JOURNAL OF SCIENCE, TECHNOLOGY AND EDUCATION (JSTE) VOL. 8. NO. 7

JSTE PUBLICATIONS, 2024 www.nsukjste.com/

ISSN: 2651-5539

EFFECTS OF ZOOM AND GOOGLE CLASSROOM ON STUDENTS' INTEREST AND ACHIEVEMENT IN GEOMETRY IN AMAC, ABUJA, NIGERIA

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Citation: Omeji M. & Musa D. C. (2024). Effects of zoom and google classroom on students' interest and achievement in geometry in AMAC, Abuja, Nigeria. *Journal of Science, Technology, and Education (JSTE)*; www.nsukjste.com/ *8*(7), 73- 82

Abstract

This study examined the effects of Zoom and Google Classroom on students' interest and achievement in geometry within the Abuja Municipal Area Council (AMAC), Nigeria. The research addressed two main questions and their corresponding null hypotheses. A quasi-experimental design was utilized, focusing on all SS 2 students during the 2023/2024 academic session. A random sample of 172 students was selected, and data were gathered using the Geometry Interest Scale (GIS) and Geometry Achievement Test (GAT), with the GIS exhibiting a reliability index of 0.80. Mean and standard deviation were employed to address the research questions, while the null hypotheses were tested using Analysis of Covariance (ANCOVA) at a significance level of $\alpha = 0.05$. The findings indicated no significant difference in the mean interest ratings and achievement scores between students taught geometry via Zoom and Google Classroom. However, a significant difference was observed between these groups and students taught using conventional methods. The study recommends the integration of digital platforms such as Zoom and Google Classroom into school curricula to enhance student engagement and interest in subjects like geometry. Additionally, professional development programs should be provided to equip teachers with the necessary skills to effectively utilize digital teaching tools, maximizing the potential of platforms like Zoom and Google Classroom.

Keywords: Zoom, Google Classroom, Students' Interest, Achievement, Geometry, AMAC.

Introduction

Mathematics, universally recognized as the fundamental language that governs the world, consistently demonstrates its profound influence across various domains. Its unparalleled ability to shape our understanding of the universe and its pervasive influence on advancements in science, technology, and societal progress is evident. Smith and Johnson (2023) indicated in their research the pivotal role of mathematics as a universal medium for conveying intricate concepts and relationships. This universality is essential for facilitating effective communication in scientific research and fostering international collaborations. Brown et al. (2021) explicates the versatile function of mathematics in modeling and scrutinizing dynamic systems, emphasizing its capacity to encapsulate real-world phenomena through exploration of numbers, quantities, structures, and patterns, thereby revealing the intrinsic elegance inherent in abstract mathematical concepts. A comprehensive exploration of diverse branches of mathematics, spanning from algebra to contemporary fields like calculus and set theory, furnishes a deeper understanding of mathematics' indispensable role in advancing knowledge. For instance, algebraic principles provide a foundational framework for resolving intricate equations and manipulating mathematical structures. This holds pivotal

significance in modern technology and scientific inquiry. Smith and Johnson (2022) accentuate the significance of calculus in disciplines such as Physics, Engineering, and Economics. Calculus also serves as a crucial tool for comprehending rates of change, accumulation, and optimization, which are imperative for modeling and analyzing dynamic systems.

Statistics, as a core branch of mathematics, plays a critical role in data science and decision-making processes. According to Brown and Davis (2020), statistical methods are essential for extracting valuable insights from large datasets, shaping business strategies, and informing policy-making. Additionally, number theory, modular arithmetic, and graph theory provide foundational support for fields like coding and information security. These mathematical principles are crucial for protecting digital communications, ensuring secure business transactions, managing network systems, and addressing computational challenges.

Patel and Lee (2021) explored the practical relevance of geometry in fields such as computer graphics and architectural design. Geometric concepts are pivotal in creating realistic 3D models, simulations, and ensuring the structural integrity of engineering and architectural projects. Furthermore, geometry has broad applications in surveying, navigation, art, architectural aesthetics, land demarcation, and the visual aspects of various media.

From this analysis, it is evident that mathematics, particularly geometry holds undeniable significance. However, the subject is often regarded as difficult and perceived as an exclusive domain reserved for individuals with exceptional talent. This misconception not only impedes individual progress in mathematics but also raises broader concerns, affecting both educational systems and society at large.

Table 1. West African Senior Secondary Certificate Examination Result in Mathematics in the Federal Capital Territory, Abuja from the year 2018 to 2023

Year	No. of Reg Candidates	No. that Sat for the Exam	Total Credits (A1-C6)	% Pass	Total Failure (D7-F9)	% Failure
2018	13031	13022	7016	53.88	6006	46.12
2019	13036	13036	8084	62	4952	38
2020	15062	14570	5545	36.8	9517	63.2
2021	13896	13843	10878	78.3	3018	21.7
2022	16078	15935	11021	69.2	4914	29.8
2023	17895	16754	13062	77.9	3692	22.1

An analysis of the West African Senior School Certificate Examination (WASSCE) mathematics results in the Federal Capital Territory (FCT), Abuja, from 2018 to 2023 reveals fluctuating student performance. Over this period, the number of registered candidates increased from 13,031 in 2018 to 17,895 in 2023, and the actual number of students sitting for the exam closely matched these registration figures, indicating high attendance rates. However, the percentage of students achieving passing grades (A1-C6) varied annually. The peak performance occurred in 2021, with 78.3% of students achieving passing grades, while the lowest was in 2020, with just 36.8% of students passing. Conversely, the failure rate (D7-F9) mirrored this trend: the lowest failure rate was 21.7% in 2021, while 63.2% of students failed in 2020. Across the six years, an average of 63.01% of students passed, while 36.82% failed.

In 2022, the Chief Examiner of the West African Examination Council (WAEC) identified several areas where students struggled, particularly in trigonometry, geometry, and bearings. Egwu et al. (2018) also pointed out that geometry is often perceived as one of the most difficult topics in mathematics. This difficulty stems from the complexity of the rules and formulas involved, which require consistent memorization and understanding.

Geometry's challenges intensify as students progress from two-dimensional (2D) shapes to three-dimensional (3D) shapes, as each has unique rules that must be applied. The subject also demands strong visual and spatial reasoning skills, deductive proofs, and practical application in real-world contexts, all of which contribute to

students' struggles. Addressing these difficulties calls for a more effective pedagogical strategy to enhance students' understanding and engagement with the subject. As a result, this study aimed to investigate the impact of innovative teaching approaches on improving students' interest, achievement, and retention in geometry, and by extension, mathematics.

In response to the low levels of academic achievement, educators have increasingly adopted technology-based teaching platforms like Zoom and Google Classroom. These tools provide student-centered learning environments that promote greater engagement with academic content. Zoom, in particular, facilitates real-time communication between students and teachers, regardless of their locations. It offers interactive features such as chat, polls, and breakout rooms, all of which help boost engagement and create a more dynamic and flexible learning experience. The chat function enables text-based communication, allowing students to ask questions, share resources, and engage in discussions. Polls provide teachers with immediate feedback from students, fostering active participation, while breakout rooms allow for smaller group discussions, which promote deeper understanding of course material. Furthermore, Zoom includes assessment tools, session recording features, and security measures to ensure a safe and effective learning environment.

Similarly, Google Classroom offers an easy-to-use platform that integrates with tools like Google Drive and Google Docs, enabling educators to create, manage, and distribute course materials digitally. Students can access and submit assignments, participate in discussions, and collaborate with peers, creating a continuous and active learning environment. The platform's features, such as announcements and threaded discussions, support interactive communication between teachers and students, thus enhancing the overall learning experience (Richardson & West, 2019). Both Zoom and Google Classroom offer personalized learning opportunities, catering to individual student needs, which can help improve student performance and engagement in subjects like geometry.

In this context, the study explored the effects of Zoom and Google Classroom on students' interest and achievement in geometry, providing valuable insights into their effectiveness as educational tools. Student engagement is strongly influenced by interest, a key factor in academic success. The interactive capabilities of Zoom, combined with the personalized learning experiences offered by Google Classroom, enhance engagement through real-time feedback and peer collaboration.

Statement of Problems

Mathematics remains a critical subject across various academic fields, yet low achievement in the subject persists. The National Mathematical Center (2009) and the West African Examinations Council (2023) have identified significant challenges in teaching and learning geometry, contributing to underachievement. Students often struggle with topics like mensuration and cyclic quadrilaterals, partly due to outdated instructional methods. Students' achievement in WAEC exam in AMAC in recent years corroborates this fact. This ongoing issue has raised concerns among educators, parents, and government, highlighting the need for modern teaching approaches. Technology-based platforms like Zoom and Google Classroom offer interactive and engaging alternatives that could enhance student performance. While studies have explored technology's role in education, there is a gap in research comparing the effectiveness of these tools specifically for teaching geometry, an area needing further exploration to improve outcomes in mathematics.

Objectives of the Study

The main objective of this research was to investigate the effects of zoom and google classroom on students' interest and achievement in geometry in AMAC, Abuja, Nigeria. Specifically, the study aimed to:

1. Investigate the effect of Zoom and Google classroom on students' interest in geometry.
2. Find out the effect of Zoom and Google classroom on students' achievement in geometry.

Research Questions

The following questions were raised to guide the study:

1. What are the mean interest ratings of students taught geometry using Zoom, Google Classroom and conventional methods?
2. What are the mean achievement scores of students taught geometry using Zoom,

Google Classroom and conventional method?

Research Hypotheses

The following hypotheses were formulated and tested at significance level of 0.05:

H01: There is no significant difference in the mean interest ratings of students instructed in geometry using Zoom and Google Classroom and those taught through the conventional approach.

H02: There is no significant difference in the mean achievement scores of students instructed in geometry using Zoom, Google Classroom and those taught through the conventional approach.

Literature Review

Anekwe, Uzoamaka, and Amadi (2020) studied the impact of Google Classroom on the interest and performance of 1,460 final-year trainee teachers in Computer Education at the University of Port Harcourt. Utilizing purposive sampling and two validated instruments—the Computer in Education Interest Inventory (CEII) and the Computer in Education Achievement Test (CEAT), with reliability coefficients of 0.78 and 0.86, respectively. They found that the Google Classroom Discussion Strategy (GCDS) significantly enhanced both interest and academic performance. In contrast, the traditional Face-to-Face Method (FTFM) showed no significant effect on interest. Limitations included unaccounted confounding variables and insufficient discussion of practical implications.

The study "Effect of Google Classroom on Secondary School Students' Engagement and Achievement in Mathematics" by Okeke et al. (2022) examined the impact of Google Classroom on 67 SS2 students in Calabar, Nigeria. Using purposive sampling, two intact classes were selected, with students randomly assigned to experimental (Google Classroom) and control (face-to-face) groups. Data were gathered through the Students' Learning Engagement Questionnaire (SLEQ) and the Mathematics Achievement Test (MAT). Results showed no significant difference in engagement scores, but Google Classroom significantly improved students' mathematics achievement during the five-week intervention.

The study "Google Classroom Aided Instruction on Student Teachers' Mathematics Achievement in Owerri, Nigeria" by Alwell et al. (2023) investigated the impact of Google Classroom on mathematics achievement at Alvan Ikoku University from 2019 to 2021. Using a quasi-experimental design with 127 students, data were collected through examination papers and teacher-made tests. Results indicated that male students outperformed females, and those taught without Google Classroom scored significantly higher than those taught using the platform.

The study highlights the significance of quality education in mathematics, which remains challenging for students despite advancements, particularly during the COVID-19 pandemic. The literature review assessed previous research on Google Classroom's role in education, noting its potential benefits and challenges for student engagement and achievement. Utilizing a quasi-experimental design with non-randomized control groups, the study employed examination papers and teacher-made tests for data collection. It acknowledges limitations related to sampling techniques, instrument validity and reliability, statistical analysis methods, and the generalizability of findings, suggesting that addressing these issues could enhance the study's validity and insights for educators and researchers.

Methodology

The study utilized a quasi-experimental design with three groups: a Control group and two Experimental groups, all participating in pretest-posttest assessments in geometry. The total population included 2,500 students, with 833 being senior secondary school II students in the Abuja Municipal Area Council (AMAC). A sample of 172 students was randomly selected from three schools, which had 43, 67, and 62 students, respectively. Data were gathered using the Geometry Interest Scale (GIS), which had a reliability index of 0.80, and the Geometry Achievement Test (GAT), with a reliability index of 0.76. The GAT, consisting of 30 multiple-choice questions, assessed students' geometry proficiency. The GIS featured 20 opinion-based items using a 4-point scale. One experimental group was taught using Zoom, the other with Google Classroom, while the control group received traditional instruction. Pretests were conducted before treatment, followed by posttests immediately afterward. Data analysis involved mean, standard deviation, and ANCOVA at a 0.05 significance level to answer the research questions and test hypotheses.

Results

Research question 1: What are the mean interest ratings of students taught geometry using Zoom, Google Classroom and conventional methods?

Table 2: Mean Interest Ratings of Students Taught Geometry Using Zoom, Google Classroom and those taught Using Conventional Methods

Group		Pre-intervention Interest	Post-intervention Interest
Zoom	Mean	47.12	58.6
	N	43	43
	Std. Deviation	6.888	7.261
Google Classroom	Mean	49.57	61.36
	N	67	67
	Std. Deviation	5.975	5.336
Conventional	Mean	45.65	51.21
	N	62	62
	Std. Deviation	6.09	3.586

Table 2 shows the mean and standard deviation of the interest ratings of students taught geometry using zoom, google classroom and those taught using conventional methods. The means of pre-intervention and post-intervention interest ratings of Zoom are 47.12 and 58.60 respectively while their standard deviations are 6.89 and 6.26 respectively. The means of pre-intervention and post-intervention interest ratings for group taught using Google Classroom (GC) are 49.57 and 61.36 with standard deviations of 5.975 and 5.336 respectively, while for the group taught using Conventional Method, the means of pre-intervention and post-intervention interest ratings are 45.65 and 51.21 with standard deviations of 6.09 and 3.586 respectively.

Hypothesis One: There is no significant difference in the mean interest ratings of students instructed in geometry using zoom and google classroom and those taught through the conventional approach.

The result of the test of hypothesis one is presented in Table 4.2.

Table 3: Analysis of Covariance (ANCOVA) of Mean Interest Ratings of Students Taught Geometry Using Zoom and Google Classroom and those Taught Using the Conventional Approach

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	3954.823a	3	1318.274	50.505	0.00	0.474
Intercept	5613.896	1	5613.896	215.07	0.00	0.561
Pre-Interest	492.802	1	492.802	18.88	0.00	0.101
Group	2649.472	2	1324.736	50.752	0.00	0.377
Error	4385.154	168	26.102			
Total	567396	172				
Corrected Total	8339.977	171				

a. R Squared = 0.474 (Adjusted R Squared = 0.465)

Table 3 presents the ANCOVA results comparing the mean interest ratings of students taught geometry through Zoom, Google Classroom, and the conventional method. The analysis yielded $F(2,169) = 50.752$, $p = 0.000$, which is below the $\alpha = 0.05$ significance threshold. Since the p-value (0.000) is less than 0.05, there is a statistically significant difference in the mean interest ratings among the groups. Consequently, the null hypothesis is rejected, necessitating post-hoc multiple comparison procedures, as displayed in Table 4.

Table 4. Pairwise Comparisons of the post-intervention Mean Interest Ratings of Students Taught Geometry Using Zoom and Google Classroom and Those Taught Using the Conventional Approach

(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
					Lower Bound	Upper Bound
Zoom	G. Classroom	-2.084	1.01	.122	-4.527	0.358
	Conventional	6.993*	1.018	.000	4.531	9.455
G. Classroom	Zoom	2.084	1.01	.122	-0.358	4.527
	Conventional	9.078*	0.933	.000	6.82	11.335
Conventional	Zoom	-6.993*	1.018	.000	-9.455	-4.531
	G. Classroom	-9.078*	0.933	.000	-11.335	-6.82

Based on estimated marginal means

*a. The mean difference is significant at the 0.05 level.

b. Adjustment for multiple comparisons: Bonferroni

Table 4 presents the results of pairwise comparisons of post-intervention mean interest ratings. For the comparison between Zoom and Google Classroom, $p = 0.122$, which is greater than $\alpha = 0.05$, indicating no significant difference in the mean interest ratings of students taught geometry via Zoom and those taught using Google Classroom. However, for Zoom versus the conventional method, $p = 0.000$, which is less than $\alpha = 0.05$, demonstrating a significant difference in interest ratings between these groups. Similarly, for Google Classroom versus the conventional approach, $p = 0.000$, also less than $\alpha = 0.05$, showing a significant difference in the mean interest ratings between these instructional methods.

Research question 2: What are the mean achievement scores of students taught geometry using Zoom, Google Classroom and conventional method?

The information used to answer this research question is displayed in Table 5

Table 5. Mean Scores and Standard Deviation of Achievement Scores of Students Taught Geometry Using Zoom, Google Classroom and Conventional Method

Group		Pre-intervention Achievement test score	Post-intervention Achievement test score
Zoom	Mean	12.44	71.77
	N	43	43
	Std. Deviation	5.091	23.758
Google Classroom	Mean	12.63	83.27
	N	67	67
	Std. Deviation	6.232	13.699
Conventional Method	Mean	12.53	60.18
	N	62	62
	Std. Deviation	6.201	20.456

Table 5 presents the mean achievement scores and standard deviations for students taught geometry through three instructional methods: Zoom, Google Classroom, and the conventional approach. The results indicate that students instructed via Zoom had a pre-intervention mean score of 12.44 (SD = 5.091) and a post-intervention mean score of 71.77 (SD = 23.758). In contrast, students taught using Google Classroom had a pre-intervention mean score of 12.63 (SD = 6.232) and a post-intervention mean score of 83.27 (SD = 13.699) while those taught using the conventional method recorded a pre-intervention mean score of 12.53 (SD = 6.201) and a post-intervention mean score of 60.18 (SD = 20.456).

Hypothesis Two

There is no significant difference in the mean achievement scores of students instructed in geometry using Zoom, Google Classroom and those taught through the conventional approach.
The result of this hypothesis is presented on Table 6.

Table 6. Analysis of Covariance (ANCOVA) of the Mean Achievement Scores of Students Taught Geometry Using Zoom, Google Classroom and Conventional Method

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	17236.764a	3	5745.588	15.681	0	0.219
Intercept	154091.772	1	154091.772	420.562	0	0.715
Pretest	61.488	1	61.488	0.168	0.68	0.001
Group	17159.806	2	8579.903	23.417	0	0.218
Error	61554.399	168	366.395			
Total	972168	172				
Corrected Total	78791.163	171				

a. R Squared = 0.219 (Adjusted R Squared = 0.205)

Table 6 displays the outcomes of the ANCOVA procedure investigating the mean achievement scores of students instructed in geometry via three distinct methods: Zoom, Google Classroom, and conventional. The results reveal a statistically significant effect, with $F_{(2,168)} = 23.417$ and $p = 0.000$, which is below the predetermined significance level of 0.05. This indicates that the observed differences in mean achievement scores among the three instructional groups are statistically significant and unlikely to be attributed to chance. Consequently, the null hypothesis is rejected, necessitating a pairwise comparison presented on table 7 below.

Table 7: Pairwise Comparisons of the Mean Achievement Scores of Students Taught Geometry Using Zoom, Google Classroom and Conventional Method

(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
					Lower Bound	Upper Bound
Zoom	G. Classroom	-11.482*	3.741	0.007	-20.528	-2.437
	Conventional	11.599*	3.799	0.008	2.413	20.785
G. Classroom	Zoom	11.482*	3.741	0.007	2.437	20.528
	Conventional	23.082*	3.373	0.000	14.925	31.239
Conventional	Zoom	-11.599*	3.799	0.008	-20.785	-2.413
	G. Classroom	-23.082*	3.373	0.000	-31.239	-14.925

Based on estimated marginal means

*a . The mean difference is significant at the 0.05 level.

b. Adjustment for multiple comparisons: Bonferroni.

Table 7 presents the results of pairwise comparisons for post-intervention achievement scores, highlighting statistically significant differences among the instructional groups. The comparison between Zoom and Google Classroom yielded a p-value of 0.007, which is below the significance threshold of 0.05, indicating a significant difference in mean achievement scores between these two groups. The comparison between Zoom and the conventional teaching method produced a p-value of 0.008, also below 0.05, indicating a significant difference in achievement scores. Likewise, the comparison between Google Classroom and the conventional method yielded a p-value of 0.000, signifying a significant difference between these groups. These results suggest that each instructional approach has a distinct effect on student achievement, with Google Classroom proving to be the most effective, followed by Zoom, and then the conventional teaching method.

Discussion of Results

The findings of this study regarding hypothesis one reveal a significant difference in the mean interest ratings of students taught geometry through Zoom, Google Classroom, and conventional methods. This result is consistent with Anekwe, Uzoamaka, and Amadi (2020),

who explored the effects of Google Classroom on trainee teachers' interest in computer education. While no significant difference in interest was observed between Google Classroom and Zoom, both significantly outperformed conventional teaching methods.

Regarding hypothesis two, a significant difference in mean achievement scores was found across Zoom, Google Classroom, and conventional methods, in line with Alwell et al. (2023) and Okeke et al. (2022), who studied the impact of Google Classroom on students' mathematics achievement. The interactive features of online platforms such as real-time video, screen sharing, virtual whiteboards, and breakout rooms, enhance student engagement and participatory learning. Moreover, multimedia integration in online platforms makes learning more engaging and effective than in conventional classrooms.

Conclusion

The findings demonstrate that students instructed via Zoom and Google Classroom display higher levels of interest and achievement in geometry when compared to traditional teaching methods, underscoring the potential of these digital tools to effectively engage learners and improve educational outcomes in the subject.

Recommendations

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

1. Schools should integrate digital platforms like Zoom and Google Classroom into the curriculum to enhance student engagement and interest in subjects like geometry.
2. Continuous professional development programs should be conducted to equip teachers with the necessary skills and knowledge to utilize digital teaching tools effectively. This will ensure that teachers can maximize the benefits of platforms like Zoom and Google Classroom.

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