EFFECT OF DEMONSTRATION METHOD ON STUDENTS' ACHIEVEMENT IN JUNIOR SECONDARY MATHEM1ATICS IN PANKSHIN LOCAL GOVERNMENT AREA

[1]Jonah D. Tali Phd, [2]obadiah M. Dalong Phd And [1]Sambo S. Emmanuel
talijonah@gmail.com, dalongobadiah@yahoo.com and suwatkyae@gmail.com
[1]General Studies Education Department and [2]Psychology Department
Federal College of Education, Pankshin

Abstract

The study examined the effect of demonstration method of mathematics teaching on the performance of Junior Secondary school II (JSS II) students in the study area. A quasi-experimental design was used, and 120 students were randomly selected from four schools. The experimental group was exposed to the demonstration method, while the control group was taught the lecture method. The Mathematics Achievement Test (MAT) was used for data collection, and the reliability coefficient was 0.76. Three research questions and three null hypotheses were formulated to guide the study. The results showed a significant difference in learning outcomes between students who received the demonstration method and those who received the lecture method. There were no significant differences in academic performance between male and female students taught using the demonstration method. However, there was a significant difference in academic performance between male and female students who received the lecture method, with female students achieving better results. The study suggests that the demonstration method improves students' performance in mathematics regardless of gender, while the lecture method is passive and has a gender bias. The study recommends that the demonstration method be adopted when teaching JSSII students.

Keywords: Demonstrative method, secondary school, teaching and learning, mathematics achievement, gender.

INTRODUCTION

Mathematics is an academic subject that requires teachers to use appropriate teaching methods that allow students to participate actively. Teaching methods are crucial in helping

students learn effectively, including classroom organization, techniques, subjects, and teaching aids and materials. Each teacher's method can enhance or hinder learning, and it is the teacher's responsibility to choose the most appropriate method based on the circumstances and individual level of the students. Teachers often use the lecture method to cover the in-depth mathematics syllabus before external examinations, which can affect students' interest and performance. This method is one-way communication, with the teacher being the dominant figure and student participation virtually non-existent. An active and student-centered approach, such as the demonstration method, should be used to stimulate students' interest, attention, and curiosity and promote their achievement in mathematics.

Empirical studies have shown that the demonstration method can bridge the gap between theory and practice, as demonstrated by Okoko's (2014) study in Niger State. Omwirhiren and Khalil (2016) examined the effects of demonstration and lecture methods on student performance in chemistry among selected UB II students in Kaduna metropolis, Nigeria. They found a statistically significant difference in the learning outcomes of students who followed the demonstration method, with both male and female students achieving good average academic performance. Daluba (2013) also examined the effects of a demonstration teaching method on student performance in Agricultural Sciences using a quasi-experimental research design. Using a targeted random sampling technique, 480 students were drawn from a population of 18,202 students at UB II. The data collection instrument was the Agricultural Science Achievement Test (ASAT), which consisted of 30 items. The study found that students taught using the demonstration method performed better on the ASAT than their peers who used the traditional lecture method. The study by Ameh and Dantani (2012) found that using demonstration and lecture methods in teaching can significantly enhance students' interest, performance, and overall learning outcomes. The study involved 180 students from UB III school in Nassarawa Local Government Area of Kano State, with 58 students selected using stratified sampling techniques. The results showed that those who used the demonstration method scored higher than those who used the lecture method. There was no significant difference in average results between male and female students who followed the demonstration method.

Statement of the Problem

It has been noted that for over a decade now, despite the relevance of mathematics to individuals and nation-building, students' interest and academic achievement in science subjects and mathematics, in particular, are still alarming and spell doom for a nation like Nigeria that is struggling to grow technologically. This has been attributed to factors like the use of inappropriate mathematical instructional methods and materials or the availability of inexperienced instructors. Mathematics education in Nigerian schools faces many challenges, one of which is the use of teaching methods. This is when a teacher is assigned to teach subjects for which he or she does not have adequate training and qualifications. These categories of teachers need a change of teaching method, as most of them teach using a teacher-based, instructional-centred method. The technique has been criticised for lacking a practical, interactive approach and for poor academic achievement. Therefore, the statement of the problem is to examine whether the use of the demonstration method can promote students' achievement in mathematics compared to the conventional lecture

method. The study's objectives were to determine the difference in the academic achievement mean scores of UB II students taught mathematics with demonstration and conventional lecture methods; determine the difference in the academic achievement mean scores of male and female UB II students in mathematics taught with the demonstration method and examine the difference in the academic achievement mean scores of male and female UB II students in mathematics taught using the lecture method.

Research Questions

The following research questions were raised to guide the study:

1. What is the difference in the mean academic achievement scores of JSS II students exposed to the demonstration method and those exposed to the conventional lecture method?
2. What is the difference between the mean academic achievement scores of male and female JSS II students taught with the demonstration method?
3. What is the difference between the mean academic achievement scores of male and female JSS II students taught using the conventional lecture method?

Hypotheses

The following hypotheses were formed to test the hypotheses at the 0.05 level of significance:

HO_1: There is no significant difference in the learning outcome of JSS II students in mathematics exposed to demonstration and those exposed to conventional methods.

HO_2: There is no significant difference in the learning outcomes of male and female JSS II students in mathematics taught using the demonstration method.

HO_3: There is no significant difference in the academic achievement of male and female JSS II students in mathematics taught using the conventional lecture method.

Methodology

The study's research design was a quasi-experimental pre-test, post-test control group. A pre-test was used to establish no difference between treatment groups at the beginning of the experiment. The population consisted of all JSS II students in 24 public schools in Pankshin Local Government Area of Plateau State. The total population was 1876, comprising 1052 male and 824 female Junior Secondary (JS) II students. The population comprised two (2) single-male schools and ten (10) co-educational schools. A sample of four (4) co-educational schools was drawn from the population. One hundred and twenty (120) JS II students were selected for the study. The purposive sampling technique was used to select the sample for the study. The technique was adopted to ensure that the subjects chosen had similar backgrounds, experiences, and environmental exposure. Forty (40) Mathematics Achievement Test (MAT) items were constructed from five identified difficult topics in the mathematics curriculum of JS II content areas. The forty-item multiple-choice questions were made up of four options, lettered A-D. The MAT was divided into five sections (A–E based on the content areas covered. The areas covered were: (i) simple algebraic expressions; (ii) properties and classification of two (2) dimensional or plane shapes; (iii) properties and

classification of three (3) dimensional solid shapes; (iv) areas and volumes of two (2) or three (3) dimensional solid shapes; and (v) logical reasoning and mathematical statements.

The questions were to measure the JS students' ability on the five major topics, and MAT was used for both the pre-test and post-test. The MAT was subjected to content and face validity by specialists' scrutiny from the Department of Mathematics Education and Measurement and Evaluation Unit of the Psychology Department, Federal College of Education, Pankshin. They were requested to determine the appropriateness of the questions for the research study. The MAT was pilot-tested to determine the reliability coefficient using the Kuder-Richardson-21 test, and the reliability coefficient was found to be 0.76, indicating that the instrument was reliable and usable.

A pre-test was administered to both the experimental and control groups before the commencement of the treatment. The pre-test scores were analysed using a t-test to ascertain any difference in the students' achievement in the experimental and control groups. The study lasted for eight weeks, during which the topics were treated with the students in collaboration with the mathematics teachers. A pre-test was administered to the whole group of students that constituted the sample for the study before being divided into two groups where treatment was given, and a post-test was also administered to all the sampled students. In the first group (the experimental group), which consisted of sixty students, the demonstration method of teaching was exposed, and in the second group (the control group), the students were subjected to the lecture method of teaching, which consisted of sixty students. The scores from the experimental and control groups form the data for the study. The research questions were answered using the mean and standard deviation, while the hypotheses were tested using independent sample t-test statistic at the 0.05 level of significance.

Results

Research Question 1. What is the difference in the mean achievement scores of JSS II students in mathematics exposed to demonstration and conventional methods?

Table 1. Mean Academic Achievement Scores of JSS II Students in MAT in Relation to the Teaching Methods.

Group	Symbol	Pre-test	Post-test	Mean Gain Diff.
Experimental method	N	60	60	
	Mean	47.44	68.20	20.76
	S.D	5.67	8,01	
Lecture method	N	60	60	
	Mean	45.30	50.32	5.02
	S.D	4.54	8.52	

Table 1 reveals the mean academic achievement scores of JSS II students in MAT in relation to the teaching methods. It was revealed that prior to the use of the demonstration method in teaching mathematics, the mean scores of the students in MAT were 47.44 with a standard deviation of 5.67. The mean score increased to 68.20 with a standard deviation of 8.01 after the same students were taught with the demonstration method. On the other hand,

in the control group, their mean score in MAT in the pre-test was 45.30 with a standard deviation of 4.51, while their mean score in MAT in the post-test also increased to 50.32 with a standard deviation of 8.50. Comparing the performance of the two groups, the experimental group and the control group, It was discovered that the mean gain difference of the experimental group of 20.76 was much higher than the mean gain of the control group, which stands at 5.02. This implies that the demonstration instructional method has a greater influence on the academic achievement of JSS II students in mathematics than the lecture method. By implication, the demonstration method proved to be better than the conventional lecture method.

Research Question 2: What is the difference between the mean academic achievement scores of male and female JSS II students taught with the demonstration method only?

Table 2. Mean Scores Difference of Male and Female JSS II students taught Mathematics using Demonstration Instructional Method only

Group	Gender	Symbol	Pre-test	Post-test	Mean Gain Diff.
Demonstration method	Male	N	15	15	
		Mean	23.20	68.40	45.20
		S.D	0.72	1.01	
	Female	N	15	15	
		Mean	22.80	68.09	45.29
		S.D	0.98	1.04	

Table 2 shows the mean difference between male and female JSS II students in MAT who were taught mathematics with a demonstration instructional method. It was observed that both genders had almost the same score in the post-test. The male student's mean score increased from 23.20 to 68.40, leading to a mean gain difference of 45.20, while the female student's mean score also increased from 22.80 to 68.09, producing a mean gain of 45.29. This means that in terms of the variability of test scores, the standard deviation obtained in both genders showed a minimal spread of scores. By implication, the finding is that the demonstration teaching method tends to produce equal results in JSS II students' academic achievement, irrespective of gender.

Research Question 3: What is the difference between the mean score of male and female JSS II students taught mathematics with the lecture method only?

Table 3. Mean Scores difference of Male and Female, JSS II students, taught Mathematics using Conventional Lecture Method (Control group) only.

Group	Gender	Symbol	Pre-test	Post-test	Mean Gain Diff.
Lecture method (Control Group)	Male	N	15	15	17.43
		Mean	23.20	40.63	
		S.D	0.71	1.07	
	Female	N	15	15	9.21
		Mean	22.80	32.01	

S.D	0.98	1.22

Table 3 shows that the mean scores of the male JSS II students who were taught with only the lecture method increased from 23.20 to 40.63, giving rise to a mean gain difference of 17.43, while those of the female counterparts who were also taught with the same lecture method increased from 22.80 to 32.01 and produced a similar mean gain difference of 9.21 when compared with the male students. This finding revealed that the lecture method tends to favour male students. The implication of this is that the lecture method, unlike the demonstration method, tends to be gender biased, which is not very good for learning mathematics as a science subject.

$HO_{1:}$ There is no significant difference in the mean score of academic achievement of JSS II students in mathematics when exposed to demonstration and conventional lecture methods.

Table 4: Summary of post-test Mean Scores of the Experimental (Demonstration Method) and Lecture Method (Control Group).

Group	**N**	**Mean**	**S.D**	**Df**	**t-cal.**	**Sig**	**Decision**
Experimental	60	68.20	8.01	118	11.84	0.000	S
Control	60	50.32	8.52				

S=significant

From Table 4, the experimental group represents the mathematics students who were taught with the demonstration method of instruction, while the control group stands for students who were taught with the conventional lecture method of teaching mathematics. The result revealed that the value of t-cal. is 11.84, and associated probability value of 0.00. Comparing the associated probability value of 0.00 with 0.05 level of significance, it is noticed that the associated probability value was less than 0.05. Hence, the null hypothesis (H_{01}) is rejected. This implies a significant difference in the achievement scores of JSS II students who were exposed to the demonstration method and those exposed to the conventional method of instruction in mathematics in favour of the demonstration method group.

HO_2: There is no significant difference in the learning mean scores of male and female JSS II students in mathematics who were taught using the demonstration teaching method only.

Table 5: Summary of the Post-test Mean Scores of Male and Female JSS II Students who were Taught Mathematics using the Demonstration Method (Experimental Group) only.

Group	N	Mean	S.D	Df	t-cal.	SiG.	Decision
Males	15	68.40	1.01	28	0.828	0.415	NS
Female	15	68.09	1.04				

SN= Not Significant

From Table 5, efforts were made to compare the post-test mean achievement scores of male and female JSS II students in mathematics taught in the experimental group using the t-test statistic. It was revealed that at the 0.05 significance level, the value was 0.42. Since the associated probability value is more than 0.05, the null hypothesis H_{02} was not rejected and affirmed that there was no significant difference in the mean scores of male and female JSS II students in mathematics who were taught using the demonstration method (experimental group). In other words, the demonstration instructional method produces the same learning

outcome in both male and female students in the post-test. The implication of this is that the demonstration teaching method is not gender-biased. It is a viable method for both genders.
HO_3: There is no significant difference in the academic achievement of male and female UB II students when mathematics is taught using the conventional lecture method.

Table 6: Summary of Post-test Mean Scores of Male and Female UB II Students when Taught Mathematics using Lecture Method (Control Group) only.

Group	N	Mean	S.D	Df	t-cal.	Sig.	Decision
Males	15	40.63	1.07	28	20.573	0.000	S
Females	15	32.01	1.22				

S=significant

Table 6 compares the academic achievement of male and female JSS II students when taught with the conventional lecture method of instruction (control group). The result revealed that the value of t-cal. is 20.57, and associated probability value of 0.00. Comparing the associated probability value of 0.00 with 0.05 level of significance, it is noticed that the associated probability value was less than 0.05. Based on this, the null hypothesis (H_{03}) is rejected and therefore it is affirmed that there is a statistically significant difference in the academic achievement of male and female JSS II students who were taught mathematics using the lecture method. By implication, the lecture method tends to be gender-biased and favours male students.

Discussion of Findings

Based on the analysis of the data collected for the study, the following results and findings were: Each of the two groups Experimental and control groups recorded higher mean scores in the post-treatment test than in the pre-treatment test. It means that each of the two groups of the study, those taught with the demonstration method and those taught with the lecture method, had higher mean scores in the MAT post-test than in the pre-test. This finding is in agreement with the earlier finding of Daluba (2013), who observed that both those who were taught agricultural science with the lecture method and those with the demonstration method recorded higher mean scores in the Agricultural Science Achievement Test (ASAT) in the post-test treatment than in the pre-test treatment.

The present study also revealed that there exists a statistically significant difference between the mean scores of UB II students in mathematics who were taught using the demonstration instructional method and those exposed to the lecture method. This result is in line with the earlier findings of Daluba (2013), Ameh and Dantani (2012), and Omwirhiren & Khali (2016). The researchers noted in their separate studies that the students in the experimental group who were allowed to interact and carry out activities obtained a higher learning outcome than those in the control group who were passive listeners in their classes. The study also revealed that the male students who were taught using the demonstration method performed better and achieved higher than the male students who were taught using the lecture method. Similarly, it was observed that the female UB II students in mathematics who were taught with the demonstration method also achieved higher and better than the female students who were taught with the lecture method. This result was in support of Daluba (2013), who revealed that a significant difference existed in the mean achievement

scores in favour of the UB II students who were taught Agricultural Science using the demonstration method as opposed to those taught with the lecture method. The implication of these results is that the demonstration method as an activity-based method tends to positively influence the students' academic achievement. This is also in agreement with Musa (2007), who noted that the option of a good and thought-provoking teaching method in a conducive learning environment facilitates better learning and mastery of the learned materials by students. Daluba (2013) observed that the activity nature of the demonstration method made the students more able to provide answers to the ASAT questions than their counterparts in the control group who taught with the traditional lecture method.

The result of the present study revealed that there is no significant difference in the academic achievement of male and female UB II students who were taught mathematics using the demonstration teaching method. This implies that both males and females who were exposed to the demonstration had the same learning outcomes, irrespective of their gender differences. This finding collaborates with the earlier findings of Omwirhiren (2015) and Ameh and Dantani (2012), who noted that there is no significant difference in the post-test mean achievement scores between the male and female students taught using the demonstration method. The authors asserted that the demonstration method promotes homogeneity of achievement between boys and girls. In other words, the demonstration method is not gender-biassed in learning outcomes. The implication of this is that, irrespective of the gender of a student, teaching him or her with the demonstration method will enhance his or her achievement in mathematics and in science in general. This implies that the high rate of failure in mathematics and sciences, which is occasioned by a lack of interest on the part of the students on the one hand and poor instructional methods on the other hand, will be greatly minimised if the instructor can be professional enough to select and use appropriate instructional methods like demonstration methods that will help to enhance the interest and performance of UB II students in both internal and external examinations. The study, in contrast, revealed a significant difference between the achievement of male and female students who were taught with the conventional lecture method. It was further revealed that the observed differences in achievement were in favour of male students. The implication is that, unlike the demonstration method, the lecture method of teaching tends to promote gender inequality in academic achievement, and this will not help a nation like Nigeria that is craving scientific and technological advancement.

Conclusion and Recommendations

Based on the present study's analysis, it is concluded that the demonstration method enhances effective teaching and learning of mathematics. Students' achievement levels are a function of the instructional method adopted by the teacher in transmitting information and knowledge to them. The teacher's responsibility is to professionally select and use appropriate instructional strategies that will improve students' overall learning outcomes. Sequel to the findings of the study and its conclusion, the following recommendations are made:

1. The mathematics teachers at the JS school level should adopt more activity-based methods of instruction, like demonstration methods, that will not only stimulate and

motivate the learners but also have the potential to enhance learning outcomes for both genders.

2. The JSS school teachers should be encouraged to use lecture instructional method in the teaching of mathematics in Boys' only schools.
3. The government at all levels, in conjunction with other stakeholders in education, should encourage and sponsor mathematics teachers to attend seminars, conferences, and workshops on the effective use of demonstration methods in teaching mathematics.
4. Professional bodies like the Mathematical Association of Nigeria (MAN) should champion the course and encourage its members to accept and adopt more result-oriented teaching methodologies, such as the demonstration method and other student-centred strategies.
5. Policymakers and curriculum planners should help mathematics educators emphasise the use of demonstration teaching methods in the learning process at UB schools for all science subjects in general and mathematics in particular.
6. The government, through its agencies, should be responsible for overseeing the development of education in the country as a matter of urgency and providing the financial and material resources that will enhance the adoption and application of demonstration teaching methods in mathematics in schools.

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