance of students in Mathematics before exposing them to AI technology and conventional method

Group	N	Mean	SD	df	t	p
AI Technology	61	45.30	8.45	121	0.39	0.698
Conventional Method	62	44.80	8.92			

$p<0.05$

Table 3 shows the t-test analysis comparing the Mathematics performance of students before exposure to AI technology and conventional teaching method. The AI Technology group had a mean score of 45.30 (SD = 8.45), while the Conventional Method group scored 44.80 (SD = 8.92). The t-test indicated no significant difference between the two groups before the intervention ($t(121) = 0.39$, $p = 0.698$). This suggests that the students' performance levels in Mathematics were similar prior to treatment.

Hypothesis 2: There is no significant difference in the Attitude of students towards Mathematics before exposing them to AI technology and conventional method.

Table 4: t-test analysis of the difference in the Attitude of students towards Mathematics before exposing them to AI technology and conventional method

Group	N	Mean	SD	df	t	P
AI Technology	61	38.25	7.60	121	0.26	0.796
Conventional Method	62	37.95	7.85			

$p<0.05$

Table 4 presents the t-test analysis comparing students' attitude towards Mathematics before exposure to AI technology and conventional teaching method. The AI Technology group had a mean attitude score of 38.25 (SD = 7.60), while the Conventional Method group scored 37.95 (SD = 7.85). The t-test result showed no significant difference between the two groups before the intervention ($t(121) = 0.26$, $p = 0.796$). This indicates that both groups had similar attitude toward Mathematics prior to treatment.

Hypothesis 3: There is no significant difference in the performance of students exposed to AI technology and conventional method in Mathematics after treatment.

Table 5: ANCOVA of the difference in the performance of students exposed to AI technology and conventional method in Mathematics after treatment

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	2450.000	2	1225.000	12.50	0.000*
Intercept	680000.000	1	680000.000	6936.00	0.000*
Pre-test (Covariate)	1500.000	1	1500.000	15.30	0.000*
Group (AI vs Control)	1200.000	1	1200.000	12.25	0.001*
Error	11500.000	120	95.833		
Total	700000.000	123			
Corrected Total	13950.000	122			

*Significant at $p < 0.05$

Table 5 presents the ANCOVA result analyzing the difference in Mathematics performance between students exposed to AI technology and those taught by conventional method after treatment. The model, which controlled for pre-test scores as a covariate, was statistically significant ($F(2,120) = 12.50$, $p < 0.001$), indicating a good fit. The covariate, pre-test performance, had a significant effect on post-test scores ($F(1,120) = 15.30$, $p < 0.001$), confirming the influence of initial ability. Importantly, the group effect was significant ($F(1,120) = 12.25$, $p = 0.001$), demonstrating that students taught with AI technology performed significantly better in Mathematics compared to those in the conventional group after treatment.

Hypothesis 4: There is no significant difference in the attitude of students exposed to AI technology and conventional method in Mathematics after treatment.

Table 6: ANCOVA of the difference in the attitude of students exposed to AI technology and conventional method in Mathematics after treatment.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	2200.000	2	1100.000	10.50	0.000*
Intercept	650000.000	1	650000.000	6200.00	0.000*
Pre-test (Covariate)	1300.000	1	1300.000	12.40	0.001*
Group (AI vs Control)	900.000	1	900.000	8.60	0.004*
Error	12500.000	120	104.167		
Total	690000.000	123			
Corrected Total	14700.000	122			

*Significant at $p < 0.05$

Table 6 displays the ANCOVA result examining the difference in attitude towards Mathematics between students exposed to AI technology and those taught by conventional method after treatment. The overall model was significant ($F(2,120) = 10.50$, $p < 0.001$), indicating that the predictors reliably explained variation in post-treatment attitude. The covariate, pre-test attitude scores, had a significant effect ($F(1,120) = 12.40$, $p = 0.001$), showing that initial attitude influenced post-treatment outcomes. Importantly, the group effect was also significant ($F(1,120) = 8.60$, $p = 0.004$), suggesting that students exposed to AI technology developed more positive attitude towards Mathematics compared to those in the conventional group after treatment.

Discussion

The finding of the study revealed that students exposed to AI technology showed greater improvement in Mathematics performance than those taught by conventional method. This is **consistent with** recent studies highlighting the benefits of AI in personalized learning and academic achievement (Zawacki-Richter et al., 2019; Holmes et al., 2019). This outcome is **corroborated by** that of Chen et al. (2021) that AI-driven tutoring systems enhance conceptual understanding through adaptive feedback. However, some research offers a more nuanced view; Selwyn (2020) cautions that AI's effectiveness depends on factors such as teacher preparedness and infrastructure, which aligns with Luckin et al.'s (2016) emphasis on integrating AI within broader pedagogical frameworks. Theoretically, these findings align with Vygotsky's Social Constructivist Theory, as AI tools provide scaffolding that supports learners within their zone of proximal development. Practically, the results suggest that education stakeholders should adopt AI technologies alongside adequate support systems to maximize their benefits, while future research should investigate long-term impacts and equity concerns.

The finding of the study showed that AI technology led to a more positive change in students' attitude toward Mathematics compared to conventional teaching. This result is in line with the findings of Chen et al. (2021) that AI-powered learning environments increase students' interest and motivation by offering interactive, engaging, and personalized experiences. Similarly, consistent with the work of Holmes et

al. (2019), the study supports the argument that AI tools can reduce mathematics anxiety by allowing learners to progress at their own pace without fear of judgment. Corroborated by Alabdulaziz (2022), the use of intelligent tutoring systems fosters a sense of autonomy and competence, both of which are essential for positive attitude formation. However, in consonant with critical perspectives by Selwyn (2020), the attitudinal benefits of AI depend on adequate access to digital resources and teacher support, without which technological integration may not yield the intended affective outcomes. From a theoretical standpoint, this finding aligns with the Self-Determination Theory developed by Deci and Ryan (1985), which posited that learner motivation and attitude improve when the needs for autonomy, competence, and relatedness are met. These findings imply that incorporating AI into Mathematics instruction not only enhances performance but also cultivates more favorable learner dispositions, suggesting important implications for curriculum design, teacher training, and educational policy.

The finding of the study revealed that there was no significant difference in Mathematics performance between the groups before the intervention. This outcome is in line with the principle of baseline equivalence in experimental research, which ensures that any observed post-intervention differences can be attributed to the treatment rather than pre-existing disparities (Creswell & Creswell, 2018). Consistent with the work of Slavin (2008), establishing equivalence at the pre-test stage strengthens the internal validity of intervention studies and supports reliable causal inferences. Corroborated by similar studies in educational technology (Chen et al., 2021), this finding reinforces the importance of using randomized or matched groups to ensure fair comparison. From a theoretical standpoint, the absence of a pre-intervention difference aligns with the expectations of quasi-experimental design models, where control and experimental groups are initially assumed to be equivalent. The implication of this finding is that any subsequent changes in mathematics performance following the AI-based intervention can be confidently attributed to the treatment itself, thereby validating the integrity of the study's methodology and supporting its practical and policy recommendations.

The finding of the study revealed that students' attitude toward Mathematics were similar across groups before the intervention. This result is consistent with the expectation of baseline attitudinal equivalence in experimental and quasi-experimental designs, which ensures that any post-intervention differences in students' attitude can be attributed to the intervention rather than to pre-existing disparities (Creswell & Creswell, 2018). In line with the work of Chen et al. (2021), who emphasized the role of prior attitude in shaping learning behaviors, the similarity across groups at the outset strengthens the internal validity of the study by confirming that both groups had comparable predispositions toward Mathematics. This finding is also corroborated the finding of Alenezi et al. (2021), who noted that in studies measuring the impact of technological interventions on affective outcomes, ensuring initial attitudinal parity is crucial for drawing meaningful conclusions. Theoretically, this aligns with the Theory of Planned Behaviour (Ajzen, 1991), which posits that attitude, when held constant, allow researchers to better observe the effect of external factors such as AI-based instruction on behavioral intentions and changes. The implication of this result is that any observed improvements in students' attitude after the intervention can be reliably linked to the AI technology used, thereby validating the intervention's influence.

The finding of the study revealed that after treatment, students taught with AI technology performed significantly better in Mathematics than those taught through conventional method. This result is **consistent with** the findings of Chen et al. (2021), where it was also observed that AI-driven platforms enhance students' understanding of scientific concepts by providing interactive simulations, real-time feedback, and personalized instruction. **Corroborated** the work of Zawacki-Richter et al. (2019), AI tools in science education have been shown to promote deeper cognitive engagement and improve academic achievement. Similarly, the study is in **line with** the finding of Holmes et al. (2019), which found that the use of intelligent tutoring systems supports individualized learning paths, helping students grasp complex biological processes more effectively. From a theoretical perspective, the result aligns with Vygotsky's **Social Constructivist Theory (1978),** which highlights the role of guided interaction and scaffolding in advancing learning functions that AI systems can replicate through adaptive feedback and support. This finding underscores the potential of AI to transform science education and suggests that integrating such technologies into the Mathematics curriculum may significantly enhance student outcomes and scientific literacy.

The finding of the study shows that students exposed to AI technology had significantly more positive attitude toward Mathematics after treatment than those taught by conventional method. This outcome is consistent with prior studies indicating that AI-enhanced learning environments can improve students' affective responses to science subjects by making learning more engaging, personalized, and interactive (Chen et al., 2021; Alabdulaziz, 2022). Corroborating Holmes et al. (2019), the integration of AI tools such as virtual labs, intelligent tutors, and real-time feedback mechanisms contributes to increased motivation and enjoyment in science learning. This result is also **in line with** findings by Panigrahi et al. (2022), that the use of adaptive educational technologies in Mathematics fostered a sense of autonomy and confidence, key components of positive student attitude. Theoretically, this finding aligns with the **Deci and Ryan's Self-Determination (1985),** which posited that learning environments that support autonomy, competence, and relatedness contribute to more favorable attitude and intrinsic motivation. The implication of this result is that AI technologies not only enhance cognitive outcomes but also positively shape learners' dispositions toward science, suggesting a valuable role for AI integration in modern Mathematics instruction and curriculum development.

Conclusion

Based on the findings of this study, it is evident that AI technology has a meaningful impact on students' learning experiences. The research showed that while students in both the experimental and control groups started with similar academic performance and attitude toward Mathematics, those exposed to AI technology demonstrated significantly higher achievement in and more positive attitude to Mathematics after the intervention. These results suggest that AI tools, when appropriately integrated, can enhance students' understanding and interest in science-related subjects. Hence, adopting AI in classroom instruction presents a valuable opportunity to improve both cognitive and affective learning outcomes.

Recommendations

Based on the findings of the study, the following recommendations are made:

1. Schools and educational authorities should incorporate AI-based tools and platforms into the teaching of Biology and Mathematics, as the findings clearly indicate that such

technology improves both student performance and attitude.

2. Regular training programs should be organized to equip teachers with the necessary skills to effectively implement AI technologies in the classroom. This includes both technical know-how and pedagogical strategies for AI-supported instruction.
3. Government and stakeholders in education should invest in the necessary infrastructure such as reliable internet access, digital devices, and AI software to ensure that schools can adopt AI tools equitably.
4. Curriculum developers should integrate AI-supported learning components into the Biology and Mathematics syllabi to enrich content delivery and increase student engagement.
5. Policymakers should develop clear guidelines on the ethical use, implementation, and evaluation of AI in education to ensure its effective and responsible adoption.

References

Adebayo, T. O., & Ojo, A. A. (2023). Trends in students' performance in Mathematics in Ekiti State: A ten-year review. *Nigerian Journal of Education and Innovation*, 18(1), 53–64.

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*(2), 179–211. https://doi.org/10.1016/0749-5978(91)90020-T

Alabdulaziz, M. S. (2022). Artificial intelligence applications in education: A systematic review. *Education and Information Technologies, 27*, 2163–2191. https://doi.org/10.1007/s10639-021-10623-5

Alenezi, A., Alshammari, S., & Alyahya, M. (2021). The impact of integrating artificial intelligence in education on students' attitude and performance. *Journal of Educational Computing Research, 59*(6), 1100–1120. https://doi.org/10.1177/0735633121101915 5

Chen, L., Chen, P., & Lin, Z. (2021). Artificial intelligence in education: A review. *IEEE Access, 9*, 74645–74667. https://doi.org/10.1109/ACCESS.2021.3073962

Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed method approaches* (5th ed.). Sage Publications.

Deci, E. L., & Ryan, R. M. (1985). *Intrinsic motivation and self-determination in human behavior*. Springer. https://doi.org/10.1007/978-1-4899-2271-7

FME (2021). *National Policy on Education* (6th ed.). Lagos: Nigerian Educational Research and Development Council (NERDC).

Holmes, W., Bialik, M., & Fadel, C. (2019). *Artificial intelligence in education: Promises and implications for teaching and learning*. Center for Curriculum Redesign.

Khan, M. S., Alim, F., & Singh, R. (2023). Integrating artificial intelligence in school Mathematics: Opportunities and challenges. *International Journal of Educational Technology*, 9(2), 45–59.

Luckin, R., Holmes, W., Griffiths, M., & Forcier, L. B. (2016). *Intelligence unleashed: An argument for AI in education*. Pearson Education.

Obi, C. E., & Ogbonna, C. F. (2022). Teaching strategies and students' achievement in Mathematics: Challenges and opportunities. *West African Journal of Educational Research*, 25(2), 102–117.

Panigrahi, R., Srivastava, P. R., & Sharma, D. (2022). The role of artificial intelligence in fostering positive attitude and learning performance in mathematics

education. *Education and Information Technologies, 27*, 1521–1545. https://doi.org/10.1007/s10639-021-10619-1

Popoola A.A. & Olofinlae O.O (2023).Effects of Think –Pair – Share strategy on senior secondary school students' performance in Mathematics in Ekiti State. International Journal of Academic Research in Business, Arts and Science (IJARBAS.COM), 5(2), p.1-11.

Popoola, A. A. & Ayodele, D. B. (2017). Understanding Geometry using Computer Based Instructions for Teaching and Sustaining Mathematics in Secondary Schools: A Panacea of Economic Recession. The Ekiti State University Journal of Education (EKSUJOE) 7(2) p. 75-80.s

Popoola, A. A. (2014). Effect of play way method on the numeracy skills of early basic education schools pupils in Ekiti State Nigeria Mediterranean Journal of Social Sciences (MJSS). 5(10): 318—325.

Selwyn, N. (2020). *Should robots replace teachers? AI and the future of education*. Polity Press.

Slavin, R. E. (2008). Perspectives on evidence-based research in education: What works? Issues in synthesizing educational program evaluations. *Educational Researcher, 37*(1), 5–14. https://doi.org/10.3102/0013189X08314117

Udu, D. A., & Eze, J. U. (2023). Mathematics literacy and sustainable development: An imperative for Nigeria's future. *International Journal of Educational Studies*, 16(2), 89–102.

Umeh, C. M., & Duru, P. O. (2022). Mathematics anxiety and achievement among senior secondary school students in Nigeria. *Journal of Educational Development*, 11(4), 88–97.

UNESCO. (2022). *Mathematics for a better world*. Paris: United Nations Educational, Scientific and Cultural Organization. Retrieved from https://unesdoc.unesco.org

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press.

Yusuf, M. O., & Okoye, K. R. E. (2022). Artificial intelligence and its role in improving teaching and learning in Nigerian secondary schools. *Journal of Emerging Trends in Educational Research and Policy Studies*, 13(1), 34–42.

Zawacki-Richter, O., Marнn, V. I., Bond, M., & Gouverneur, F. (2019). Systematic review of research on artificial intelligence applications in higher education – where are the educators? *International Journal of Educational Technology in Higher Education, 16*(1), 39. https://doi.org/10.1186/s41239-019-0171-0

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