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Effect of Blended Instructional Strategy on Achievement and Misconceptions in Mathematics Concepts among Secondary School Students in Sokoto State, Nigeria

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Abstract
This study investigated the Effect of Blended instructional strategy on Achievement and Misconceptions in Mathematics concepts among secondary school students in Sokoto State, Nigeria. A non-randomized control group, pretest-posttest quasi-experimental design was employed. The study sampled 383 SS2 students proportionately from the population of public senior secondary school two (II) students during the 2024/2025 academic session in Sokoto Metropolis using stratified random sampling technique based on Krejcie-Morgan Table. The instruments were validated, pilot tested and reliability coefficients of 0.80 and 0.91 were obtained, respectively, using split-half. Data were collected using the Mathematical Achievement Test (MAT) and 5-Tier Mathematics Misconception Diagnostic Test (5-Tier MMDT). The experimental group were taught mathematical content domains using blended learning strategy, while the control group received treatment through conventional method. Descriptive and inferential statistics of mean, standard deviation, and independent samples t-test, were used to analyze the data. Therefore, the findings of this study reveal that the blended learning strategy significantly improved SS2 students' achievement in mathematical content domains compared to the conventional method. It also significantly reduced students' misconceptions in mathematical content domains. Moreover, the significant differences in both achievement and misconception levels between students taught using blended learning and those taught using conventional methods highlight the potential of blended learning as an effective instructional approach for mathematics education. The findings suggest that integrating technology into mathematics instruction can enhance student learning outcomes and provide a more meaningful and personalized learning experience.

***Keywords**: Blended learning, Mathematical Content Domains, Achievement, Misconception.*

Introduction
Mathematics is very important for scientific and technological progress, but many students find it difficult to understand because of ineffective teaching methods (Hansson, 2020). Traditional ways of teaching have been linked to students' misunderstandings and poor academic performance (Keykha & Heidarzadegan, 2016). Blended Learning (BL) is a teaching method that combines regular classroom teaching with online materials, creating a more interactive and flexible way of learning (Kumar, Krishnamurthi, Bhatia, Kaushik, Ahuja, Nayyar & Masud, 2021). Blended learning is used in many countries and has been proven to improve students' interest, thinking skills, and understanding of mathematical concepts (Boelens, De Wever & Voet, 2017). Studies from the United States and Finland show that combining digital tools with classroom lessons helps students remember information better and solve problems more effectively (Ojala, 2017; Collins & Halverson, 2018). The Organization for Economic Co-operation and Development (OECD) also supports using digital learning to meet students' different learning needs (OECD, 2021). In Africa, blended learning is becoming more common to help overcome educational challenges. Research from South Africa shows that using both face-to-face teaching and online platforms increases students' participation and performance in mathematics (Ngampornchai & Adams, 2016). Similarly, Kenya and Ghana have introduced digital tools to support mathematics education and address weaknesses in traditional

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teaching (Luneta, 2022). However, a lack of digital resources and teacher training makes full implementation difficult. In Nigeria, blended learning is gradually being introduced, especially in universities and secondary schools. The Federal Ministry of Education recognizes the benefits of digital learning and is working to include it in school programs (FME, 2022). Research by Yusuf and Afolabi (2020) shows that Nigerian students taught through blended learning perform better in mathematics than those taught using only traditional methods. However, limited internet access, insufficient funding, and teachers' reluctance to use digital tools have slowed its widespread adoption. In Sokoto State, blended learning is still new in mathematics education. Although some schools have started using digital tools, most still rely on traditional methods due to infrastructure problems and a lack of teacher training. Research in northern Nigeria suggests that blended learning can help students correct misunderstandings and improve their mathematics skills (Adeyemi, 2024).). However, proper planning, teacher training, and better resources are needed to maximize its benefits. According to the West African Examinations Council (WAEC) Chief Examiners' reports, many students in Sokoto State struggle with mathematics, leading to a high failure rate. The reports highlight common mistakes, such as difficulties in solving algebraic equations, poor understanding of set theory, and inability to apply mathematical concepts to real-life problems. These challenges are largely due to the traditional teaching approach, which does not encourage active student participation or conceptual understanding. Although blended learning has been successful in many places, its use in Sokoto State is still very limited. Many students continue to struggle with mathematics because schools mainly use traditional teaching methods (Nasamu, 2021). There is a need to study how effective blended learning is in improving students' understanding and correcting their misconceptions in mathematics.

Aim and Objectives of the Study

This research aims to examine the Effect of Blended instructional strategy on Achievement and Misconceptions in Mathematics concepts among secondary school students in Sokoto State, Nigeria. Specifically, this study aims to:

1. Determine the effectiveness of the blended learning strategy in improving SS2 students' achievement in mathematical content domains.
2. Assess the impact of blended learning strategy on students' misconception in learning mathematical content domains.
3. Compare the achievement and misconceptions levels of students taught with blended learning strategy and those taught with conventional methods.

Research Questions

Based on the stated objectives, the study raised the following questions and hypotheses;

1. What is the mean achievement scores of students taught mathematical concept using blended instructional strategy and those exposed to lecture method in Sokoto State?
2. What is the level of misconceptions of students taught mathematical concept using blended instructional strategy and those exposed to lecture method in Sokoto State?
3. What is the difference in mathematical content domains achievement and misconception level between SS2 students taught using blended learning strategy and those taught using conventional method?

Hypothesis

The study formulated the following hypotheses;

1. There is no significant difference in mathematical content domains achievement between SS2 students taught using blended learning strategy and those taught using conventional method.
2. There is no significant difference in the misconception level between SS2 students taught using blended learning strategy and those taught using conventional method.
3. There is no significant difference in mathematical content domains achievement and misconception level between SS2 students taught using blended learning strategy and those taught using conventional method.

Methodology

The study adopted a non-randomized control group, pretest posttest quasi-experimental design. The experimental group was taught mathematical content domains using blended learning strategy, while the control group received instruction through conventional teaching method. The population consists of all SS2 students in public senior secondary schools in Sokoto Metropolis, with a total of 76,660 students across four Local Government Education Authorities (LGEAs), as shown in Table 1.

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Table 1: Population of the Study

S/N	Local Government Education Authorities	No. of Schools	Population
1	Sokoto North	**12**	16,447
2	Sokoto South	**18**	51,882
3	Wamakko	**10**	6,782
4	Dange-Shuni	**2**	1,549
	Total	**42**	**76,660**

Source: Ministry for Basic and Secondary Education Sokoto State (2024)

Table 1 presents a proportionate distribution of the sample from the population of 76,660 was used to generate a sample of 383 students, presented in Table 2, using stratified sampling technique across the LGEAs. The selection of this sample size is based on Kreijcie-Morgan Table.

Table 2: Sample and Sampling Techniques

S/N	LGEA	No. of Students
1	Sokoto North	82
2	Sokoto South	259
3	Wamakko	34
4	Dange-Shuni	8
	Total	**383**

The instruments used in the data collection include; Mathematical Achievement Test (MAT): A structured test covering key topics in mathematical content domains relevant to SS2 students, and 5-Tier Mathematics Misconception Diagnostic Test (5-Tier MMDT): To identify and measure common misconceptions students hold in mathematical content domains. Both instruments were validated by mathematics education experts to ensure reliability and content relevance. The reliability coefficients of 0.80 and 0.91 were obtained. The study was conducted for a period of six weeks, beginning with a pre-test to assess students' baseline knowledge and misconception. The experimental group received instruction via BL, incorporating digital resources, while the control group was taught using conventional method. After the intervention, a post-test was administered to evaluate achievement and misconceptions levels. Data were analyzed using descriptive and inferential statistics, including mean, standard deviation, and t-tests, to determine the significance of differences between groups. The data collected through the Mathematical Achievement Test (MAT) and the 5-Tier Mathematics Misconception Diagnostic Test (5-Tier MMDT) are presented here.

Presentation of Results

This section presents the results obtained in order to answer the research questions and analyse the hypotheses.

Research Question 1: What are the mean achievement scores of students taught mathematical concept using blended instructional strategy and those exposed to lecture method in Sokoto State? To answer this question, the mean and standard deviation of students' pre-test and post-test scores were calculated for both the experimental (blended learning) and control (conventional) groups. The results are presented in Table 3.

Table 3: Mean and Standard Deviation of Students' Achievement Scores in the experimental and control groups Pretest and post-test were compared.

Group	N	Pretest	Posttest	Mean Gain
Experimental (BL)	192	23.45 (5.21)	76.89 (6.45)	53.44
Control (CM)	191	23.67 (5.15)	54.32 (7.02)	30.65
Total	**383**			

From Table 3, students taught using the blended learning strategy had a mean achievement gain of 53.44, while those taught using the conventional method had a mean achievement gain of 30.65. This suggests that the blended learning strategy was more effective in improving students' achievement.

Research Question 2: What is the level of misconceptions of students taught mathematical concept using blended instructional strategy and those exposed to lecture method in Sokoto State? To answer this question, the mean and standard deviation of students' misconception scores were computed before and after the intervention. The results are presented in Table 4.

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Table 4: Mean and Standard Deviation of Students' Misconception Scores in the experimental and control groups Pretest and post-test were compared.

Group	N	Pretest	Posttest	Mean Reduction
Experimental (BL)	192	62.34 (7.89)	24.21 (5.67)	38.13
Control (CM)	191	61.98 (7.76)	43.56 (6.84)	18.42
Total	**383**			

From Table 4, students taught using the blended learning strategy showed a greater reduction in misconceptions (mean reduction = 38.13) compared to those taught using the conventional method (mean reduction = 18.42). This indicates that the blended learning strategy was more effective in addressing misconceptions in mathematical content domains.

Research Question 3: What is the difference in mathematical content domains achievement and misconception level between SS2 students taught using blended learning strategy and those taught using conventional method? To answer this question, an independent sample t-test was conducted to compare the post-test achievement and misconception scores of students in both groups. The results are presented in Table 5.

Table 5: Means and Standard Deviations on students Achievement and Misconception

Variables	Group	N	Mean	S.D	Mean gain
Achievement	Experimental	192	76.89	6.45	53.44
	Control	191	54.32	7.02	30.65
Misconception	Experimental	192	24.21	5.67	38.13
	Control	191	43.56	6.84	18.42

Table 5 shows the Means and Standard Deviations on students Achievement and Misconception. Students taught using the blended learning strategy had a mean achievement of (M=76.89, SD=6.45), while those taught using the conventional method had a mean achievement of (M=54.32, SD=7.02). This suggests that the blended learning strategy was more effective in improving students' achievement. Again, students taught using the blended learning strategy showed a mean misconception of (M=24.21, SD=5.67) compared to those taught using the conventional method having (M=43.56, SD=6.84). This indicates that the blended learning strategy was more effective in addressing misconceptions in mathematical content domains. Furthermore, independent sample t-test was used to test the hypotheses at $\propto= 0.05$ level of significance.

Hypothesis One: There is no significant difference in the mean achievement scores of students taught mathematical concept using blended instructional strategy and those exposed to lecture method in Sokoto State. The result of the analysis is presented in Table 6.

Table 6: Summary of Independent sample t-test on students achievement

Group	N	Mean	S.D	t-value	p-value	Decision
Experimental	192	76.89	6.45	12.67	0.000	Sig.
Control	191	54.32	7.02			

Table 6 presents the independent sample t-test results on students achievement which shows $t(381) = 12.67, p = 0.001$ is less than $\propto= 0.05$, leading to the rejection of $H0_1$. This confirms that the blended learning strategy significantly improved students' achievement.

Hypothesis Two: There is no significant difference in the misconceptions level of SS2 students in learning mathematical content domains when taught using the blended learning strategy and those taught using conventional methods. The result of the analysis is presented in Table 7.

Table 7: Summary of Independent sample t-test on students' misconception

Group	N	Mean	S.D	t-value	p-value	Decision
Experimental	192	24.21	5.67	10.43	0.000	Sig.
Control	191	43.56	6.84			

From Table 7, the students misconception result shows that $t(381) = 10.43,\ p = 0.001)$, which is less than $\propto= 0.05$ value leading to the rejection of $H0_2$. This suggests that the blended learning strategy significantly reduced students' misconceptions compared to the conventional method.

Hypothesis Three: There is no significant difference between the achievement and misconceptions levels of students taught with the blended learning strategy and those taught using conventional methods. The result of the analysis is presented in Table 8.

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Table 8: Summary of Independent sample t-test on students' achievement and misconception

Variables	Group	N	Mean	S.D	t-value	p-value	Decision
Achievement	Experimental	192	76.89	6.45	12.67	0.000	Sig.
	Control	191	54.32	7.02			
Misconception	Experimental	192	24.21	5.67	10.43	0.000	Sig.
	Control	191	43.56	6.84			

Table 8 presents the independent sample t-test results on students achievement which shows $t(381) = 12.67, p = 0.001$ is less than $\propto = 0.05$, leading to the rejection of $H0_1$. This confirms that the blended learning strategy significantly improved students' achievement. Also, the students misconception result shows that $t(381) = 10.43,\ p = 0.001)$, which is less than $\propto = 0.05$ value leading to the rejection of $H0_2$. This suggests that the blended learning strategy significantly reduced students' misconceptions compared to the conventional method.

Summary of Findings

1. There is a significant difference in the mean achievement scores of students taught mathematical concept using blended instructional strategy and those exposed to lecture method in Sokoto State.
2. There is a significant difference in the misconception levels of SS2 students in learning mathematical content domains when taught using the blended learning strategy and those taught using conventional methods.
3. There is a significant difference in the achievement and misconceptions levels of SS2 students in learning mathematical content domains when taught using the blended learning strategy and those taught using conventional methods.

Discussion of Findings

The findings of this study align with previous research that supports the effectiveness of blended learning strategies in enhancing students' achievement and reducing misconceptions in mathematics. The significant improvement in achievement and the reduction of misconceptions suggest that blended learning offers an interactive and engaging learning experience that strengthens students' understanding of mathematical concepts. The results also support constructivist learning theories, which emphasize active participation and student-centered learning approaches. The blended learning strategy provided opportunities for self-paced learning and access to digital resources, which helped students grasp abstract concepts more effectively. Unlike conventional methods that rely primarily on teacher-centered instruction, blended learning integrates both face-to-face teaching and online instructional materials, allowing students to review lessons at their own pace. This flexibility enhances retention and comprehension, particularly in complex topics such as geometry and algebra. Additionally, the use of multimedia resources, simulations, and interactive exercises in blended learning fosters a deeper conceptual understanding by accommodating different learning styles. Furthermore, the reduction in students' misconceptions highlights the role of blended learning in addressing persistent misunderstandings in mathematical content domains. By offering multiple representations of concepts such as visual models, real-life applications, and step-by-step problem-solving, blended learning helps students identify and correct their misconceptions. This finding aligns with research suggesting that traditional instructional methods may not always effectively address students' pre-existing misconceptions, whereas blended learning strategies promote critical thinking and conceptual clarity.

The study's findings also corroborate Vygotsky's Social Constructivism Theory, which emphasizes the importance of social interactions and scaffolding in the learning process. The blended learning strategy facilitated collaborative discussions, peer engagement, and teacher support, all of which contributed to improved mathematical reasoning. The integration of online discussions, quizzes, and real-time feedback allowed students to assess their understanding and correct errors promptly, reinforcing knowledge acquisition. Moreover, the significant difference found between students taught using blended learning and those taught with conventional methods further underscores the need for adopting innovative teaching strategies in secondary education. The conventional method, often characterized by rote learning and passive reception of information, may not be sufficient to develop students' higher-order thinking skills. In contrast, blended learning promotes active engagement, problem-solving skills, and autonomy in learning, which are crucial for academic success in mathematics. Therefore, the findings of this study reveal that the blended learning strategy significantly improved SS2 students' achievement in mathematical content domains compared to the conventional method. It also significantly reduced students' misconceptions in mathematical content domains. Moreover, the significant differences in both achievement and misconception levels between students taught using blended learning and those taught using conventional methods highlight the potential of blended learning as an effective instructional approach for mathematics education. These findings suggest

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that integrating technology into mathematics instruction can enhance student learning outcomes and provide a more meaningful and personalized learning experience.

Recommendations

1. Secondary school teachers should employ Blended Learning in the teaching of Mathematics
2. Book Authors should prepare mathematics contents based on Blended Learning teaching Strategy
3. Curriculum developers and policy makers should incorporate the use of Blended Learning in Secondary School Mathematics Curriculum

References

Adeyemi, O. O. (2024). Effects of blended learning strategy on senior secondary schools students' performance in geometry in kogi state, nigeria. *Custech international journal of education*, *1*(1), 326-344.

Boelens, R., De Wever, B., & Voet, M. (2017). Four key challenges to the design of blended learning: A systematic literature review. *Educational research review*, *22*, 1-18.

Collins, A., & Halverson, R. (2018). *Rethinking education in the age of technology: The digital revolution and schooling in America*. Teachers College Press.

Hansson, S. O. (2020). Technology and mathematics. *Philosophy & Technology*, *33*(1), 117-139.

Keykha, M., & Heidarzadegan, A. (2016). Improve academic achievement, reduce misunderstanding lasting materials and fifth grade students in science teaching approach based on the concept map. *Journal of Novel Applied Sciences*, *5*(6), 253-260.

Kumar, A., Krishnamurthi, R., Bhatia, S., Kaushik, K., Ahuja, N. J., Nayyar, A., & Masud, M. (2021). Blended learning tools and practices: A comprehensive analysis. *Ieee Access*, *9*, 85151-85197.

Luneta, K. (2022). Special challenges in mathematics education in Sub Sahara Africa. *Current Opinion in Behavioral Sciences*, *48*, 101211.

Nasamu, R. A. (2021). *Influence of teaching styles and learning styles on pupils' academic performance in numeracy in Ilorin Kwara State* (Master's thesis, Kwara State University (Nigeria)).

Ngampornchai, A., & Adams, J. (2016). Students' acceptance and readiness for E-learning in Northeastern Thailand. *International Journal of Educational Technology in Higher Education*, *13*, 1-13.

Ojala, A. (2017). Learning through producing: The pedagogical and technological redesign of a compulsory music course for Finnish general upper secondary schools.

West African Examinations Council (WAEC). (2023). Chief Examiner's Report. Lagos: WAEC.

Yusuf, M. O., & Afolabi, A. O. (2020). Effectiveness of Blended Learning Models on Students' Academic Performance in Nigeria. *International Journal of Instruction*, 13(2), 1-14.