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EFFECT OF ACTIVITY-BASED INSTRUCTIONAL STRATEGY ON SENIOR SECONDARY SCHOOL STUDENTS' ACADEMIC ACHIEVEMENT IN MATHEMATICS IN NUMAN EDUCATION ZONE, ADAMAWA STATE, NIGERIA

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ABSTRACT

This study examined the effect of activity-based instructional strategy on senior secondary school student' academic achievement in Mathematics in Numan Education Zone, Adamawa State. The study centred on two research questions and two hypotheses that were tested at a significance level of 0.05. A quasi-experimental research design was adopted. A sample size of 169 from the population of 8734 out of 84 senior secondary school students (SS2) was used, which entailed four intact classes from four different schools. The experimental group was taught Mathematics using activity-based while the control group was taught using conventional lecture method. In order to test the null hypotheses of the study, Mathematics Achievement Test (MAT) was administered at the pre and post-tests stages. The instrument was validated by three experts, pilot tested with a reliability coefficient of 0.80 obtained using Guttmann split-half statistics. The data obtained from the MAT were analysed using descriptive and inferential statistics (t-test). The analysis revealed that there is a significant difference in the mean score of students' taught mathematics by the use of activity-based instructional strategy in Numan Education Zone. The study also revealed that there is significant difference in the academic achievement of students taught mathematics by the use of activity-based instructional strategy with the highest mean scores (Mean = 41.90, pre-test (Mean = 19.19) and ($t = 20.69$, $df = 84$, $p < 0.05$) in Numan Education Zone. The study therefore concluded that activity-based instructional strategy was effective in improving students' academic achievement in Mathematics and based on this, it was recommended that the strategy should be adopted more in Nigerian schools than conventional lecture method especially at all levels of secondary schools in order to yield higher academic achievement of students.

Keywords: ***Activity-Based Instructional Strategy, Mathematics, Quasi-experimental, Students' Academic Achievement, Numan Education Zone***

INTRODUCTION

All students in senior secondary schools in Nigeria are required to take Mathematics. Because it is required, mathematics is given priority in both primary and secondary schools by the Federal Republic of Nigeria (FGN, 2014) in the National Policy on Education. As a result, it became necessary for all students to have a solid understanding of mathematics. In its abstract forms or when applied to other fields like physics and engineering, mathematics is an analysis of number, amount, and space. Geometry, algebra, trigonometry, statistics, and arithmetic are among the many but connected subjects that are included in Mathematics. According to Odili (2016), mathematics has been referred to as the Queen of sciences, in addition to being the handmaid, the master, and the servant, due to the leadership it provides and the tasks it fulfils. This subject has caused many worries and anxieties for teachers as well as students in their educational experiences. Both the content and the pedagogy of mathematics education are undergoing significant transformation for today's teachers. The majority of these teachers attended school during a time when mathematics was merely a set of knowledge and abilities that were taught in a lecture format to a fairly homogeneous class of students.

According to a number of studies conducted by individuals, governmental organisations, and non-governmental organisations, such as the Community Participation for Action in the Social Sector (COMPASS), secondary school maths teachers in Nigeria typically use the lecture method of instruction, or direct instruction (COMPASS, 2020, Salami, 2020). Therefore, the depressingly low learning level that was seen in students during mathematics courses had to have resulted from their completion of the class activities according to the teacher's method (also known as the "do-it-I-have-done-it" syndrome). According to Olosunde (2016) and Awofala (2016), this kind of learning is ineffectual, non-functional, and not able to endure over time. Numerous studies and pieces of data demonstrate the ineffectiveness of the lecture method of instruction for secondary school students. According to research, this subject is the least popular in schools

(Brown, Browhe, & Bibby, 2019), and students' performance in it declines yearly across the board. According to a report published in 2008 by Nigeria Education Sector Analysis (NESA), students in secondary schools perform below average in mathematics and have poor problem-solving abilities. These subpar teaching/learning environments should not be permitted to continue, especially in light of the importance of mathematics in secondary school and in all areas of life.

The adoption of the activity-based method of teaching in secondary school mathematics classrooms in Nigeria is a clear call to action for all stakeholders involved in the subject matter. The activity-based instructional strategy places an element of accountability for what is being instructed and how it is learned on the students. Initially, one may wonder why teachers in secondary schools aren't able to use activity-based learning or any other type of student-centred instruction. Researchers conducted studies to address this issue, and they found that secondary school teachers' resistance to implementing student-centred strategies (particularly activity-based strategies) was a result of the teacher education courses they had completed (Omosehin, 2013; Olusunde, 2016, Salami, 2020). It was found that during their introduction to a variety of teaching methods and tactics, pre-service teachers' lectures mostly focused on explaining the concepts and highlighting the advantages and circumstances of each technique. Pre-service teachers are not permitted to plan and deliver this method while they are still in training, and most of the time, lecturers do not employ an activity-based approach in their instruction.

When hired for teaching secondary school mathematics, it has been shown that the lacuna represents the most obvious issue for qualified teachers. Furthermore, unlike lectures, activity-based learning necessitates a number of abilities that can only be acquired via hands-on practice and/or by watching role-plays. It's possible that learning these abilities through studying or comprehension of instructions will be difficult. Teachers that possess these abilities are the ones who can effectively teach mathematical concepts in today's classrooms. Unlike the way Mathematics was taught and learnt in the past century, where a Mathematics literate person is seen as "knowing Mathematics", the focus of teaching and learning the subject now is on "doing Mathematics" (Akinoso, 2018). Akinoso further refers to "knowing Mathematics" as procedural knowledge and 'doing maths as conceptual knowledge. Conceptual is preferable because it involves the acquisition of the knowledge and ability to adopt it to solve life-related problems. Therefore, teaching at this level shall be by practical, exploratory and experimental methods (FGN, 2014). Teaching method is a key to the successful learning.

Fundamentally, teachers have used the terms lecture method and activity-based instruction to describe two distinct approaches to instruction" (James, 2019). One of the major challenges contributing to this poor performance is the reliance on traditional lecture-based instructional methods, which often emphasize rote learning and fail to engage students actively in the learning process (Ajai & Imoko, 2015). This method is typically teacher-centred, with students playing a passive role in the classroom. The teacher typically gives directions, reading, illustrating ideas, and lecturing. While most of the time, students are seated at desks listening, taking notes, responding succinctly to questions posed by the teacher. This teaching method is based on a behaviour-focused theory of learning, that portray students as passive recipients of information. Behavioural learning theorists contended that since one behaviour influences another, students will emulate their teachers' actions.

As a result, many students struggle to grasp abstract mathematical concepts, leading to low retention rates and poor academic outcomes. In response to these challenges, educators and researchers have explored alternative instructional strategies that could better support students' understanding and application of mathematical concepts. One of these is the activity-based instructional strategy, which has gained attention for its potential to improve students' academic achievement in Mathematics. This strategy is rooted in the constructivist theory of learning, which posits that students learn best when they are actively involved in the learning process, constructing their own understanding through hands-on activities and problem-solving tasks (Prince & Felder, 2016). Unlike traditional lecture methods, activity-based instruction encourages students to collaborate, discuss, and apply concepts in practical, real-world contexts, thereby enhancing their engagement and comprehension (Freeman et al., 2014).

In the context of the Numan Education Zone, where socio-economic and cultural factors may further complicate students' learning experiences, the adoption of activity-based instructional strategies presents a promising approach to improving academic outcomes in Mathematics. However, despite the growing interest in this instructional method, there is limited empirical research examining its effectiveness in this specific region. This study, therefore, sought to explore the effect of activity-based instructional strategy on the

academic achievement of senior secondary school students in Mathematics within the Numan Education Zone. By doing so, the study aimed to provide insights that could inform teaching practices and educational policies towards enhancing student achievement in Mathematics.

Problem Statement

Mathematics is one of the compulsory subjects in Nigeria but yet the performance of students in the External Examination is not encouraging, there is need for improvement. Past reports of the Nigeria Examination Council and West African Examination Certificate (NECO and WAEC 2018-2022) showed massive failure of students in Mathematics in Nigeria. This situation continues over the years. Records from Adamawa State Ministry of Education Directorate of Planning, Research and Statistics show that out of 27,807 candidates who sat for May/June WAEC 2022 from Adamawa State, 13,335 males and females made five credits and above including Mathematics. Source: Adamawa State Ministry of Education Yola Directorate of Planning, Research and Statistic. This accounted for 48.0% only of Adamawa State candidates who made five credits and above including Mathematics.

Moreover, the past WAEC 2020-3 results of Mathematics students in Adamawa State including Numan Education Zone indicated high level of failure. This low level of academic achievement by Mathematics students leaves room for significant improvement and is assumed by the people to be the fault of Mathematics teachers; as the teacher's method of teaching is regarded as the direct means for improving Mathematics learning among students. The researchers were therefore left wandering if the teaching of Mathematics is done with activities/exercises that encourage learners' engagement and active participation in solving problems? Thus, there was a need to identify comparatively more effective teaching strategy that could help improve students' performance. Therefore, this study investigated the effect of activity-based instructional strategy on the academic achievement of senior secondary school students in Mathematics in Numan Education Zone. Specifically, the study sought to:

1. investigate the effect of activity-based instructional strategy on the academic achievement of senior secondary school students in Mathematics in Numan Education Zone, Adamawa State.
2. compare the academic achievement of senior secondary school students taught Mathematics using activity-based instructional strategy and those by the use lecture method in the study area.

Research Questions

The following research questions were raised for this study:

1. To what extent does the activity-based instructional strategy affect senior secondary school student's academic performance in mathematics in Numan Education Zone, Adamawa State?
2. What is the academic achievement before and after instructional treatment of students taught Mathematics using lecture method in senior secondary schools in Numan Education Zone, Adamawa State?

Research Hypotheses

The research null hypotheses raised for the study have been tested at the 0.05 level of statistical significance. They include the following:

$H_0$1: There is no significant difference in the between the pre-test and post-test scores of students taught Mathematics by the use of activity-based instructional strategy in Numan Education Zone, Adamawa State.

$H_0$2: There is no significant difference in the academic achievement of students taught mathematics by the use of lecture method of instruction in Numan Education Zone, Adamawa State.

METHODOLOGY

This study adopted the quasi-experimental non-randomized pretest, post-test and control group design. The population covered all the 8,734 SS 2 students in the 84 public senior secondary schools in Numan Education Zone of Adamawa State. Non-randomized sampling technique was used to select intact classes and the four classes were spread across four schools. The sample included 169 SS 2 students (110 male and 59 female) in the sampled schools. All the four schools were selected to avoid communication between the students from different instructional treatments. The simple random sampling technique was

used for drawing samples from the four schools selected from the four Local Government Areas. The sample also included two treatment classes (86 students) and two control (83 students) classes.

The instrument was titled: Mathematics Achievement Test (MAT) and subjected to face and content validity by experts. Lesson note was also drawn for each of the unit of the topic inline with the Post Primary Schools Management Board (PPSMB), Yola, Adamawa State's scheme of work for Senior Secondary Schools Mathematics. The items were selected from four topics namely: Simultaneous linear equation, (Variation) i.e. Direct variation, inverse variation and Partial variation to measure the academic performance of the students with the help of table of specification. The instrument was constructed in accordance with Bloom taxonomy of the behavioural objectives. All necessary corrections were made in the final body of the instrument. The instrument was also pilot tested using 64 Mathematics students in two senior secondary schools in Yola Education Zone. A split-half method was used to split the number of scores obtained from participants into two, even and odd number. Each participant's total score in even and odd number were obtained after pilot testing and correlated together using Guttmann split-half statistics to obtain a reliability coefficient index of 0.80.

At the preliminary stage, permission was sought from the sampled schools, with the intact class used. The pre-treatment stage (pre-test) focused on assessing the students' initial level of performance in mathematics in the control and experimental groups before exposing students to the treatment. After the pre-treatment stage is the treatment stage where the researcher exposes the students in the different groups to all areas of focus in the study namely: Simultaneous linear equation, (Variation) Direct variation, Inverse variation and Partial variation. The post treatment stage included the post-test phase were MAT was administered to both the experimental (activity based instructional strategy) and control (lecture method) group. The data collected from both pre-test and post-test were statistically analysed on the basis of the mean and standard deviation for answering the research questions while the null hypotheses were tested using t-test analysis at 0.05 level of significance.

RESULTS

The result of the data analysed and descriptive statistics for this study are presented in Tables and also the results of the hypotheses tested are presented in their respective Tables.

Table 1: Distribution of Participants based on School

Group		N	Percentage (%)
Control Group:(X_2)			
Lecture	School 1	42	24.9
	School 2	41	24.3
Experimental. Group:(X_1)			
Activity-based	School 3	43	25.4
	School 4	43	25.4
	Total	**169**	**100.0**

Table 1 show that the totals of 169 participants were selected from four schools. of the 169 participants, 24.9% of them in control group were from school 1 while the remaining 24.3% were from school 2 for those in experimental group (Activity-based Instructional Strategy) 25.4% were selected from school 3 and 4 respectively.

Research Questions

Research Question 1: To what extent does the activity-based instructional strategy affect senior secondary school student's academic performance in mathematics in Numan Education Zone?

To test the research question one, mean scores of the 86 students taught using Activity-based instructional strategy were analysed using the mean and standard deviation as presented in Table 2.

Table 2: Summary of Mean and Standard Deviation of Students' Taught Mathematics using Activity-based Instructional Strategy in Numan Education Zone

Source	n	Mean	SD
Pre-Test	86	19.99	4.76

Post-Test	86	41.90	9.20

The result in Table 2 clearly shows that the highest mean scores of 41.90 marks with a standard deviation of 9.20 marks was recorded during the post-test evaluation. This result was considerably higher when compared to what was obtained during the pre-test session where the Mean score was 19.19 marks. The two analyses indicated that the mean scores of students taught mathematics using the Activity-based instructional strategy is better than when they were not introduced to the treatment.

Research Question 2: What is the academic achievement before and after instructional treatment of students taught Mathematics using lecture method in senior secondary schools in Numan Education Zone, Adamawa State?

To test the research question two, the mean scores of the 83 students taught using Lecture method were analysed using the mean and standard deviation as presented in Table 3 below.

Table 3: Descriptive Statistics of Students' Taught Mathematics Pre-test and Post-test Academic Achievement Using Lecture Method in Numan Education Zone

Source of Variation	N	$\bar{X}$	Mean Difference	Std. Deviation
Pre-test	83	23.55		8.35
			22.10	
Post test	83	45.65		11.84

The result in Table 3 clearly shows that the highest mean scores of 45.65 marks with a standard deviation of 11.84 marks was recorded during the post-test evaluation. This result was considerably higher when compared to what was obtained during the pre-test session where the mean score was 23.55. The two analyses indicated that the mean scores of students taught mathematics using the lecture method is better than when they were not introduced to the treatment.

Hypothesis Testing

The hypotheses tested in the present study were aimed at investigating some critical aspect of the study based on the two research groups. All hypothesis were tested at 0.05 level of statistical analysis. The analyses are here presented accordingly.

$H_0$1: There is no significant difference in the between the pre-test and post-test scores of students taught Mathematics by the use of activity-based instructional strategy in Numan Education Zone, Adamawa State.

The hypothesis sought to determine if there is a significant difference in the mean scores of students taught using Activity-based instructional strategy. The students' academic scores in experimental group (n = 86) were obtained and the paired Samples t-Test statistic was used to analyse the data. The result is presented in Table 4 below:

Table 4: Summary of Paired Samples t-Test Analysis of Students' Pre and Post Test Scores in Activity-based Instructional Strategy in Numan Education Zone

Source of Variation	N	Mean	Mean Difference	SD	df	t	Sig. (2-tailed)
Pre-Test	86	19.99		4.76			
			21.91		85	20.69	0.000*
Post-Test	86	41.90		9.20			

*Significant; $p < 0.05$

It could be observed from the analysis in Table 2 that post-test score has the highest mean scores (Mean = 41.90) and pre-test (Mean = 19.19). To determine if these mean scores were significantly different, the paired samples test was performed. The result of the paired samples test in table 4 indicates there is significant difference in the mean scores of students taught mathematics using the Activity-based instructional strategy ($t = 20.69$, $df = 85$, $p < 0.05$). This result shows that there is a significant difference between the performances of students taught mathematics by the use of activity-based instructional strategy in Numan Education Zone.

$H_0$2: There is no significant difference in the academic achievement of students taught mathematics by the use of lecture method of instruction in Numan Education Zone, Adamawa State.

The hypothesis two is developed to find if there is a significant difference in the academic achievement of students taught mathematics by the use of lecture method of instruction. The students' academic achievement in control group (n = 83) was obtained and the paired Samples t-Test statistic was used to analyse the data as summarised in Table 5.

Table 5: Summary of Paired Samples t-Test Analysis of Students' Pretest and Post Test Scores in Lecture Method of Instruction Strategy in Numan Education Zone

Source of Variation	N	Mean	Mean Difference	SD	df	T	Sig. (2-tailed)
Pre-Test	83	23.55		8.35			
			22.10		82	25.05	0.000*
Post-Test	83	45.65		11.84			

*Significant; $p < 0.05$

It could be observed from the analysis in Table 5 that post-test score has the highest mean scores (Mean = 45.65) and pre-test (Mean = 23.55). To determine if these academic performance mean scores were significantly different, the paired samples test was done. The result of the paired samples test in table 8 shows that there is significant difference in the mean scores of students taught mathematics sussing the lecture method of instruction strategy ($t = 25.05$, $df = 82$, $p < 0.05$). This result implies that there is significant difference in the academic achievement of students taught mathematics by the use of lecture method of instruction strategy in Numan Education Zone.

DISCUSSION

This study seeks to investigate whether difference existed between the mathematics' performance scores level of students exposed to the lecture method and activity-based instructional strategy. The discussion of the findings presented in this chapter is seen around the two null hypotheses. From research question one, the two analyses indicated that the mean score of students taught mathematics by use of activity-based instructional strategy is better than when they were not introduced to the treatment.

The study revealed that there is no difference in the entry behaviour of student in lecture method and activity-based instruction scores from the pre-test. The result of the first hypothesis shows that there is a significant difference between the performances of students taught mathematics by the use of activity-based instructional strategy in Numan Education Zone. This means that activity-based instructional strategy significantly improved students' performance in Mathematics. This means that result of this finding is supported by the findings of Agbatogun (2021), which stated that when two innovative active approaches are used as treatments, there is always an improvement in the performance of students in the experimental group. There are possible explanations for the experimental class that significantly improve academic performance in Mathematics. At first, students in activity-based are exposed to series of interactive tasks such as role play, dialogue, group discussion and the use of flash cards during their Mathematics class/lesson where students would engage in a series of activities and different forms of practices that enhance students' understanding and comprehension of concepts. As such opportunities are given to the students to exhibit their talents. Students understand better when they share ideas and information within themselves while in the lecture class, they remain silent as passive learners.

In activity-based pedagogy, students assume a certain degree of responsibility for what is taught and how is being learned, also in activity-based instruction, knowledge is often discovered by the learner (Abbot,

2017) activity-based typically refers to form of instruction that for example, give students' opportunities to lead learning activities, participate more actively in discussion, design their own learning projects, explore topics that interest them and generally contribute to the design of their own course of study. According to Weimer (2014) teaching strategies are used for achieving the teaching goals and objectives. The result of the second hypothesis also reveals that there is significant difference in the academic achievement of students taught mathematics by the use of lecture method of instruction strategy in Numan Education Zone.

CONCLUSION AND RECOMMENDATION

Based on the study's findings, the study concludes that there is significant effect of treatment on senior secondary school students' academic performance in Mathematics. The study also confirmed that there is significant difference in the performance of senior secondary school students in Mathematics taught using activity-based instructional strategy. Hence, activity-based instructional strategy is found actively and pedagogically rewarding and reliable in the teaching and learning of Mathematics. This is because students assume a certain degree of responsibility for what is taught and how is being taught. Based on this, the study recommends the following:

1. The Federal Ministry of Education, State Ministry of Education should make it a policy that any teaching strategy that is aimed at achieving teaching goals and objectives such as activity-based instructional strategy be adopted in our Nigerian public senior secondary schools. One the reason why parents enrol their children in private is that, in private schools there is much engagement of students in activities/exercises to keep students even at home. As a parent if care is not taken you will be tired of helping the child to do home and assignments more especially in mathematics because of knowing its importance to education.
2. The State Ministry of Education should from time to time organise seminars and workshops that will open up the mind of mathematics teachers on engaging students fully in solving mathematics problems as activities and exercises.
3. All Stakeholders, Principals and even Head teachers should collaborate to encourage teachers' implementation, adaptation and integration to adjust to a teaching strategy that allows for achieving goals and objectives such as activity-based instructional strategy, this is because method/strategy of a teaching is a wee-known device for improving students of mathematics effectively. If teaching of mathematics is done with activities/exercises can encourage learners' engagement and active participation in solving problems in Mathematics, therefore, there is need for comparatively more effective teaching strategy that is aimed at improving students 'performance.

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