



## Effects of Flipped Classroom Strategy on Senior Secondary School Students Performance and Retention in Mathematics in Niger State, Nigeria

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### ABSTRACT

*This paper examines the effects of flipped classroom strategy on the performance and retention of senior secondary school students in mathematics in Niger State, Nigeria. The decline in students' performance in mathematics has become a matter of great concern, and traditional teaching methods have been identified as contributing factors. A study was guided by three (3) research objectives with their corresponding research questions and hypotheses formulated at 0.05 level of significance. A quasi-experimental design with a pre-test and post-test was adopted. The target population were all SSS2 Students in the North –East Senatorial Zone of Niger State and estimated to be 3,240(1500male 1740female). A study involved a sample of 180 SSS2 students to form three intact classes ensuring an equal distribution between male and female participants. The experimental group was taught using Flipped-learning strategy while the control group was taught using the conventional lecture method. The research instrument utilized was an adapted Mathematics Flipped Performance Test (MFPT) and was used to collect relevant data. The collected data were analyzed using t-test statistics to assess the effects of the treatment and potential gender differences. The findings of the study revealed that flipped instruction strategy enhance learning outcome of mathematics students when compared with the traditional lecture method currently used by teachers in Niger State. Also, the result of the study indicated that flipped strategy is gender friendly and facilitate equal comprehension rate of male and female students. The study recommends the adoption and usage of flipped classroom by mathematics teachers/instructors to enhance understanding of basic concepts and remark the abstractness of some difficult topics.*

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### INTRODUCTION

Mathematics is a compulsory and core subject offered at both the basic and post-basic levels of education in Nigeria. It plays a crucial role in various aspects of life, including science, technology, the economy, the environment, and decision-making. Mathematics is the study of numbers and its application to daily life. It is a pre-requisite subject for courses like medicine,

pharmacy, engineering, aviation radiotherapy, sociology oceanography among others, thus providing basic scientific literacy and numeracy needed for the accomplishment of the above courses (Ladan, 2018; Joseph, 2020). Similarly, Mathematics to most is a complex and difficult subject, thus poses a great challenge for teachers and educators, especially in senior secondary schools where a good study habit and a firm grasp

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of mathematical concepts should be developed. However, there has been a decline in students' performance in mathematics as evidenced by the Senior School Certificate Examinations (SSCE) conducted by the West African Examinations Council (WAEC), the National Examination Council (NECO), and the National Board of Technical Examination (NABTEB) among other as seen in the chief examiners' report from 2015-2020.

The decline in performance is a matter of great concern for the government and other stakeholders due to its implications for students' future opportunities and the negative attitudes towards the subject. Several factors have been identified as contributing to this decline, including the abstract nature of mathematical concepts, ineffective teaching methods, inadequate teaching and learning resources, shortage of laboratory facilities, large class sizes, and shortage of qualified teachers (John, 2018; Adeleke, 2021).

The importance of mathematics education necessitates the adoption of effective teaching methods that promote students' understanding, engagement, and mastery of mathematical concepts (Saribas, 2019). The traditional teacher-centered approach, where instructors primarily convey information to students instead of encouraging them to interact, ask questions or make them understand the lesson thoroughly has shown limitations in fostering active learning. Similarly, the use of conventional lecture method has also limited students retentive ability and understanding of difficult mathematical concepts. To address these challenges, there is a need to shift to learner-centered strategies that empower students to take an active role in their learning process. One such strategy is the flipped classroom (UNESCO, 2014).

The flipped classroom is an instructional approach that could reverses the traditional learning environment. In a flipped classroom, students access instructional content, such as prerecorded lectures, outside of class, allowing class time to be dedicated to interactive activities, discussions, and exercises (Abdullahi, 2020). This

approach promotes active engagement and collaboration among students, facilitated by the guidance and support of the teacher. Flipped classroom is seen as an improved pedagogy of teaching involving the use of modern telecommunication devices such as smartphone, electronic board, bulletin, projector closed circuit camera among other devices. The fundamental advantage of the flipped classrooms is that it provide needed excitement and motivation for both the learner and the facilitator (Gopalan, 2020).

An empirical study conducted by Abdullahi (2020) on the viability of using flipped in teaching algebra and geometry in Nigerian junior secondary schools using 60 JSS II students as sample revealed that students taught geometry using flipped strategy outperform than their counterpart taught same content using the traditional lecture method. The result indicated that flipped is an essential learning technique used to boost performance, interests and retention of the learner. . Flipped classroom instruction offers the potential to enhance students' understanding, critical thinking, and retention in mathematics (Flipped Learning Network, 2014; Ahmadu, 2017; Yusuf, 2019; Zeddy, 2022 & Joseph, 2020)

Retention is the ability to regurgitate content material in previous lesson to support or boast current learning concept. Good teaching method aloud learnt content to be stored in the brain over a long time and create innate ability that link the previous and current for better understanding. Flipped classroom strategy that involved the use of video clips and other instructional aids provided the needed retention as seen in the study conducted by Gopalan(2020) on the rate of retention of difficult science students based on ability level, age, school location and medium of instruction. Learning algebra, word problems, sequence and series, probability and mensuration require long-term memory that include episode "memory of events" procedural knowledge of how to perform tasks. These concepts had genuie relationship with real-life application and thus require careful presentation, explanation and comprehension using student-centered approach.

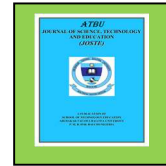
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Gender is one of the factors that have considerable effects on students' academic performance especially in mathematics. It revealed the effect of individual physical, emotional, biological and mental characteristics that uniquely differentiate the female and masculine abilities in achievement and retention of concepts. David (2013) reported that the male students develop more positive interest quickly than their female colleague, while a contrast view was expressed by Zakariya (2016), in his study on the diversities of gender in Science. In view of the mixed finding on gender abilities using lecture method, there is need for in-depth study on gender effect based on the flipped classroom strategy.

### STATEMENT OF THE PROBLEM

Instructional strategies are essential factors that determine learning outcome and students' abilities in all subjects particularly mathematics. This means that good learning strategy guarantees better achievement and retention, while poor or ill-conceived strategy weakens students' moral and understanding and consequently leads to poor performance and retention. It is important to note that modern student-centred strategies create room for the exchange of ideas and skills among learners and that empirical evidence has revealed the overwhelming effect of flipped classroom in learning of mathematics (Yusuf, 2019). In view of the limited literature available on the use of flipped classrooms for teaching and the few available ones with mixed findings, there is need to conduct an in-depth study on the effect of flipped classroom on learners' performance and retention in mathematics in Niger state.

### Purpose of the Study

This research is to investigate the effects of flipped classroom and traditional learning strategies on Senior Secondary School Students' performance and retention in Mathematics in Niger State, Nigeria. The objectives of the study are specifically set to:

1. Compare the difference in the mean performance scores of students taught mathematics using flipped classroom

and those taught using the traditional teaching method

2. Determine the mean performance score of the male and female students taught mathematics using the flipped classroom learning strategy.
3. Find out the retentive ability of students taught mathematics using the flipped and their counterparts taught the same concepts using the traditional lecture method.

### Research Questions

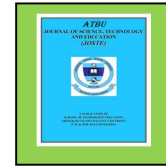
The following research questions were stated to guide the study

1. What is the difference in the mean performance scores of students taught mathematics using a flipped classroom and those taught using the traditional teaching method?
2. What is the mean performance score of the male and female students taught mathematics using the Flipped classroom learning strategy?
3. What is the mean difference in the retention ability of students taught mathematics using flipped and those taught using the traditional lecture method?

### Research Hypotheses

The following null hypotheses were formulated and tested at 0.05 level of significance to guide the study:

1. There is no significant difference in the mean performance scores of students taught mathematics using flipped classroom and that taught mathematics using the traditional teaching method.
2. There is no significant difference in the mean performance score of the male and female students taught mathematics using the flipped classroom learning strategy.
3. There is no significant difference in the mean retentive ability of students taught using the flipped classroom and their



counterparts taught same topics using the traditional lecture method.

## METHODOLOGY

A quasi-experimental design with a pre-test and post-test was employed to examine the effects of the flipped classroom strategy on students' performance and retention in mathematics. The target population for the study comprised all the Senior Secondary School (11) Students of public schools in Minna (Bosso and Chanchanga local government Area) in the North East Senatorial Zone of Niger State. There are thirty (30) Schools lies in the different settlement in the two(2) study local government Areas .The total population of the students in these schools was (3,240) comprising (1,500) males (1,740) females (Niger State Ministry of Education Digest, 2022). The choice of the study area was informed by the strategic location of Niger State within the North-Central geopolitical zone which link the North West and North South of the State. All the schools used are coeducational secondary school from the urban and rural settlement. With the large number of secondary schools and student's population, it will be difficult to cover all the schools in the senatorial Zone of Niger State given the time frame and financial implication of the study. A simple random sampling was employed to select nine (9) secondary schools within Bosso and Chanchanga local government LGAs.

Niger state has 70 co-educational Senior Secondary Schools out of which 30 Schools lies within in the study area. A reasonable representation of the sample population is needed for the study and the researcher thus employed simple random sampling technique to select nine (9) schools with estimated students' population of 2,476. The students in the nine (9) schools were pretested using Mathematics Flipped Performance Test (MFPT). Three (3) schools whose entry level equivalence tends to be similar or the same were selected and used for the study, this represent 10% of the total co-educational Schools within the study environment and thus appropriate representation of sample population (according to Krejcie and Morgan (1975), Kefan (2017) and the central limit theorem). They stated

that a sample size of 8% - 15%, 10% and greater or equal to 30 respectively is a fair representation in a scientific research. These three (3) schools consist of 180 SS2 students, with equal representation of male and female participants. The experimental group was taught selected mathematical concept such as probability, sequence and series through the flipped classroom approach, while the control group taught the same mathematical concept using traditional teacher-centered instruction. MFPT are items drawn from mathematics textbooks used in SSS II in the selected schools. The test items were made up of 50 items with four (4) options (A –D). The instrument was subjected to both face and content validated by two senior lecturers from Science Education, one curriculum expert and information technology teachers from ABU Zaria. Their advices and suggestions have helped in final selection of the instrument and logic of the presentation.

The flipped classroom strategy is a teaching technique enriched with multimedia devices that present concepts in a simple, precise and diligent manner lighting each step as a unique template, stating its characteristics and uniqueness with reference to other concept. The systematic presentation and logical display of content provide the needed understanding and comprehension. The instrument has an embedded lesson plan and schema for each topic and guidance tips for learners.

A pilot test was conducted to ascertain the effectiveness of the instrument and the reliability coefficient of 0.81 was obtained. The developed instrument was used in the experimental and control group classroom which comprised of the same learning contents. At the end of the six week-experiment, the researcher and two research assistants administered the test instrument on both the experimental and control groups simultaneously. T-test statistics was applied to test hypotheses 1 and 2 on treatment, while hypothesis 3 was on retention at 0.05 significance level. Statistical Package for Social Sciences (SPSS) version 23 was used to analyzed the scores from MFPT. The application

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of t-test takes care of the differences between groups before and after treatment.

using both descriptive (mean, standard deviation) and inferential (t-test) statistic to answer research questions and test hypotheses at 0.05 level of significance. The result are presented in tables below.

**RESULTS**

The scores from the administration of MFPT on the subjects were collated and analyzed

**Table 1:** Pre-test Scores of Experiment and Control Groups

Group	N	Mean	SD	Mean Difference
Experimental	90	39.55	15.435	
Control	90	40.45	14.693	0.9

The result in Table 1 indicated that the mean performance scores of the experimental groups was 39.55 (SD = 15.435) and that of the control group was 40.45 (SD = 14.693). The mean performance score difference between the groups was 0.90. The mean pre-test score difference was a confirmation of the same entry level equivalence of the two groups.

**Research Question One:** What is the effect of flipped classrooms and traditional lecture method on the performance of students taught Mathematics concept?

To answer this question, a descriptive statistic using means and standard deviations were carried out. The result showed in Table 2.

**Table 2:** Means and Standard Deviation of Experimental and Control Groups in Post-Test

Group	N	Mean	SD	Mean Difference
Experimental	90	56.82	16.93	
Control	90	47.42	21.50	9.40

The Table 2 showed that mean score of the experimental group 56.82 (SD= 16.93) and control group was 47.42 (SD = 21.50). The recorded mean difference was (9.40) in favour of experimental group after treatment. This shows that the flipped classroom was a better method of teaching mathematics over the lecture method.

**Research Question Two:** What is the mean performance score of the male and female students taught mathematics using the Flipped classroom leaning strategy

**Table 2.1:** Mean and standard deviation of male and female students taught mathematics using flipped strategy

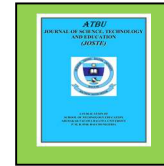
Group	N	Mean	SD	Mean Difference
Male	45	55.92	0.789	
Female	45	56.01	0.964	0.09

Table 2.1 revealed the mean score and standard deviation value of the male and female students in the experimental group. A careful examination of figures on table 2.1 revealed that 55.92 and 56.01 for male and female respectively. The mean difference of 0.09 was negligence and that shows the treatment is gender friendly and

does not discriminate between male and female mathematics students.

**Research Question Three:** What is the mean difference in the retention ability of students taught mathematics using flipped and those taught using traditional lecture method

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**Table 3:** Mean and standard deviation on retentive ability of the experimental and control group

Group	N	Post-test		Post post-test		Retention
		x <sub>1</sub>	SD	x <sub>2</sub>	SD	
Experimental	90	56.82	0.479	58.50	0.764	2.72
Control	90	47.42	0.556	49.35	0.829	0.93

Table 3.0 above revealed the mean and SD values on the retention ability of the experimental and control group. The mean gain of 2.72 and 0.93 for the experimental and control group respectively indicated better retentive ability of the students taught mathematics using the flipped classroom. Thus, flipped strategy guarantee better retention and long-term memory.

**Null Hypothesis One:** There is no significant difference between the mean performance scores of students taught Mathematics using flipped Learning Instruction and those taught using traditional lecture.

To test this hypothesis an inferential statistics of an independent sample t-test was carried out and presented in Table 4.

**Table 4:** Independent t-test Analysis of Post-test between Experimental Group and Control group

Group	N	Mean	SD	Df	t-value	P-value	Remark
Experimental	90	56.82	10.932	178	1.327	0.030	Sig.
Control	90	47.42	13.504				

\*Significant at  $p < 0.05$

From the result in Table 3, indicated that P-value was 0.030 which was much less than 1.327 at  $\alpha = 0.05$ . This showed there was significance difference in the mean performance scores of students taught with spaced learning instruction and students traditional lecture instruction. The null hypothesis was therefore rejected an indicated of better performance by students taught mathematics using the flipped strategy.

**Null Hypothesis Two:** There is no significant difference in the mean difference of male and female of students using flipped learning strategy.

In order to test the hypothesis two posttest scores of the students in experimental group, they were subjected to an independent sample t-test statistic and the result was presented in Table 5.

**Table 5:** T-test of Analysis Experimental in Post-posttest

Group	N	Mean	SD	Df	t-value	P-value	Remark
Male	45	55.92	10.807	18	0.024	0.033	Non Sig.
Female	45	56.01	12.113				

\*Significant at  $p < 0.05$

From the result of the analysis in Table 5, the p-value obtained (0.033) is less than 0.05, which was an indication that there was no significance in the male and female students ability of the experimental and control groups. Therefore, the null hypothesis was not rejected. This result indicates that flipped learning strategy

does not discriminate between male and female students' performance in mathematics.

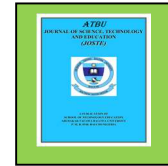
**Research Hypotheses three:** There is no significance difference in the mean retentive ability of students taught using the flipped classroom and their counterparts taught same topics using the traditional lecture method.

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**Table 6:** T-test of Analysis of the retentive ability of the experimental and control group

Group	N	$\bar{x}$	Df	T-value	P-value	Remark
Experimental	90	55.78				
Control	90	49.25	178	2.123	0.214	Sig.

Table 6 above revealed t-test analysis of the retentive ability of the experimental and control group in the post post-test. A careful examination of figures on table 6.0 shows that p-value of 0.214 is less than the t-value of 2.123 at 0.05 level of significance. Thus, hypothesis three was rejected because there was a significance retentive ability in favour of the students taught mathematics using the flipped learning strategy.

### DISCUSSION OF FINDINGS

The computed p-values for the null hypotheses were less than the critical value at 0.05 (level of significance). The first hypothesis is rejected. This implies that there exists a significant difference in the Mathematics performance of students taught using the flipped as compared to the lecture method. The difference is in favour of students in flipped learning strategy. This finding agrees with students in flipped learning instruction had better performance compared with those who were instructed through traditional lecture method. The result statistically revealed that spacing group significantly did better than the experimental group. The implications of this study can make teachers awards of the teaching through flipped can provide better results than teaching through lecture.

The second hypothesis was not rejected since the p-value is less than 0.05 level of significance. The acceptance of hypothesis two signifies that there is no significant difference in the male and female performance in the experimental group. This finding confirmed the positions of John (2020) and Ace and Remalyn (2017) that flipped classroom is gender friendly. Also, hypothesis three also maintained that performance and retention ability of students exposed in flipped teaching attained high scores in performance and retention compared with students exposed to lecture teaching as well as their attitude towards the learning of content. This finding is affirm by the result of research

conducted. John, (2020) which stated that students with high retention or long-term memory are able to get high scores in the tests.

### CONCLUSION

It has generally been found that flipped classroom instruction is more efficient than traditional lecture instruction. This was first demonstrated more than a century ago by Scholars and educations who found that flipped learning sessions produced higher retentive scores than lecture learning sessions, when the total time spent learning was kept constant for both learning conditions. The study found that learning is often more efficient if the time interval between retrieval sessions is steadily increased for successive session. This strategy is known as “expanding retrieval practice”.

Although, flipped learning has been consistently found to be superior to lecture over the long term, because of the use of online materials. The study supports that time dependence of comprehension and application of fact in flipped classrooms. This is due to the fact that the level of comprehension also depends on factors influencing performance and retention. Therefore, effort must be made by Mathematics teachers in senior secondary schools to adhere to the time table for the teaching of using the flipped learning strategy in addition to provision of conducive environment and learning resources.

### RECOMMENDATIONS

Based on the findings of this study, the researcher recommended that;

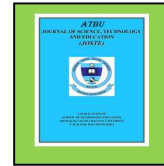
1. Flipped Instruction should be fully integrated into Nigeria Education Curriculum by mathematics teachers to enhance students’ comprehension and understanding of difficult concepts.
2. Teachers of Mathematics should be exposed to flipped learning instruction

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through seminar, symposium and in-service training.

3. Teachers of Mathematics should be made to adhere to the period allotted for the teaching of Mathematics with adequate and sufficient learning resources that help to sustain and enhance flipped strategy.

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