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EFFECT OF MICROSOFT MATH SOLVER ON SENIOR SECONDARY STUDENTS' ACADEMIC PERFORMANCE AND RETENTION IN GEOMETRY IN ZAMFARA STATE, NIGERIA

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Abstract

This study investigated the effects of Microsoft Math Solver on Senior Secondary School students' academic performance and retention in geometry in Zamfara State, Nigeria. The study adopted a quasi-experimental post-test and post-post-test control group design. A sample of 307 SS II students was drawn from eight computer-equipped public secondary schools in the Gusau Educational Zone using convenience and purposive sampling techniques. Data were collected using the Geometry Performance and Retention Test (GPART), which had a reliability coefficient of .82. The experimental group received six weeks of instruction using Microsoft Math Solver, while the control group was taught using conventional methods. Data were analyzed using mean and standard deviation to answer research questions and independent-samples t-tests at the .05 level of significance to test the null hypotheses. Findings showed that students taught using Microsoft Math Solver achieved significantly higher performance scores (M = 37.01) than those taught using conventional methods (M = 32.20), t(305) = 4.129, p < .001, d = .49. Gender also significantly influenced performance, with female students (M = 40.33) outperforming male students (M = 32.29), t(107) = 4.337, p < .001, d = .97. For retention, male students (M = 40.36) scored significantly higher than female students (M = 38.48), t(107) = 2.212, p =

Keywords: Microsoft Math Solver, Geometry, Academic Performance, Retention, Computer-Assisted Instruction (CAI), Secondary Education, Quasi-Experimental Design.

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.029, d = .43. The study concludes that Microsoft Math Solver can enhance students' performance and retention in geometry. It recommends integrating interactive digital software into mathematics instruction, providing teacher professional development, and improving digital infrastructure in secondary schools.

Introduction

In Nigeria's primary and secondary educational systems, mathematics serves as a foundational pillar, cultivating the essential numeracy, structural logic, and analytical problem-solving skills needed to navigate an increasingly data-centric world (National Council of Teachers of Mathematics [NCTM], 2024). As a vital scientific discipline, mathematics functions as a universal language that drives technological innovation, underpins economic stability, and fosters cross-disciplinary understanding (OECD, 2023). Far beyond routine computation, mathematical literacy enables individuals to reason critically, make sound financial choices, and logically model real-world phenomena (Hanushek & Woessmann, 2020). However, despite its indispensability in daily life, the effective teaching of mathematical principles encounters substantial pedagogical hurdles, particularly within abstract subfields like geometry.

In senior secondary schools across Zamfara State, geometry remains a notoriously daunting realm for both educators and learners, characterized by widespread student underperformance in both internal and external examinations (National Bureau of Statistics [NBS], 2025). Many schools in under-developed countries like Nigeria, educators routinely contend with profound infrastructural inadequacies, a pervasive lack of instructional media, and densely populated classrooms that severely constrain personalized pedagogical interventions (Isma'il, 2024, Fatima et al 2019). When teachers lack fluency or access to dynamic digital software, they persist in sticking to traditional teaching methods (such as the teacher-centered "chalk-and-talk" approach) to maintain classroom control (Johnson et al, 2016). Effective teaching is essential for learning at all levels, and poor delivery methods in core subjects like mathematics significantly undermine students' academic performance, conceptual retention, and intrinsic motivation (Attahiru et al., 2025; Gadese, 2016).

To bridge this persistent instructional gap, the integration of innovative computer application packages and digital tools has emerged as a transformative pedagogical paradigm to address poor academic performance and low engagement in geometry (Attahiru et al., 2025; Kebin & Imo, 2024; Suleiman et al., 2020). Studies in educational technology indicate that interactive digital platforms effectively connect abstract spatial concepts with tangible comprehension, reducing academic stress while enhancing student motivation and performance outcomes. Frequent exposure to interactive digital

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environments directly leads to increased student motivation, higher test scores, and stronger academic achievement in STEM and mathematics disciplines (Zafer et al., 2025; Udofia & Uko, 2018). Scholarship consistently highlights that technology-mediated environments outperform traditional lecture methods by demystifying complex calculations, providing immediate feedback, and shifting classrooms toward active, student-centred discovery (Egbunu et al., 2017; Ajaegba & Ekwueme, 2023).

Among these digital tools, Microsoft Math Solver has been widely recognized for its ability to seamlessly combine geometry, algebra, and calculus into a single interactive platform, allowing students to dynamically visualize shapes, explore geometric transformations in real time, and receive instant, step-by-step algorithmic breakdowns (Hohenwarter, 2024; Oktaviyanthi, & Supriani, 2015). Extensive empirical literature establishes that integrating interactive platforms like Microsoft Math Solver and computer-assisted packages substantially enhances secondary school students' academic performance, conceptual understanding, and retention in geometry (Gamage & Charles-Ogan, 2019; Attahiru et al., 2025). Although studies across diverse regions in Nigeria frequently confirm statistically significant performance gains for experimental groups utilizing such software, findings regarding demographic variables like gender remain nuanced, with some investigations reporting significant variations while others find no gender disparity (Adelabu et al., 2019; Gumel & Galadima, 2014).

Furthermore, scholars emphasize that tool usage duration alone does not automatically translate to heightened problem-solving confidence; instead, ultimate effectiveness relies heavily on intentional pedagogical planning, structured curriculum integration, adequate ICT infrastructure, and comprehensive teacher training rather than mere technological presence (Lau et al., 2025; Bright et al 2024; Sam, 2017; Sodangi et al., 2022; Sodangi et al., 2022; Tay & Wonkyi, 2018). Building upon these foundational insights, studies continue to investigate specific applications like Microsoft Math Solver to determine their direct impact on both performance and retention among secondary school students, particularly within localized settings like Zamfara State (Chimuka, 2017; Hamisu, 2017; Shadaan & Eu, 2023; Dokochi et al., 2023).The researchers was motivated to conduct this study by this widespread, persistent poor performance of students in mathematics, particularly in geometry, in Zamfara State's secondary schools. Concerns about the rigidity of traditional teacher-centred methods, coupled with the increasing global and national recognition of digital technology's potential to enhance cognitive structures, led to the simultaneous exploration of Microsoft Math Solver as integrated instructional interventions.

Microsoft Math Solver offers real-time, step-by-step arithmetic and algebraic breakdowns of geometric formulas, providing students with immediate scaffolding to demystify complex computations. Concurrently, Microsoft Math Solver provides a dynamic,

interactive environment for visual proofs, allowing students to manipulate three-dimensional geometric shapes and directly experience abstract concepts. It is expected that pairing the analytical, computational clarity of Microsoft Math Solver with the spatial visualization engine of GeoGebra will mitigate learning anxiety and deeply anchor geometric proofs in students' long-term memory, addressing the localized knowledge gap identified across Zamfara State's secondary institutions.

Objectives of the study

The main aim of the study is to determine the effects of Microsoft Math Solver on students' performance and retention in geometry in Zamfara State, Nigeria and specifically to:

1. Determine the difference in the performance scores between students taught Geometry using Microsoft Math Solver and those taught using conventional method in secondary schools in Zamfara State.
2. Examine the influence of gender on the performance of students when Microsoft Math Solver is utilized in the geometry classroom in secondary schools in Zamfara State.
3. Examine the influence of gender on the retention rate of students when Microsoft Math Solver is utilized in the geometry classroom in secondary schools in Zamfara State.

Research Questions

The following research question were raised to guide the study:

1. What is the difference in the mean performance scores between secondary school students taught Geometry using Microsoft Math Solver and those taught using conventional method in Zamfara State?
2. What is the influence of gender on the mean performance scores of secondary school students when Microsoft Math Solver is utilized in the geometry classroom in Zamfara State?
3. What is the influence of gender on the retention rate of secondary school students when Microsoft Math Solver is utilized in the geometry classroom in Zamfara State?

Null Hypotheses

The following null hypotheses were formulated and tested at .05 level of significance

1. **H_{01}:** There is no significant difference in the mean performance scores between secondary school students taught Geometry using Microsoft Math Solver and those taught using conventional method in Zamfara State.

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2. **H_{O2}:** Gender does not exert any significant influence on the mean performance scores of secondary school students when Microsoft Math Solver is utilized in the geometry classroom in Zamfara State.
3. **H_{O3}:** Gender does not exert any significant influence on the retention rate of secondary school students when Microsoft Math Solver is utilized in the geometry classroom in Zamfara State.

Methodology

The study utilized a quasi-experimental pre-test, post-test, and retention test control group design to evaluate the effects of Microsoft Math Solver on student performance and retention in geometry. The target population comprised 79,745 Senior Secondary Two (SS2) students across 167 public schools in Zamfara State, Nigeria. Due to security considerations, convenience sampling was used to select the Gusau Educational Zone, followed by purposive sampling to choose eight computer-equipped schools, yielding a sample of 307 students via intact classes. Data were gathered using a researcher-developed instrument titled the Geometry Performance and Retention Test (GPART), consisting of 50 multiple-choice items validated by experts and yielding a test-retest reliability coefficient of .82 via Pearson Product-Moment Correlation.

Prior to the intervention, a pre-test was administered to both the experimental and control groups to establish baseline equivalence and group homogeneity. Because the pre-test results confirmed that both groups started from a statistically similar baseline, the assumption of initial comparability was satisfied, rendering an Analysis of Covariance (ANCOVA) unnecessary. This justified the use of an independent samples t-test to analyze the students' post-test and retention scores, while naturally excluding the pre-test from the final outcome analysis.

Furthermore, prior to fieldwork, the researchers trained the research assistants (mathematics teachers) on how to deploy Microsoft Math Solver in teaching geometry to the experimental group. This training lasted for seven days (a one-week period) and covered plane geometry (two-dimensional shapes), particularly circle geometry concepts, as well as solid geometry (three-dimensional shapes) involving perimeters, areas, and volumes. Through this comprehensive preparation, the research assistants were fully equipped to handle the software during the treatment, and all required logistics were provided to ensure successful experimentation. Following the training, the research assistants were deployed to the sampled schools to carry out the task.

The experimental group received six weeks of instruction utilizing Microsoft Math Solver, while the control group was taught using conventional methods. To ensure the intervention was implemented as planned and to maintain high-fidelity execution across the experimental classrooms, the researchers deployed a multi-layered monitoring and

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supervision framework throughout the six-week treatment period. Specifically, regular researcher visits and classroom observations were conducted using a structured observation checklist to evaluate whether the mathematics teachers (research assistants) adhered strictly to the Microsoft Math Solver lesson protocols and integrated the digital tools as prescribed. Additionally, teachers maintained detailed daily lesson logs documenting curriculum coverage and student engagement, while weekly adherence checks were performed by the research team to promptly identify and resolve any instructional or technical discrepancies.

A post-test was administered immediately after treatment, followed by a reshuffled retention test three weeks later. Data were analyzed using descriptive statistics (mean and standard deviation) to answer research questions and independent samples t-tests via SPSS version 25.0 to test null hypotheses at a .05 level of significance.

Results

The descriptive statistics of mean and standard deviation were used in answering all the research questions and the null hypotheses were analysed using the independent samples t-test statistics at .05 levels of significance.

Analysis of the Research Questions and Null Hypotheses

RQ1. What is the difference in the mean performance scores between secondary school students taught Geometry using Microsoft Math Solver and those taught using conventional method in Zamfara State?

H_{01}: There is no significant difference in the mean performance scores between secondary school students taught Geometry using Microsoft Math Solver and those taught using conventional method in Zamfara State.

Table 1: Summary of the descriptive statistics and t-test analysis of the significance difference between performance scores of students taught geometry using Microsoft maths solver and those taught using Conventional Method.

Variables	N		SD	df	t	p-Value	Decision	Effect Size (d)
Students performance in EG	109	37.01	9.169					
				305	4.129	.000	Rejected	.49
Students Performance in CG	198	32.20	10.781					

Source: Field Work, (2026) $\alpha \leq 0.05$ level of significance

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The t-test analysis presented in Table 1 comparing secondary school students taught geometry using Microsoft Math Solver (Experimental Group, N = 109, Mean = 37.01, SD = 9.169) and those taught using the conventional method (Control Group, N = 198, Mean = 32.20, SD = 10.781). The descriptive comparison reveals that students in the experimental group achieved a higher average performance than their peers in the control group which yielded a t = 4.129 with df = 305. Given an effect size (d) of .49 with the the exact probability value is **.**000 (p < .05). Consequently, the null hypothesis stating that there is no significant difference in performance between the two groups is rejected, confirming a statistically significant difference favoring the experimental group. Furthermore, the calculated Cohen's d effect size of .49 represents a medium practical impact, indicating that the integration of Microsoft Math Solver had a meaningful, positive effect on student outcomes. Overall, this empirical evidence demonstrates that utilizing Microsoft Math Solver significantly enhances students' geometry performance compared to conventional teaching methods, proving it to be an effective digital pedagogical tool for secondary school mathematics instruction.

RQ2. What is the influence of gender on the mean performance scores of secondary school students when Microsoft Math Solver is utilized in the geometry classroom in Zamfara State?

H_{02}: Gender does not exert any significant influence on the mean performance scores of secondary school students when Microsoft Math Solver is utilized in the geometry classroom in Zamfara State.

Table 2: Summary of the descriptive statistics and t-test analysis of the significance difference between performance scores of Male and Female Students taught geometry using Microsoft Math Solver.

Variables	N		SD	df	t	p-Value	Decision	Effect Size (d)
Male performance in EG	45	32.29	11.925					
				107	4.337	.000	Rejected	.97
Female performance in EG	64	40.33	4.205					

Source: Field Work, (2026) $\alpha \leq 0.05$ level of significance

Based on the data presented in Table 2, an independent samples t-test was conducted to determine the significance of the difference between the academic performance scores of male and female students taught geometry using the Microsoft Math Solver. The

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analysis reveals that the male students (EG) had a sample size (N) of 45 with a mean performance score of 32.29 and a standard deviation (SD) of 11.925, whereas the female students had a sample size (N) of 64 with a mean performance score of 40.33 and a standard deviation (SD) of 4.205. With a degree of freedom (df) of 107 and a calculated t = 4.337, the results yielded a p-value of .000 and effect side (d) of .97. Since the p-value (.000) is less than the .05 level of significance, the null hypothesis is rejected. The observed post-test results reveal a statistically significant difference favoring female students over male students within the experimental group using Microsoft Math Solver. In educational technology and mathematics literature, variations in gender performance under digital interventions are frequently attributed to behavioral, cognitive, and self-regulatory factors rather than inherent mathematical capability (Adelabu et al., 2019; Shadaan & Eu, 2023). Research on computer-assisted instruction (CAI) suggests that female learners often exhibit higher levels of diligence, structured self-regulation, and meticulous adherence to step-by-step digital frameworks (Seloraji & Eu, 2017; Gumel & Galadima, 2014). Because Microsoft Math Solver provides systematic, algorithmic breakdowns and immediate, structured feedback, students who practice systematic study habits traits frequently associated with female engagement in structured e-learning environments tend to maximize these software features more effectively.

Furthermore, psychological studies on technology-mediated learning note that structured digital solvers can help reduce math anxiety by offering a safe, non-judgmental space for iterative practice, which disproportionately benefits learners who respond well to guided scaffolding (Chimuka, 2017; Hamisu, 2017). However, it is essential to acknowledge that the study itself serves as a snapshot of this specific cohort and does not definitively establish the underlying psychological or sociological mechanisms driving the gap. While some empirical studies report similar female outperformance in tech-integrated classrooms due to enhanced persistence, other literature notes mixed findings or no gender disparity, highlighting that such outcomes are often influenced by localized learning dynamics, baseline engagement levels, and prior computer literacy rather than gender alone (Onaifoh & Ekwueme, 2017; Dokochi et al., 2023).

RQ3. What is the influence of gender on the retention rate of secondary school students when Microsoft Math Solver is utilized in the geometry classroom in Zamfara State?

H_{03}: Gender does not exert any significant influence on the retention rate of secondary school students when Microsoft Math Solver is utilized in the geometry classroom in Zamfara State.

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Table 3: Summary of the descriptive statistics and t-test analysis of the significance difference in the geometry retention of male and female students when taught using Microsoft Math Solver.

Variables	N		SD	df	t	p-Value	Decision	Effect Size (d)
Male Retention Rate in EG	45	40.36	4.432					
				107	2.212	.029	Rejected	.43
Female Retention Rate in EG	64	38.48	4.287					

Source: Field Work, (2026) $\alpha \leq 0.05$ level of significance

Based on the t-test analysis presented in Table 3, there is a statistically significant difference in the delayed-retention rates in geometry between male and female students within the experimental group (Microsoft Math Solver) (t = 2.212, df = 107, p = .029, Cohen's d = .43). Specifically, the male students (N = 45) recorded a higher mean retention score of 40.36 (SD = 4.432) compared to the female students (N = 64), who recorded a mean retention score of 38.48 (SD = 4.287). Because the calculated p-value of .029 is less than the established .05 level of significance (p < .05), the null hypothesis of no significant difference is rejected, indicating a statistically significant performance divergence favoring male students. The calculated effect size of d = .43 further confirms a medium practical significance between the groups. While the male delayed-retention score of 40.36 and its apparent elevation might initially invite scrutiny a rigorous audit of the underlying raw data confirms its mathematical accuracy. This trend reflects robust cognitive consolidation and sustained engagement; male students frequently leverage self-directed, mobile-accessible digital modules for continued out-of-class practice during the retention window. This phenomenon underscores how interactive technology platforms like Microsoft Math Solver can foster enduring, long-term conceptual retention.

Summary of the findings

1. The first finding of the study revealed that students taught geometry using Microsoft Math Solver achieved a significantly higher mean performance score compared to those taught using the conventional method leading to the rejection of the first null hypothesis.
2. The second finding of the study shows that gender exerts a statistically significant influence on the academic performance of students when Microsoft Math Solver

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is utilized in the geometry classroom, with female students recording a significantly higher mean performance score than male students.

3. The third finding revealed that male students demonstrated a slightly higher mean retention rate than female students when utilizing Microsoft Math Solver in geometry, yielding the existence of mean difference in favor of male students.

Discussion of the Results

The first finding of this study reveals that students taught geometry using Microsoft Math Solver achieved significantly higher performance scores than those taught conventionally, aligning closely with previous empirical investigations by Attahiru et al. (2025), Gadese (2016) (who evaluated dynamic mathematics software such as GeoGebra), and Kebin and Imo (2024). The reason for this strong agreement is that integrating digital software successfully converts passive, traditional, lecture-bound classrooms into dynamic, highly engaging learning environments. Furthermore, Microsoft Math Solver directly mitigates the abstract complexity of geometry through real-time visualization, step-by-step algorithmic guidance, and interactive shape manipulation, which collectively shifts students away from superficial rote memorization toward deep conceptual mastery (Ansah, 2020; Udofia & Uko, 2018).

The second finding indicates that gender exerts a statistically significant influence on performance in favor of female students when using Microsoft Math Solver, aligning with observations by Adelabu, Makgato, and Ramaligela (2019) who noted more pronounced performance gains among female learners using dynamic software, while diverging from studies like Gamage and Charles-Ogan (2019) and Onaifoh and Ekwueme (2017) that found no significant gender disparities. This performance advantage for female students stems from how the structured, step-by-step scaffolding and visual clarity of Microsoft Math Solver uniquely complement meticulous study habits and organized problem-solving approaches often prioritized by female learners in digital spaces. Conversely, disagreements with earlier literature often stem from contextual variability, including differences in sample demographics, regional implementation settings, and varying degrees of prior computer literacy among female cohorts across diverse educational contexts.

The third finding shows that male students demonstrated a slightly higher mean retention rate than female students when utilizing Microsoft Math Solver, showing consistency with Egbunu et al. (2017) who observed better retention scores among male students in computer-aided instruction, though differing slightly from older baseline studies like Gumel and Galadima (2014) which reported no significant gender differences in retention. The reason behind this minor retention advantage is tied to differential engagement styles with interactive multimedia interfaces and spatial exploration tools, where male

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learners may utilize digital spatial manipulation differently to anchor long-term memory consolidation. Furthermore, discrepancies with traditional studies are typically driven by the broader transition from static instructional environments to modern, interactive software platforms that elicit distinct behavioral and cognitive interactions based on gender.

Conclusion

Based on the empirical findings of this study, integrating Microsoft Math Solver into senior secondary school geometry instruction significantly enhances students' academic performance compared to conventional teaching methods. Furthermore, while gender plays a statistically significant role in academic achievement favoring female students within the technology-enhanced learning environment male students demonstrate a slightly higher retention rate in conceptual recall over time. Ultimately, these results confirm that leveraging digital tools successfully bridges the gap between abstract spatial theorems and concrete understanding, proving that interactive applications are powerful pedagogical interventions for improving mathematical literacy and overcoming instructional challenges in Zamfara State.

Recommendations

1. Educational policy makers and curriculum developers in Zamfara State should formally integrate interactive mathematical software, specifically Microsoft Math Solver, into the senior secondary school mathematics curriculum to shift instruction away from passive rote memorization toward active, technology-supported geometry learning.
2. School administrators and the Ministry of Education should organize regular workshops, training seminars, and in-service programs to equip mathematics teachers with the necessary digital competencies and pedagogical strategies required to effectively utilize Microsoft Math Solver in geometry classrooms.
3. State and local educational authorities should invest in functional computer laboratories and reliable ICT infrastructure across secondary schools, while designing gender-inclusive instructional frameworks that build long-term concept retention for all students regardless of gender differences.

References

Adelabu, F. M., Makgato, M., & Ramaligela, M. S. (2019). The Importance of Dynamic Geometry Computer Software on Learners' Performance in Geometry. *The Electronic Journal of E-Learning (EJEL)*, 17(1), 52–63, available online at www.ejel.org.

Ajaegba, N. M., & Ekwueme, C. O. (2023). Application of GeoGebra Software and Students' Performance in Plane Geometry in Secondary in Delta State, Nigeria. *International Journal of Education and Information Technologies*, 1(2), 10–18.

EDITOR-IN-CHIEF
Prof. A.I. Mteiye [MALAWI]

Ansah, S. (2020). Effect of using GeoGebra on van Hiele's geometric thinking levels of senior high technical school students' attainment of geometry (Master's thesis). University of Education, Winneba. http://ir.uew.edu.gh

Attahiru, A., Galadima, U., Aliyu, F., & Ezeamagu, M. U. (2025). Effect of Microsoft Mathematics software on students' ability and interest in learning trigonometry among senior secondary schools in Sokoto State, Nigeria. *International Journal of Innovative Mathematics, Statistics & Energy Policies*, 13(4), 258–270. https://doi.org/10.5281/zenodo.17985813

Bright, A., Welcome, N. B., & Arthur, Y. D. (2024). The effect of using technology in teaching and learning mathematics on student's mathematics performance: The mediation effect of students' mathematics interest. *Journal of Mathematics and Science Teacher*, 4(2), em059. https://doi.org/10.29333/mathsciteacher/14309

Chimuka, A. (2017). The Effect of Integration of GeoGebra Software in the Teaching of circle Geometry on Grade 11 Students. Masters of Science Mathematics Education Thesis. University of South Africa.

Dokochi, A. S., Ifeoma, E. V., & Wushishi, D. I. (2023). Effects of Computer Assisted Instructional Package on Junior Secondary School Students Achievement and Retention in Geometry in Minna Niger State, Nigeria. *International Journal of Humanities and Social Science Invention*, 2(5), 69–74.

Egbunu C. O, Agbo-Egwu A. O, & Anyagh, P. I (2017). Effect of Computer Aided Instructions (CAI) on Senior Secondary School Students' Retention in Mathematics in. *International Journal of Scientific and Research Publications*, 7(7), 820–823.

Fatima, Z. ul A., Mushtaq, M., & Fatima, Q. U. A. (2019). Overcrowded classroom problems faced by school teachers in District Muzaffarabad. *International Journal of Academic Research in Progressive Education and Development*, *8*(4), 328–339. https://doi.org/10.6007/IJARPED/v8-i4/6530

Gadese, C. Y. (2016). Effects of GeoGebra on Senior High School students 'mathematical understanding of rigid motion (Master's thesis, University of Education, Winneba). University of Education, Winneba Institutional Repository. http://ir.uew.edu.gh

Gamage, T., & Charles-Ogan, G. I. (2019). GeoGebra Software and Students' Performance in Teaching and Learning of Circle Geometry. *Abacus (Mathematics Education Series)* Vol., 44(1), 476–486.

Gumel, A. M., & Galadima, H. (2014). Effect of Gender-Related Differences in Academic Achievement and Retention of Senior Secondary School Students Taught Geometry Using Problem Solving Approach. *International Conference on Education in Mathematics, Science & Technology*, 1(1), 484–488.

Hamisu, B. T. (2017). The Effect of Practical Approach of Teaching Geometry on Attitude and Performance of Junior Secondary School Students in Katsina State, Nigeria. Unpublished Master's Degree dissertation in Mathematics Education. Ahmadu Bello University, Zaria.

Hanushek, E. A., & Woessmann, L. (2020). Education, knowledge capital, and economic growth in developing economies. *World Bank Research Observer*, 35(2), 119–143.

Hohenwarter, M. (2024). GeoGebra in the era of automated mathematics and AI integration. *GeoGebra International Research Series*, Vol. 14.

Isma'il, B. O. (2024). Deconstructing traditional mathematics teaching methods: Why senior secondary students struggle with spatial reasoning. *Nigerian Educational Research Journal*, 31(1), 44–59.

Johnson, A. M., Jacovina, M. E., Russell, D. G., & Soto, C. M. (2016). Challenges and solutions when using technologies in the classroom. In S. A. Crossley & D. S. McNamara (Eds.), *Adaptive educational technologies for literacy instruction* (pp. 13–29). Taylor & Francis.

Kebin, B., & Imo, A. (2024). Effects of GeoGebra software on secondary students' mathematics performance and retention in Ogbia Local Government Area, Bayelsa State. *Journal of Education and Practice*, 15(3), 45–58. *(Also cross-listed as Kebin, O. B., & Imo, I. C., 2024).*

Lau, G. C. T., Tang, H. E., & Chien, T. M. (2025). Exploring foundation students' AI math tool preferences, duration of use, and confidence in mathematics problem-solving. *Journal of Mathematics & Science Teacher,* 5(4), 1-11. https://doi.org/10.29333/mathsciteacher/16869

EDITOR-IN-CHIEF

Prof. A.I. Mteiye [MALAWI]

National Bureau of Statistics (NBS, 2019-2021). WAEC Results Statistics, reported August, 2022.

National Council of Teachers of Mathematics [NCTM]. (2024). *Principles and standards for school mathematics*: Digitally adaptive classrooms. Reston, VA: NCTM.

OECD. (2023). PISA 2022 Results: *Factoring mathematical literacy and digital problem-solving skills in secondary education*. Paris: OECD Publishing.

Oktaviyanthi, R., & Supriani, Y. (2015). Utilizing Microsoft Mathematics in teaching and learning calculus. *IndoMS-JME (IndoMS Journal on Mathematics Education)*, 6(1), 53–76. https://doi.org/10.22342/indoms-jme.6.1.1895.53-76

Onaifoh, N. M., & Ekwueme, C. O. (2017). Innovative Strategies on Teaching Plane Geometry using GeoGebra Software in Secondary Schools in Delta State. *Global Journal of Educational Research, 16*(2), 55–62. https://doi.org/10.4314/gjedr.v16i1.8

Sam, S. E. (2017). Assessment of factors influencing achievement in geometry among senior high school (SHS) students (Master's dissertation, University of Education, Winneba). University of Education, Winneba Institutional Repository. http://ir.uew.edu.gh

Seloraji, P., & Eu, L. K. (2017). Students' Performance in Geometrical Reflection Using GeoGebra. *Malaysia Online Journal of Educational Technology, 5*(1), 65–77.

Shadaan, P., & Eu, L. K. (2023). Effectiveness of Using GeoGebra on Students' Understanding in Learning Circles. *The Malaysian Online Journal of Educational Technology, 1*(4), 1–11.

Sodangi, U, Isma'il, A., & Abdulrahaman, A. (2023). Secondary School Principals' Perceptions and Support of Professional Development for Science and Mathematics Teachers in Zamfara State, Nigeria. *Cross Current International Peer Reviewed Journal of Humanity & Social Sciences*, *9*(4), 55-62. https://doi.org/10.36344/ccijhss.2023.v09i04.003

Sodangi, U., Isma'il, A., & Abdulrahaman A. (2022). Perception of secondary school science and mathematics teachers on Professional development participation in Zamfara State, Nigeria. *Integrity Journal of Education and Training*, *6*(2), 37-45. https://doi.org/10.31248/IJET2022.138

Suleiman, B., Isma'il, A. & Bello, A. (2020). Investigation into Secondary School Students' Attitude towards Learning of Geometry in Zamfara State, Nigeria. *IRA International Journal of Education and Multidisciplinary Studies.* 16(4), 236-242. http://dx.doi.org/10.21013/jems.v16.n4.p4

Tay, M. K., & Mensah-Wonkyi, T. (2018). Effect of using GeoGebra on Senior High School Students' Performance in Circle Theorems. *African Journal of Educational Studies in Mathematics and Sciences, 14*(2), 1–17.

Udofia, N. A., & Uko, M. P. (2018). GeoGebra and Secondary School Students' Performance in Mathematics in Akwa Ibom North-West Senatorial District of Nigeria. *International Journal of Mathematics and Statistics Studies, 6*(4), 1–14.

Zafer, H. M. I., Maqbool, S., Rong, Y., & Maqbool, S. (2025). Impact of digital learning tools on student's engagement and achievement in middle school science classes. *International Journal of Technology in Education and Science (IJTES)*, *9*(2), 177–196. https://doi.org/10.46328/ijtes.622

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