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EFFECT OF GENDER ON ACADEMIC ACHIEVEMENT OF STUDENTS EXPOSED TO ACTIVITY-BASED INSTRUCTIONAL STRATEGY IN MATHEMATICS IN NUMAN EDUCATION ZONE, ADAMAWA STATE, NIGERIA

[1]Ahmed Auwal Ibrahim, [2]Hamza Shuaibu and [3]Saratu Midankiya Ezekiel
E-mail: AhmedauwalIbrahim2016@gmail.com; hamshu50@gmail.com; saratuezekiel2016@gmail.com;
[1&2]Department of Mathematics Education, Adamawa State Polytechnic, Yola
[3]Department of Mathematics, Modibbo Adama University, Yola, Adamawa State, Nigeria

ABSTRACT

This study examined the gender difference in academic performance of senior secondary school students taught Mathematic through the use of activity-based instructional strategy 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 no significance difference in the relative academic performance of male and female students exposed to activity-based instructional strategy. The female gained the highest mean scores (Mean = 43.45), while their male counterparts gained (Mean 41.11) and (t = 1.12, df = 84, p> 0.05 in Numan Education Zone. The study therefore concluded that gender has no effect on activity-based instructional strategy for improving students' academic performance in Mathematics in senior secondary schools. Hence, it was recommended among others that training programmes for Mathematics teachers should emphasize the benefits of activity-based instructional strategy, ensuring that all students, regardless of gender, have equal access to engaging and effective learning experiences in Mathematics.

Keywords: Gender, Activity-Based Instructional Strategy, Mathematics, Quasi-experimental, Students' Academic Achievement

INTRODUCTION

Education is universally recognized as a critical driver of social and economic development, providing individuals with the knowledge and skills necessary to participate fully in society. Globally, educational systems have evolved to meet the changing demands of the 21st century, with a growing emphasis on inclusive and quality education for all (UNESCO, 2015). In Africa, education remains a key priority as countries strive to address the challenges of access, equity, and quality (United Nations, 2020). Nigeria, as Africa's most populous country, faces significant educational challenges, including inadequate infrastructure, teacher shortages, and gender disparities in school enrolment and completion rates (Federal Ministry of Education [FME], 2020). These challenges are particularly pronounced in subjects such as Mathematics, where students often struggle to achieve satisfactory performance levels. Mathematics, a core subject in the curriculum, is essential for developing logical reasoning, problem-solving skills, and the ability to think in abstract terms (NCTM, 2019). Despite its importance, many students in Nigeria continue to perform poorly in Mathematics, highlighting the need for effective instructional strategies to improve learning outcomes.

Mathematics education is crucial for fostering analytical and critical thinking skills, which are vital in various fields such as science, technology, engineering, and mathematics (STEM). Globally, there has been a concerted effort to improve Mathematics education through the adoption of

innovative teaching methods and curricula designed to engage students more effectively (OECD, 2018). In Nigeria, however, students' performance in Mathematics remains a concern, with results from standardized examinations such as the West African Senior School Certificate Examination (WASSCE) consistently showing low pass rates (Owadiae, 2018). Various factors contribute to this underperformance, including a lack of qualified teachers, insufficient instructional materials, and traditional teaching methods that fail to engage students effectively (FME, 2020). To address these challenges, educators and policymakers have called for the adoption of more interactive and student-centred instructional strategies that can enhance students' understanding and interest in Mathematics (Akinoso, 2018).

Academic performance in Mathematics is influenced by a variety of factors, including socio-economic status, learning environment, teacher quality, and instructional methods (Tella, 2008). Poor academic performance in Mathematics has been attributed to the use of traditional lecture-based teaching methods, which often fail to cater to the diverse learning needs of students (Ajai & Imoko, 2015). These methods typically emphasize rote memorization rather than conceptual understanding, leading to disengagement and poor retention of mathematical concepts. To combat these issues, educational researchers have advocated for the use of more dynamic and interactive instructional strategies, such as activity-based learning, which can help to improve students' understanding and performance in Mathematics (Awofala, 2016). Activity-based instructional strategies involve students in hands-on activities and problem-solving tasks that make learning more relevant and engaging, fostering deeper understanding and retention of concepts.

Activity-based instructional strategies differ significantly from traditional lecture methods in their approach to teaching and learning. While lecture methods are teacher-centred, with the instructor delivering information and students passively receiving it, activity-based strategies are student-centred, encouraging active participation and collaboration among students (Prince & Felder, 2016). In the context of Mathematics education, activity-based learning typically involves practical exercises, group work, and real-world problem-solving tasks that allow students to apply mathematical concepts in meaningful ways (Freeman et al., 2014). These strategies have been shown to improve students' engagement, motivation, and overall academic performance compared to traditional lecture methods (Akinoso, 2018). The shift from passive learning to active engagement is particularly important in Mathematics, where understanding complex concepts often requires hands-on experience and interaction with the material.

Gender is a significant factor in education, influencing how students learn and perform across various subjects. Research has shown that gender can affect students' learning experiences and outcomes, with differences often attributed to socialization patterns, cognitive abilities, and learning styles (Hyde, 2016). In the context of instructional strategies, there is evidence that male and female students may respond differently to different teaching methods. For instance, some studies suggest that male students may benefit more from competitive and hands-on activities, while female students may excel in collaborative and discussion-based environments (Li & Koch, 2017). These differences highlight the importance of considering gender when implementing instructional strategies, such as activity-based learning, to ensure that all students are equally supported in their learning.

Given the persistent challenges in Mathematics education in Nigeria and the potential impact of gender on learning outcomes, there was a need for research that examines the effectiveness of activity-based instructional strategies across different student groups. Understanding how these strategies affect students of different genders can provide valuable insights for educators and policymakers seeking to improve academic performance in Mathematics. This study therefore aimed to fill this gap by investigating the effect of gender on the academic achievement of students exposed to activity-based instructional strategies in Mathematics in the Numan Education Zone, Adamawa State, Nigeria. The study therefore aimed to contribute to the advancement of teaching strategies that are more effective and fairer, with the goal of improving learning outcomes for all students.

Problem Statement

Mathematics is a foundational subject that plays a crucial role in the academic and professional development of students. Despite its importance, there are persistent concerns about the low levels of achievement in Mathematics among secondary school students in Nigeria (Adigun, Onihunwa, Irunokhai, Sada, & Adesina, 2015). To address these concerns, educators have increasingly turned to innovative teaching methods, such as activity-based instructional strategies, which are designed to make learning more engaging and effective (Adeyemo & Babajide, 2014). However, the impact of gender on students' academic achievement in Mathematics, particularly when exposed to activity-based instructional strategies, remains unclear. While some studies suggest that gender differences in cognitive abilities and learning preferences may affect how students benefit from different teaching methods (Hyde, 2016), others argue that effective instructional strategies can mitigate these differences, leading to similar outcomes for both male and female students (Ali, 2018).

In the Numan Education Zone of Adamawa State, these issues are particularly pressing due to the region's diverse socio-cultural dynamics, which may influence educational experiences and outcomes differently for male and female students. Despite the growing adoption of activity-based instructional strategies in the region, there is limited empirical evidence on whether these strategies are equally effective for all students, regardless of gender. This gap in the literature highlights the need for a focused study to examine the effect of gender on the academic achievement of students exposed to activity-based instructional strategies in Mathematics. This study seeks to address this gap by investigating whether gender differences exist in the academic achievement of students who are taught Mathematics using activity-based instructional strategies in the 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. establish the effect of gender on the academic achievement of students exposed to Mathematics instruction by use of activity-based instructional strategy in Numan Education Zone, Adamawa State.

1.2 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. How do male and female students who are exposed to an activity-based instructional technique in mathematics perform academically differently in the Numan Education Zone?

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 mean academic performance of male and female students in Mathematics exposed to activity-based instructional strategy to those not exposed to activity-based instructional strategy 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 in line 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: Gender Distribution of Participants

Gender	Number of Participants	Percentage (%)
Male	110	65.09
Female	59	34.91
Total	169	100.00

Table 1 show that 169 students participated in the study, 110 were male (65.09%) while 59 were female (34.91%). this indicated male students participated in the study than the female students.

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 performance of male and female students in Mathematics when exposed to activity-based instructional strategy in Numan Education Zone?

To test the research question two, mean scores of the 86 students when exposed to the Activity-based instructional strategy were classified based on their gender as presented in Table 3.

Table 3: Mean and Standard deviation of Male and Female Students Exposed to Activity-based Instructional Strategy in Numan Education Zone

Source	**n**	**Mean**	**SD**
Female	29	43.45	7.02
Male	57	41.11	10.09

The analysis in Table 3 reveals that the academic performance of the female students exposed to the activity-based instructional strategy has a mean score of 43.45 marks compared to the male students who fall behind them with a Mean score of 41.11 marks. This implies that the female students slightly performed better than their counterpart despite the fact that the overall performance in mathematics is moderately low.

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

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 pretest and post-test scores of students taught mathematics by the use of activity-based instructional strategy in Numan Education Zone.

$H_0$2: There is no significance effect in the relative academic performance of male and female students exposed to activity-based instructional strategy in Numan Education Zone, Adamawa State.

The hypothesis two is sought to find if there is a significant difference in the academic achievement of students taught mathematics using the activity-based instructional strategy. The students' academic performance in experimental group (n = 86) was collected and the independent Samples t-Test was used to analyse the data as presented in Table 5.

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

Source of Variation	n	Mean	Mean Difference	SD	Df	t	Sig. (2-tailed)
Female	29	43.45		7.02			
			2.34		84	1.12	0.297**
Male	57	41.11		10.09			

*Significant; $p < 0.05$

The analysis in Table 5 shows that the female gained the highest mean scores (Mean = 43.45), while their counterparts gained (Mean = 41.11). To ascertain if the academic performance mean scores between the genders were significantly different, the independent samples test was performed. The result of the independent samples test in table 9 shows that there is no significant difference in the mean scores of students taught mathematics using the lecture method of instruction strategy based on gender ($t = 1.12$, $df = 84$, $p > 0.05$). This result indicates that we maintain the null hypothesis, which states that there is no significance difference in the relative academic performance of male and female students exposed to activity-based instructional 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. This study also examined the gender of students in the experimental group (i.e. the activity-based instructional strategy) that was introduced during the research. The discussion of the findings presented in this chapter is seen around the three 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. And from research question two it implies that the female students slightly performed better than their male counterpart despite the fact that the overall performance in mathematics is moderately low.

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, 2013) 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 Shama (2002) teaching strategies are used for achieving the teaching goals and objectives.

Gender is one of the key factors influencing students' academic performance, the result of this study indicated the difference between the performance of Females and Males students of senior secondary school taught mathematics by the use of activity-based instructional strategy in Numan Education Zone. Result from research question two signifies that the male students slightly performed better than the female students when exposed to the lecture method of instruction. The result indicated that the null hypotheses be maintained because there is no significant difference in the relative academic performance of male and female students exposed to activity-based instructional strategy in Numan Education Zone. In the same vein the last hypothesis equally specifies that 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.

CONCLUSION AND RECOMMENDATION

Based on the study's findings, the study concludes that there is no significant effect of gender on activity based instructional strategy treatment on senior secondary school students' academic performance in Mathematics. This suggests that when students are engaged in hands-on, interactive learning experiences, both male and female students benefit equally, leading to comparable academic outcomes. The absence of significant gender differences in this context underscores the potential of activity-based instructional strategies to promote equitable learning environments where all students can thrive, regardless of gender.

These results align with previous research suggesting that innovative, student-centred teaching methods can help bridge the gender gap in academic performance, particularly in subjects like Mathematics that have historically seen gender disparities. By focusing on engaging and inclusive instructional practices, educators can support all students in achieving their full academic potential, contributing to more balanced and equitable educational outcomes. This study reinforces the importance of adopting effective teaching strategies that cater to diverse learning needs and highlights the role of activity-based learning in fostering academic success across gender lines. Based on this, the study recommends the following:

1. Mathematics teacher should promote inclusive activity-based instruction since gender does not influence the effectiveness of activity-based instructional strategies, schools should implement these strategies universally across all student groups.

2. Training programmes for Mathematics teachers should also emphasize the benefits of these activity-based instructional strategies, ensuring that all students, regardless of gender, have equal access to engaging and effective learning experiences in Mathematics.
3. With gender shown to be a non-significant factor, educators and policymakers should focus on other variables that may affect the success of activity-based instructional strategies, such as socioeconomic background, prior knowledge, and learning styles. Tailoring instructional approaches to address these factors may further enhance academic performance.
4. Schools and educational bodies should encourage ongoing research and evaluation of activity-based instructional strategies to identify any emerging trends or nuances. Even though gender has been found to have no significant effect, continuous monitoring can help in detecting other potential influences or ensuring that the findings remain consistent across different contexts and student populations.

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