Effects of Laboratory Instructional Approach on Senior Secondary Students' Achievement in Mensuration in Ankpa Education Zone, Kogi State, Nigeria

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Abstract

This study was designed to investigate the effects of laboratory instructional approach (LIA) on senior secondary students' achievement in mensuration in Ankpa Education Zone, Kogi State, Nigeria. The design of the study was quasi-experimental research design, specifically, non- equivalent pre-test post-test control group design. Three research questions and three hypotheses tested at 0.05 level of significance guided the study. One hundred and seventeen (117) SSI students participated in the study out of a total population of 1657 SSI students in public secondary schools using a simple random sampling technique. Two schools were randomly assigned to experimental and control groups respectively. The 61 students in the experimental group were exposed to the use of laboratory instructional approach while the

conventional method was used for the 56 students in the control group. One instrument - Circle Achievement Test (CAT) was adopted. Research questions were answered using mean and standard deviation while the hypotheses were tested using Analysis of Covariance (ANCOVA). The results revealed that students taught mensuration using laboratory instructional approach had higher mean achievement than their counterparts in the control group. Since the use of laboratory instructional approach enhanced students' achievement, new mathematics curriculum that aimed at mathematics learning interesting such as laboratory instructional approach be recommended.

Keywords: Mathematics Education, Mensuration, Laboratory Instructional Approach, Academic Achievement, Secondary Education

Introduction

The importance of Mathematics in everyday life activities has been the reason for its inclusion as a core subject in Senior Secondary School curriculum. The teaching and learning of mathematics are most compelling because of the relevance of modern science and technology to the society (Osuagwu, 2019). All works of science and technology have their bases in Mathematics.

One of the challenges in mathematics teaching and learning is the increasingly poor achievement in the subject among secondary school students. (Abakpa & Iji, 2011). Achievement can be defined as a measure of learner's level of knowledge, skills or performance (Ugwu, 2018). Eze (2013) defined achievement as the extent of success or failure of goal been exposed. Deductively, achievement can be described as successful accomplishment of desired objectives or goals and students' performance in Mathematics concepts in a given period of time. Research reports showed that students have consistently low achievement in mathematics over the years (West African Examination Council - WAEC - Chief Examiner's Report, 2016- 2021).

With the increase in students' apathy and poor achievement in mathematics, a lot of things have been attributed as the cause (Oguche, 2020), including poor teaching approach and learning environment (Olunloye, 2019). Ohiefuna (2018) in her study found out that teachers shy away from activity-oriented methods in favour of approaches which are inappropriate and inadequate.

Various steps had been taken by government and educational planners in Nigeria to overcome the problem of students' poor achievement and lack of interest in Mathematics. For instance, Okigbo & Okeke (2018) emphasized on how teachers should use activity-based strategies to reduce the abstractness in mathematics to remove the students' apathy and fear of the subject.

The laboratory instructional strategy may help the students to improve their achievement in Mathematics teaching and learning (Borich, 2011). Mathematics laboratory instructions approach is a method of teaching whereby children in small groups work through assignment/task card and make discovery for themselves. Eydinyien (2015) stated that procedure in using laboratory mathematics approach include aim of the practical work,

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provision of materials and instruments, provision of clear instruction, carrying out the experiment and drawing of conclusion.

The poor achievement of students in Mathematics in general and Mensuration in particular has been a source of concern to Mathematics Educators (Umeh, 2011). Mensuration, according to Adu (2014) is a branch of Mathematics that deals with measurement, especially the derivation and use of algebraic formulae to measure the areas, volumes and different parameters of geometric figures. The difficulties experienced by the students at senior secondary school level in Nigeria made a study on it pertinent. Therefore, will SS1 students' achievement improve when taught mensuration using Laboratory Instructional Strategy? The study is limited to Senior Secondary One (SSI) students in Ankpa Education Zone of Kogi State, Nigeria. The content scope includes Arcs and Sectors of Circles, Segment of Circles and Determination of Pie (π).

Statement of the Problem

There seems to be persistent students' poor achievement in Mathematics in general and Mensuration in particular. This could be attributed to teachers' continuous use of conventional method of instruction. Students are always bored, discouraged and inattentive in Mathematics classes with the assumption that Mathematics is difficult. The problem of this study is therefore, to investigate the effects of laboratory instructional approach on secondary school students' achievement in Mensuration.

Objectives of the Study

The main purpose of this study is to investigate the effects of laboratory instructional approach on senior secondary students' achievement in Mensuration. Specifically, the study sought to:

    i.   Determine the mean achievement scores of senior secondary students taught Mensuration using laboratory instructional approach and those taught using conventional method.

    ii.   Determine the effects of laboratory instructional approach on male and female senior secondary students' achievement in Mensuration.

    iii.   Determine the interaction effect of laboratory instructional approach and gender on students' achievement in Mensuration.

Research Questions

The following research questions were asked to guide the study:

    i.   What are the mean achievement scores of senior secondary students taught mensuration using laboratory instructional approach and those taught with conventional method?

    ii.   What are the mean achievement scores of the male and female students taught Mensuration using laboratory instructional approach?

Research Hypotheses

The following research hypotheses were formulated and tested at 0.05 level of significance:

i. There is no significant difference in the mean achievement scores of students taught Mensuration with laboratory instructional approach and conventional method.

ii. There is no significant difference in the mean achievement scores of male and female senior secondary students taught mensuration using laboratory instructional approach.

Methodology

The design of the study was quasi-experimental, specifically, nonequivalent pretest posttest control group design. The population of the study was 1657 SSI students in the 2021/2022 academic session. Simple random sampling technique was used for sample selection. Two schools were randomly selected and were assigned to experimental (61 students) and control (56 students) groups. The instrument for data collection was Circle Achievement Test (CAT) developed by the researcher. The instrument was trial tested using two classes at St. Charles College Ankpa. The reliability of CAT was established using Kuder-Richardson 20 (KR-20) formula and that yielded the reliability coefficient of 0.78. The score is high enough which shows the instrument is reliable. Research questions were answered using mean and standard deviation and the hypotheses were tested using Analysis of Covariance (ANCOVA).

Results

Results of the study are presented according to research questions posed and the hypotheses formulated.

Research Question One
What are the mean achievement scores of senior secondary students taught mensuration using laboratory instructional approach and those taught with conventional method?

Table 1: Mean and standard deviation of pre-test and post-test achievement scores of senior secondary students taught Mensuration using laboratory instructional approach and conventional method

Group	N	Pre-test		Post-test		Mean Gain
		Mean	SD	Mean	SD	
LIA	61	20.9	8.9	82.9	12.1	62.0
CM	56	20.5	10.2	30.5	10.0	10.0
Total	117					

The result presented in Table 1 shows that the students taught Mensuration using Laboratory Instructional Approach had a pretest mean of 20.9 with a standard deviation of 8.9 and a posttest mean of 82.9 with a standard deviation of 12.1. The mean gain for the experimental group (LIA) was 62 and that of control (CM) was 10.0. For each of the groups, the posttest means were greater than the pretest means with the experimental group having

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a higher mean gain (MG). This shows that Laboratory Instructional Approach improved students' achievement in Mensuration.

Research Question Two
What are the mean achievement scores of the male and female students taught Mensuration using laboratory instructional approach?

Table 2: Mean and Standard Deviation of Male and Female Students Achievement Scores on Circle Achievement Test (CAT)

Gender	N	Pre-test		Post-test		Mean Gain
		Mean	SD	Mean	SD	
Male	65	21.3	1.7	26.4	1.3	5.1
Female	52	21.3	0.8	26.4	1.6	5.1
Total	117					

Table 2 shows that in the pre-test, the mean achievement score of male students in experimental group was 21.3 with standard deviation of 1.7 while the mean achievement score of female students was 21.3 with the standard deviation of 0.8 in the Pretest. The mean achievement score of male students was 26.4 with the standard deviation of 1.3 while that of the female students was 26.4 with the standard deviation of 1.6. There is no difference in the mean achievement of the male and female students.

Research Hypothesis One
There is no significant difference in the mean achievement scores of students taught Mensuration with laboratory instructional approach and conventional method.

Table 3: Analysis of Covariance (ANCOVA) of the mean achievement score of students taught Mensuration using Laboratory Instructional Strategy and Conventional Method

Source	Type III Sum of Sq.	Df.	Mean Sq.	F	Sig
Corrected Model	13611.058a	2	6805.529	218.226	.000
Intercept	2290.294	1	22290.294	73.441	.000
Pre-test Ach.	2543.697	1	2543.697	81.566	.000
Methods	**4657.612**	**1**	**4657.612**	**149.351**	**.000**
Error	3555.164	114	31.186		
Total	336244.000	117			
Corrected Total	17166.222	116			

The result in Table 3 shows that an F-ratio of 149.351 with associated probability value of .000 was obtained with regards to the mean achievement score of students taught Mensuration using Laboratory Instructional Strategy and Conventional Method. Since the

associated probability (0.00) was less than 0.05, set as level of significance, the null hypothesis which stated no significant difference in the mean achievement scores of senior secondary students taught mensuration using Laboratory Instructional Approach and those taught without using it was rejected. This implies that there is a significant difference in the mean achievement scores of senior secondary students taught mensuration using Laboratory Instructional Approach and the Conventional Method with those taught using Laboratory Instructional approach having a higher mean gain.

Research Hypothesis Two
There is no significant difference in the mean achievement scores of male and female senior secondary students taught mensuration using laboratory instructional approach.

Table 4: Analysis of Covariance (ANCOVA) of the Achievement Scores of Male and Female Senior Secondary Students taught Mensuration using Laboratory Instructional Approach

Source	Type III Sum of Sq.	Df.	Mean Sq.	F	Sig
Corrected Model	80274.342a	2	40137.171	322.276	.000
Intercept	60330.058	1	38910	484.412	.000
Gender	**80113.841**	**1**	**80113.841**	**.312**	**.577**
Error	14197.880	114	124.543	643.263	.000
Total	485050.000	117			
Corrected Total	94474.222	116			

Table 4 shows that the p-value of ANCOVA analysis of mean achievement of male and female senior secondary students taught Mensuration in the experimental group is 0.577 which is greater than the 0.05 level of significance. Hence, the null hypothesis is not rejected. This implies that there is no significant difference between the mean achievement scores of male and female students taught Mensuration using Laboratory Instructional Approach.

Discussion

Laboratory Instructional Approach had a more positive effect on the students in experimental group since they obtained a higher mean achievement score than their counterparts in the control group who were taught using Conventional Method. The high mean score and the moderate standard deviation by the experimental group indicated that the objective of the instructional approach was realized, and a good mastery of the topic was achieved, and this enabled the students in the experimental group to perform better.

The result of this study is in line with the consensus of the opinion that students are likely to be more engaged in the learning activities that appeal to their interest (Okoro, 2012). It is pertinent to state that the use of Laboratory Instructional Approach improves the achievement of students in Mathematical concepts. Also, the result of hypothesis one showed that a significant difference was found to exist among the students taught Mensuration using Laboratory Instructional Approach and those taught with the Conventional method. The result gave credence to what was earlier found by Imoko &

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Agwagah (2006) that the students' achievement can improve through the use of appropriate technique.

Recommendations

The results of this study have some implications for teachers, students, policy makers, students and researchers. Efforts aimed at improving the students' achievement in Mathematics in the senior classes should be broadened to address all important factors that contribute to students' achievement in Mathematics. Teachers should use activity-based, student-centered constructivist instructional models such as Laboratory Instructional Approach for more effective teaching. Policy makers are expected to use the information provided by this study as a basis for taking decision on the kind of instructional approach to adopt.

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