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Augmenting Students' Academic Achievements in Quadratic Equations through Access and Usage of GenerativeAI-SymboLab in Akwa Ibom State

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Abstract

Generative artificial intelligence (GenAI) is expanding opportunities for digital support in mathematics education. This study examined the relationships between students' access to and use of Symbolab and academic achievement in quadratic equations in Uyo Local Government Area. A mixed-methods research design involved 110 Senior Secondary II mathematics students drawn from intact classes in two schools. Data were collected using the Symbolab Generative AI Questionnaire (SGenAIQ) and the Quadratic Equation Achievement Test (QEAT). Reliability coefficients estimated using the Kuder–Richardson 21 formula were .78 for the SGenAIQ and .72 for the QEAT. Data were analyzed using linear regression. The findings indicated statistically significant positive associations between students' access to Symbolab and achievement, and between their use of Symbolab and achievement, after controlling for gender. Access and use had reported contributions to achievement of 62% and 66%, respectively. These findings suggest that access to and use of Symbolab are relevant to students' achievement in quadratic equations, providing evidence to inform the integration of AI tools into mathematics instruction. The study recommends that educational stakeholders improve the availability, accessibility, and affordability of these tools and that mathematics teachers incorporate Symbolab as an instructional resource to support learning.

Keywords: Generative Artificial Intelligence; Symbolab; Quadratic Equations; Mathematics Education; Academic Achievement

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INTRODUCTION

Generative Artificial Intelligence (GenAI) has emerged as a transformative force in Education, capable of enhancing teaching, learning and assessment through automation, personalization and creativity. Leveraging large language models and multimodal systems, GenAI tool can generate explanations, quizzes, essays and visual materials tailored to individual learning needs (Zawacki-Richter *et al.*, 2019). AI-assisted instruction improves engagement, promotes differentiated learning and supports immediate feedback, which collectively enhance academic Achievement (Kasneci *et al.,* 2023). These tool can simplify complex problem-solving by offering step-by-step reasoning, adaptive practice, and error correction in mathematics and STEM subjects, (Holmes *et al.,* 2021).

Despite the benefits, the use of generative AI in education presents significant challenges. Like accuracy and reliability: AI-generated responses can sometimes contain factual or conceptual errors, particularly in mathematics, where precision is crucial (Kasneci *et al.,* 2023). Over-reliance on Gen AI tool may also hinder students' critical thinking and problem-solving skills, as learners might accept outputs without verifying their correctness (Selwyn, 2023). Moreover, unequal access to digital devices, internet connectivity and AI literacy contributes to a growing "AI divide," disadvantaging learners from under-resourced schools or regions (Holmes *et al.,* 2021). Ethical issues such as data privacy, plagiarism and the opacity of AI decision processes further complicate classroom integration.

Integration of Generative Artificial Intelligence (GenAI) in virtual classrooms also fosters autonomous learning and reduces cognitive overload by presenting abstract ideas unlike Quadratic Equations. Learning through multimodal formats such as text, audio and imagery. Quadratic Equation is a second-degree polynomial equation in one variable, typically expressed in the standard form $ax^2 + bx + c = 0$ (Stewart, 2016). The solutions (or roots) of a Quadratic Equation can be obtained using several methods, including factorization, completing the square and the quadratic formula, which provides a general solution applicable to all Quadratic Equations (Lay *et al.,* 2019). Quadratic Equations are fundamental in mathematics and have wide applications in physics, engineering, economics and computer science, particularly in modeling projectile motion, optimization problems, and area calculations (Stewart, 2016). Quadratic Equations often challenge students due to their abstract nature and the need to understand multiple solution methods, such as factorization and the quadratic formula (Stewart, 2016). Many learners struggle with identifying the

appropriate method to apply in different problem contexts, leading to confusion and errors (Boaler, 2016). The concept of the discriminant and interpreting the nature of roots can also be difficult for students to grasp conceptually (Kieran, 2018). Additionally, weak algebraic manipulation skills, such as handling signs and simplifying expressions, further hinder students' Achievement (Schoenfeld, 2014). These challenges can reduce students' confidence and interest in mathematics if not properly addressed through effective instructional strategies.

The learning of Quadratic Equations has been significantly enhanced through the use of generative artificial intelligence tool such as SymboLab, which provide step-by-step solutions, graphical representations, and interactive feedback that support students' conceptual understanding and procedural fluency (Kumar and Sharma, 2023). By breaking down solution methods such as factorization, completing the square, and the quadratic formula into guided steps, SymboLab enables learners to visualize the problem-solving process, identify errors, and reinforce mathematical reasoning (Lopez, 2022). This aligns with constructivist and self-directed learning principles, as students actively engage with content, explore multiple solution paths, and receive instant feedback, thereby improving retention and problem-solving skills (Siemens, 2005). Furthermore, generative AI tool promote personalized learning by adapting explanations to the learner's pace and needs, making abstract concepts like discriminants and roots more accessible and meaningful (Holmes et al., 2021). Consequently, the integration of tool like SymboLab in teaching Quadratic Equations fosters deeper understanding, increased engagement and improved academic Achievement in mathematics. Holmes *et al.* (2021) suggests that when Gen AI is used as a collaborative tutor rather than a substitute for human instruction, it can improve students' Quadratic Equation reasoning and motivation

SymboLab is an advanced computer algebra system (CAS) and educational platform designed to help students learn and solve mathematical problems step by step across topics such as algebra, calculus, trigonometry, and linear algebra. It utilizes artificial intelligence and symbolic computation to break down complex problems into understandable procedures, thereby supporting conceptual understanding and procedural fluency (SymboLab, 2024). The platform is particularly valuable in mathematics education because it not only provides final answers but also detailed solution steps, enabling learners to identify errors and improve problem-solving skills (Zhu & Simon, 2023). Additionally, SymboLab offers features such as graphing, equation solving, and practice exercises, which make it a comprehensive tool for both independent learning and classroom support. Its accessibility via web and mobile

applications further enhances its usefulness for students in diverse learning environments (SymboLab, 2024). From a gender perspective, tool like SymboLab can help bridge gaps in mathematics achievement and participation between male and female students by providing self-paced, individualized learning opportunities that reduce classroom bias and anxiety often associated with gender stereotypes in STEM fields (UNESCO, 2020). By offering equal access to instructional support and feedback, SymboLab contributes to promoting gender equity in mathematics education.

Academic Achievement refers to the extent to which a student has successfully attained educational goals, learning outcomes, and academic standards set by an educational institution. Achievement is the performance of students in school, Nwagba (2013). However, Bitrus (2024) describe achievement as a measure of knowledge gained through education process usually indicated by test score, grade point average (GPA) or ranking in class. Achievement could be referred to as a learning outcome acquired as a result of test, examination administered to the learners. When students become active in the learning process, achievement is enhanced. This advocates why educational researchers are encouraging for use of Technology and some Generative AI tools like symboLab to enhance student academic achievement.

Statement of the Problem

Despite the rapid global advancement of Generative Artificial Intelligence (GenAI) tool such as SymboLab is improving teaching and learning, their access and effective utilization in education for solving Quadratic Equation within Uyo Local Government Area of Akwa Ibom State remain limited. Quadratic Equation which demands strong visualization, reasoning and problem-solving skills, can be significantly enhanced through these tool that provide interactive simulations, visual illustrations and instant feedback. However, many schools in Uyo face challenges such as poor internet connectivity, lack of digital devices, inadequate teacher training, and limited awareness of AI-assisted learning, which hinder students' access and meaningful use of these innovations. Consequently, students continue to experience difficulties in grasping abstract Quadratic Equation concepts, leading to poor academic achievement. There is also a lack of empirical data on how these GenAI tool are accessed and used by both teachers and students, making it difficult to assess their impact on learning outcomes. However, the researcher intends to investigate the access and usage of

generative AI tool (SymboLab) to enhance students' Achievement in Quadratic Equation in Uyo Local Government Area Akwa Ibom State.

Purpose of the Study

The main purpose of this study is to determine the level of access and usage of generative AI tool (SymboLab) to enhance students' Achievement in Quadratic Equation in Uyo local government Area Akwa Ibom State.

Specifically, the study sought to:

i. To determine the relationship between Access to Generative AI tool (SymboLab) and students' achievement in Quadratic Equation when taught using SymboLab in Uyo Local Government Area, Akwa Ibom State.
ii. To determine the relationship between Use of Generative AI tool (SymboLab) and students' achievement in Quadratic Equation when taught using SymboLab in Uyo Local Government Area, Akwa Ibom State.

Research Questions

The following research questions are formulated to guide the study:

i. What is the relationship between Access to Generative AI (SymboLab) tool and students' achievement in Quadratic Equation when taught using SymboLab in Uyo Local Government Area, Akwa Ibom State?
ii. What is the relationship between Use of Generative AI (SymboLab) tool and students' achievement in Quadratic Equation when taught using SymboLab in Uyo Local Government Area, Akwa Ibom State?

Research Hypotheses

i. There is no significant relationship between Access to Generative AI tool (SymboLab) and students' academic achievement in Quadratic Equation when taught using SymboLab in Uyo Local Government Area, Akwa Ibom State.
ii. There is no significant relationship between Use of Generative AI tool (SymboLab) and students' academic achievement in Quadratic Equation when taught using SymboLab in Uyo Local Government Area, Akwa Ibom State.

METHODS

Research Design

The study adopted a mixed research design This is a research approach that combines both quantitative and qualitative methods within a single study. The researcher adopted this method because it provides a more comprehensive understanding of a research problem than either method could achieve alone. Quantitative methods aid the researcher to generate numerical data that was statistically analyzed to identify patterns, relationships, or differences, while qualitative methods help to collect non-numerical data, such as interviews, focus group discussions, observations, or documents, to explore participants' experiences, perceptions, and meanings. By integrating these two approaches, the researchers corroborate findings, explain statistical results in greater depth, and obtain a richer understanding of the subject matter.

Population, sampling Technique and Instrumentations

This study was carried out in Uyo Local Government Area, Akwa Ibom State, Nigeria. The population of the study consisted of 1096 senior secondary School two (SSII) Mathematics students in 2025/2026 school session from the seventeen (17) public secondary schools in Uyo Local Government, Akwa Ibom State. The sample size consisted of 110 respondents drawn from the entire population of 1096 senior secondary two students (SSII) as intact classes, selected by method of clustered random technqiue from two public secondary school in Uyo Local Government Area, Akwa Ibom State. The researcher developed two instruments titled "SymboLab Generative AI Questionnaire (SGENAIQ) and Achievement Test in Quadratic Equation (QEAT)" with 20 items to be used for data collection. The instrument SGENAIQ is divided into two sections: Section A sought to elicit general information on the personal data of the respondents while Section B contain questionnaire items on Generative Ai tool with 3 items in each clusters A – B.

Instrument Validations and Reliability Indices

The instruments for the study, namely SGenAIQ and QEAT were face and content validated by three experts, one in Computer and Robotics Department and two experts in Mathematics Department of Uyo, Uyo Akwa Ibom State. Their comments and suggestions were incorporated into the final draft of the instrument. The motive of the validation is to ensure the appropriateness of the instrument for the study. The validated instrument was administered on 30 students who were not part of the sample size but members of the accessible population. On computation, the reliability indices for each instrument using the

kuder-Richardson Formula 21 (KR-21) yielded the values 0.78 and 0.73 for SGenAIQ and QEAT respectively.

Experimental Procedure

The researcher obtained permission from the Principal and Heads of Science department in the public secondary school before administering the instrument to the students. The questionnaire administration process was handled by the researcher with the help of research assistants in all public secondary school in Uyo Local government Area of Akwa Ibom State, Nigeria. The treatment lasted for six (6) weeks. The Posttest was administered during and at the end of every treatment for proper evaluation of students' engagement. The duration of the test was an hour; The test contain twenty (20) multiple choice questions with four options (A-D) each questions carried 10 marks score point for students to pick the correct answer from the topics that was taught on Quadratic Equation concepts using SymboLab and SGenAIQ with options: Strongly Disagree (SD), Disagree (D), Agree (A), Strongly Agree (SA) were also given. The responses were collated for scoring and used for analysis. Linear Regression Analysis correlation was used to answer the research questions, as well as to test the null hypotheses at the 0.05 level of significance.

RESULTS

Research Question 1: Relationship between access to Generative AI tool (SymboLab) and students' Achievements in Quadratic Equation

Table 1 Relationship between access to Generative AI tool (SymboLab) and students' Achievements in Quadratic Equation

Source of Variation	r	R^2	Adj. R^2	F-test	Sig.	Remark
Level of Access to SymboLab	.791	.63	.62	178.52	.000	MP
Students' Achievement in Quadratic Equation						

Source: Field Data (2026): MP: Moderately positive

This is the correlation and regression coefficient of determination that establishes the relationship between students' level of access to SymboLab and their Achievement in Quadratic Equations. The result indicates a strong positive relationship between access to SymboLab and students' Achievement, as reflected by the correlation coefficient ($r = .791$). The coefficient of determination ($R^2 = .63$) reveals that 63% of the variation in students' Achievement in Quadratic Equations can be explained by their level of access to SymboLab.

The adjusted R^2 value of .622 further confirms that the model provides a reliable estimate of the influence of access to SymboLab on students' achievement, even after adjusting for gender as a potential source of confounding variable. This finding implies that increased access to SymboLab significantly contributes to improved students' Achievement in Quadratic Equations, suggesting that the availability and accessibility of the platform play an important role in supporting mathematics learning outcomes. Furthermore, the result indicates that the regression model is statistically significant. This implies that there is a significant relationship between students' level of access to SymboLab and their Achievement in Quadratic Equations[$F(1,107) = 211.21, p = .00$].

Research Question 2: Relationship between Use of Generative AI tool (SymboLab) and students' achievement in Quadratic Equation

Table 2: Relationship between Use of Generative AI tool (SymboLab) and students' achievement in Quadratic Equation

Source of Variation	r	R^2	Adj. R^2	F-test	Sig.	Remark
Level of usage to SymboLab	.815	.66	.66	211.21	p = .00	SP
Students' Achievement in Quadratic Equation						

Source: Field Data (2026): SP: Strongly Positive

Table 2 presents the regression analysis on the level of usage of SymboLab in enhancing students' Achievement in Quadratic Equations. The result indicates a strong positive relationship between the level of usage of SymboLab and students' Achievement, with a correlation coefficient (r) of 0.815. The coefficient of determination ($R^2 = 0.66$) shows that 66% of the variation in students' Achievement in Quadratic Equations can be explained by their level of usage of SymboLab. The adjusted R^2 value of 0.661 further confirms that the model provides a good fit, indicating that SymboLab usage significantly contributes to predicting students' Achievement in Quadratic Equations, after controlling for gender as a possible confounding variable. Therefore, the finding suggests a significant increase in usage of SymboLab is associated with improved students' achievement in Quadratic Equations [$F(1,107) = 211.21$] demonstrating the effectiveness of the tool as a supportive instructional resource for mathematics learning.

DISCUSSION

The level of access of SymboLab and Students' Achievement in Quadratic Equation

The finding of the study indicates that increased access to SymboLab significantly contributes to improved students' Achievement in Quadratic Equation, demonstrating that the availability and accessibility of the platform enhance students' engagement, understanding and achievement in mathematics learning. This result suggests that when students have adequate access to SymboLab, they are more likely to benefit from its step-by-step solutions, immediate feedback, and problem-solving support, which can strengthen their conceptual understanding of Quadratic Equations. Consequently, the null hypothesis stating that there is no significant difference between students' level of access to SymboLab and their Achievement in Quadratic Equations in Uyo Local Government Area, Akwa Ibom State was rejected, implying that access to the platform is an important factor influencing learning outcomes. This finding is consistent with the study by Eze (2025), which examined the influence of SymboLab on students' motivation and Achievement and reported that the use of SymboLab positively enhances students' learning experiences and academic achievement. Both studies are related because they emphasize the effectiveness of SymboLab as a digital mathematics learning tool that supports improved Achievement. However, they differ in focus, as the present study specifically examines the influence of students' access to SymboLab on Achievement in Quadratic Equations, whereas Eze (2025) focused more broadly on how SymboLab affects students' motivation and overall academic achievement. Thus, the present finding extends existing literature by highlighting access as a critical condition for maximizing the educational benefits of SymboLab in mathematics instruction.

The level of usage of SymboLab and Students' Achievement in Quadratic Equation

The finding of the study reveals that increased usage of SymboLab is significantly associated with improved students' achievement in Quadratic Equations, indicating that the platform serves as an effective instructional resource that supports mathematics learning and enhances students' problem-solving abilities. The result further demonstrates that the level of usage of SymboLab has a significant effect on students' Achievement in Quadratic Equations; hence, the null hypothesis which states that there is no significant difference between the level of usage of SymboLab and students' Achievement in Quadratic Equations in Uyo Local Government Area, Akwa Ibom State was rejected. This is possible because frequent

engagement with SymboLab provides students with opportunities for guided practice, immediate solution feedback, and deeper understanding of mathematical concepts, thereby contributing to improved academic outcomes. The finding is consistent with the study by Khan and Adewale (2023), which investigated the effect of SymboLab on students' conceptual understanding of algebraic and Quadratic Equation relationships. They found out that the use of SymboLab enhanced students' comprehension of mathematical concepts. Both studies are related as they highlight the positive influence of SymboLab on students' mathematics learning outcomes, particularly in improving understanding and achievement. Therefore, the present study contributes further evidence that consistent and purposeful use of SymboLab can improve students' achievement in specific mathematical topics such as Quadratic Equations.

CONCLLUSION

The study concludes that the use of SymboLab significantly enhances students' Achievement in Quadratic Equations by providing an effective digital learning platform that supports improved understanding, problem-solving skills, and academic achievement in mathematics. The findings demonstrate that increased access to and usage of SymboLab positively influences students' learning outcomes, indicating that the availability of the tool and students' engagement with its features are important factors in promoting mathematics achievement. Therefore, the study concludes that integrating SymboLab into mathematics instruction can serve as a valuable instructional strategy for improving students' learning experiences and academic Achievement in Quadratic Equations.

Recommendations

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

1. It is recommended that secondary schools, educational authorities, and stakeholders should provide adequate access to digital learning platforms such as SymboLab to enhance students' engagement and achievement in mathematics.
2. Mathematics teachers should integrate SymboLab into instructional activities and encourage students to use the platform as a supplementary learning resource for practicing and solving Quadratic Equations.

3. Schools should promote equal opportunities for all students to access and utilize digital mathematics tools, ensuring that technology-supported learning benefits learners irrespective of gender.
4. Educational policymakers should develop strategies and programmes that improve students' digital literacy and technological skills, enabling them to effectively utilize SymboLab and other computer-based learning resources for improved mathematics learning outcomes.

REFERENCES

Adeyemi, T. O. (2024). SymboLab as a learning assistant and its impact on students' academic achievement in higher education. *Journal of Educational Technology and Innovation, 18*(2), 45–57.

Ainamani, H. E., Twine, J., & Okurut, F. N. (2023). Artificial intelligence-enhanced SymboLab and students' conceptual understanding in quadratic equations: An exploratory study. *International Journal of STEM Education, 10*(1), 1–14.

Akhtar, Z. B. (2024). Unveiling the evolution of generative AI (GAI): A comprehensive and investigative analysis toward LLM models (2021–2024) and beyond. *Journal of Electrical Systems and Information Technology, 11*(1), Article 22. https://doi.org/10.1186/s43067-024-00145-1

AlAli, R. M., & Al-Barakat, A. A. (2023). The effectiveness of SymboLab in enhancing mathematics learning and teaching. *Eurasian Journal of Educational Research, 23*(1374), 1–12.

Al-Malah, K. (2024, August 30). *What is ChatGPT? Generative AI in action*. ICARUS Education. https://icarus.education/what-is-chatgpt/

Anton, H., Bivens, I., & Davis, S. (2013). *Calculus* (10th ed.). Wiley.

Banerjee, S. (2023). *The conundrum of ChatGPT*. Indian Institute of Technology Delhi. https://www.cse.iitd.ac.in/~suban/reports/SymboLab2.pdf

Bian, N., Han, X., Sun, L., Lin, H., Lu, Y., He, B., Jiang, S., & Dong, B. (2023). *ChatGPT is a knowledgeable but inexperienced solver: An investigation of commonsense problem in large language models*. arXiv. https://doi.org/10.48550/arXiv.2303.16421

Boaler, J. (2016). *Mathematical mindsets: Unleashing students' potential through creative math, inspiring messages and innovative teaching*. Jossey-Bass. https://ccsre.stanford.edu/publications/mathematical-mindsets-unleashing-students-potential-through-creative-math-inspiring

Butler, J. (1990). *Gender trouble: Feminism and the subversion of identity*. Routledge.

Casteleiro-Pitrez, J. (2024). Generative artificial intelligence image tools among future designers: A usability, user experience, and emotional analysis. *Digital, 4*(2), 316–332. https://doi.org/10.3390/digital4020016

Connell, R. W. (2009). *Gender: In world perspective* (2nd ed.). Polity Press.

Lay, D. C., Lay, S. R., & McDonald, J. J. (2019). *Linear algebra and its applications* (5th ed.). Pearson.

Stewart, J. (2016). *Calculus: Early transcendentals* (8th ed.). Cengage Learning. https://www.cengage.com/c/calculus-early-transcendentals-8e-stewart/9781285741550