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Effect of Audio-Visual Aided Instruction on Senior Secondary School Students' Academic Achievement in Geometry in Akure South Local Government Area of Ondo State, Nigeria

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Abstract **Original Research Articles**

This study investigated the effectiveness of Audio-Visual Aided instruction on students' performance in mathematics as compared to the conventional method of teaching. Quasi-experimental, non-equivalent control group design was employed using intact classes approach. The sample comprised 80 Senior Secondary 1 students (44 males and 36 females) of two co-educational schools in Akure South Local Government Area, Ondo State, and employing multi-stage sampling technique. Mathematics Achievement Test (MAT) specifically designed by the researchers was used to collect data. Validity of the instrument was established using expert judgment from two mathematics teachers and two test and measurement specialists, while reliability was confirmed using the test-retest method of testing reliability and the Correlation Coefficient (r) was 0.82. Statistical analysis verified a significant effect of the Audio-Visual pedagogical method on students' performance in geometry (df = 1, 79; F = 27.259; p = 0.001). Gender did not significantly affect attainment (F = 0.336; p = 0.564). Thus, the findings show that Audio-Visual instruction presents a viable option to improve mathematics learning outcomes at senior secondary level. Mathematics teachers are advised to embrace Audio-Visual approaches in order to promote instructional delivery as well as student performance.

Keywords: *Audio Visual Aided Instruction, Academic Achievement, Geometry, Conventional method of Instruction, School.*

INTRODUCTION

Mathematics forms the foundation upon which any nation's technological development is based and is key in building national capacity in science and technology. Any deficiency in mathematics education is therefore a direct limitation to a nation's scientific and technological advancement. The role of mathematics in national development cannot be overstated, especially for those nations with ambitions to achieve scientific and technological development. In recognition of this, the majority of nations are adopting new strategies in the pedagogy of teaching mathematics at all levels of education. It is in line with this reality that education policymakers in Nigeria made mathematics a compulsory subject from the primary to the secondary level of education. Mathematics is also compulsory for admission into the tertiary level of education, where a credit pass is required at a minimum in Nigerian Universities. As Anaduaka and Hassan (2017) note, mathematics is the cornerstone upon which scientific knowledge is built; in today's era of rapid technological advancement, a proper grasp of mathematics cannot be foregone. In the same perspective, Davies and Hersh (2012) point out that mathematics is not only crucial for academic achievement but also provide students with skills, regardless of their future career.

Despite its significance, the Nigerian student continues to perform woefully in internal and external exams like the West African Senior School Certificate Examination (WASSCE) and the Senior School Certificate Examination (SSCE) conducted by West African Examination Council (WAEC) and the National Examination Council (NECO) respectively. WAEC data from 2017 to 2019 show a high failure rate in mathematics, a great setback to secondary education in Nigeria. As Oloruntegbe and Omoifo (2008) have observed, effectiveness in teaching to a large degree depends on the teaching method

employed by teachers. One major reason traced to the underperformance of students in mathematics is the dominance of lecture method a largely one-way teaching method that limits the involvement of students.

In attempting to break this drawback, the use of audio-visual aids has been found to be an effective alternative. Audio-visual aids, which combine sound and visuals, further improve the learning experience beyond what can be achieved through reading. Instructors use them to render their teaching more understandable, engaging, and motivating. Visual aids, according to Okeke (2013), are teaching materials or devices that aid learning through the sense of sight, while Roberta (2014) conceptualizes visual education as a method of education based on the psychological fact that people form clearer conceptions of things they see than of things they merely read or hear about. Audio-visual aids supplement verbal explanations of teachers, facilitate the communication of ideas, and save instructional time while stimulating curiosity, motivation, interest, and imagination. Examples include flashcards, charts, pictures, posters, radio, television, videos, and computers.

In mathematics, audio-visual aids are particularly helpful in the learning of geometry, as they help students visualize abstract concepts. Geometry, derived from the Greek words geo (earth) and metry (measure), deals with the measurement of shapes, sizes, and properties of space. It develops students' spatial awareness, aesthetic appreciation of their environment, and inductive reasoning skills. Visualization is essential in understanding geometric theorems and definitions that students tend to struggle with. Math achievement, as operationalized in this study, is the development of the reasoning abilities of students in cognitive and psychomotor domains as manifest in teacher-made or standardized test scores. Poor achievement or underachievement is when students fail to meet expected performance, but meeting or exceeding expectations creates a feeling of pride and satisfaction in their abilities and efforts (Ojo, 2015; Olga, 2008).

Statement of the Problem

Despite mathematics being the fulcrum of national development, Nigerian secondary school students' performance on internal and external exams has persistently been weak. External examination such as WASSCE conducted by West African Examinations Council (WAEC) and SSCE conducted by National Examinations Council (NECO) results all point towards an existing trend of mathematics underperformance. The issue has been attributed by available literature to be caused by a range of factors such as the consistent use of ineffective pedagogical practices by mathematics educators. Gimba (2014) demonstrated that use of computer-aided instruction can increase students' performance in the subject significantly, placing hopes high in technology-enabled methods. Therefore, there is critical need to examine new teaching practices that have the capacity to improve students' performance in mathematics. The current research was performed to determine whether the Audio-Visual teaching strategy was a useful method for encouraging students' performance in mathematics.

Objectives

1. Compare the mean achievement scores of students in geometry taught by the Audio-Visual instructional method and those taught by the conventional instructional method.
2. Examine the variation in mean attainment levels among male and female students in the experimental group.

Research Questions

1. What is the average academic achievement score for students taught geometry with the Audio-Visual Instruction compared to students taught with the Conventional Instruction?
2. What is the variance in mean academic achievement scores in geometry among male and female students taught with the Audio-Visual Instructional method?

Research Hypotheses

The following null hypotheses were tested at the 0.05 level of significance:

H_{01}: There is no significant difference in the academic performance in geometry between students taught with the Audio-Visual Instructional method and those taught with the Conventional Teaching Method.

H_{02}: There is no significant difference in the academic achievement in geometry between genders of students taught with the Audio-Visual Instructional Method.

H_{03}: There is no significant interaction effect of the Audio-Visual Instructional Strategy and gender on students' mean performance in geometry.

Research Approach

A quasi-experimental design was used for this study, that is, the non-equivalent control group design with two groups. The design was used since intact classes were employed and random assignment of the pupils was not feasible without disrupting the scholastic timetables of the schools (Anaekwe, 2007). The design is suitable in situations where the participants cannot be assigned into treatment and control groups by random selection.

Design structure is outlined below:

E_1: O_1 X_1 O_2 → Experimental Instructional Strategy (Experimental Group)

C_1: O_3 Xc O_4 → Control Teaching Method (Control Group)

Where:

O_1, O_3 = Pre-test observations (before treatment)

O_2, O_4 = Post-test observations (after treatment)

X_1 = Treatment with the Experimental Instructional Strategy

X_c = Treatment with the Control Teaching Method

This quasi-experimental research design made it possible to compare the achievement of students in geometry under instruction using the Audio-Visual Instructional Strategy and the Conventional Teaching Method. It enabled comparison of pre-test and post-test scores between two unmatched groups, understanding that the traits of participants might not be equi-balanced between experimental and control groups. The experimental group were subjected to Audio-Visual teaching strategy while the control group on the other hand were subjected to conventional method of teaching, both classes taking pre-tests and post-tests. All SSS1 students in Ondo State, Nigeria, constituted the study population since this is the point of entry into senior secondary education. A multi-stage sampling procedure was employed: Akure South Local Government Area was purposively selected, two public senior secondary schools were selected using random sampling technique, and then they were randomly allocated to experimental and control groups based on comparable mean scores. 80 students were involved in the study 42 (24 males, 18 females) for the experimental group and 38 (20 males, 18 females) for the control group. Data were collected using a researcher-designed Mathematics Achievement Test (MAT) in geometry, with 50 multiple-choice items from the SSS1 curriculum and created in accordance with test blueprint specifications. Face, content, and construct validity were pretested by two mathematics education experts and two test and measurement experts. Reliability, based on the test–retest procedure with students from a different school, the scores were analysed and the Correlation Coefficient (r) = 0.82 was obtained using Pearson Product Moment Correlation Coefficient (PPMC) method of statistical analysis which indicated a high reliability.

Data collection took four weeks from the commencement with a pre-test to both groups, through the instructional intervention, to a post-test for measuring achievement gains. The lessons were taught by mathematics teachers of regular classes who had undergone training for consistency. Descriptive statistics (standard deviation and mean) were used in addressing the research questions, whereas Analysis of Covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance with pre-test scores as covariates to equate initial differences.

RESULTS

Table 1: Mean of academic performance of group taught geometry with Audio Visual Instruction and the other group taught with Conventional Instruction

Method		Pre-test		Post-test	
	N	Mean	SD	Mean	SD
Audio Visual	42	16.50	2.482	31.55	5.571
Conventional	38	16.74	2.152	22.21	2.683
Mean Difference		0.24		9.34	

Table 1 displays the mean academic performance scores of students taught geometry through the Audio-Visual Instructional method and students taught through the Conventional Instructional Method, both of which were measured by the Mathematics Achievement Test (MAT). The result points out that the experimental group taught by the Audio-Visual method posted a greater post-test mean score ($\bar{x}$ = 31.55) compared to their pre-test mean score ($\bar{x}$ = 16.50). In addition, the control group taught by the Conventional Method performed better during the post-test ($\bar{x}$ = 22.21) than they did on their pre-test ($\bar{x}$ = 16.74). The Audio-Visual group performed higher on the post-test than the Conventional group with a difference of means of 9.34 in favour of students who were taught by the Audio-Visual Instructional Strategy.

Table 2: Mean of academic achievement of Male and Female students Taught geometry with Audio Visual Instructional method in Mathematics Achievement Test (MAT)

Audio Visual		Pre-test		Post-test	
	N	Mean	SD	Mean	SD
Male	24	16.83	2.444	32.29	5.945
Female	18	16.06	2.532	30.56	5.020
Mean Difference		0.77		1.73	

Table 2 presents the comparison of male and female students' mean academic performance after learning geometry through the Audio-Visual Instructional Strategy under the Mathematics Achievement Test (MAT). Post-test mean score of male students was higher compared to their pre-test mean score ($\bar{x}$ = 32.29 > $\bar{x}$ = 16.83). Likewise, female students' post-test mean score was higher compared to that of their pre-test mean score ($\bar{x}$ = 30.56 > $\bar{x}$ = 16.06). Generally, male students outperformed their female counterparts by a mean of 1.73 when taught through the Audio-Visual Instructional Strategy.

Table 3: ANCOVA Results of Statistical Analysis

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	949.714[a]	4	237.429	20.440	.001
Intercept	138.870	1	138.870	11.955	.001
Pretest	634.257	1	634.257	54.604	.001
Method	316.636	1	316.636	27.259	.001
Gender	3.901	1	3.901	.336	.564
Method * Gender	8.811	1	8.811	.759	.387
Error	871.173	75	11.616		
Total	74001.00	80			
Corrected Total	1820.888	79			

a. R Squared = .522 (Adjusted R Squared = 496)

To ascertain whether there was a significant difference in the academic achievement between the experimental and the control groups, ANCOVA was applied to compare their mean values. df (1, 79), F-ratio = 27.259, and p-value = 0.001, as shown in Table 3, is significant at the 0.05 level. Thus, null hypothesis that there is no substantial variation in the mean academic achievement scores between students taught geometry using the Audio-Visual Instructional Strategy and those taught using the Conventional Method was rejected. This represents a statistically significant difference in favor of students taught using the Audio-Visual Instructional method.

Results in table 3 indicates the effect of gender on students' performance who studied geometry using the Audio-Visual Instructional method in the Mathematics Achievement Test (MAT). The computed F-ratio of 0.336 with p-value of 0.564 was not significant at alpha level 0.05. Thus, the null hypothesis that there is no significant difference in mathematics achievement between male and female students instructed through the Audio-Visual Instructional Strategy was kept.

A cursory look at table 3 shows the interaction effect of instructional mode and gender on students' academic performance in the Mathematics Achievement Test. The F-ratio calculated was 0.759 and p-value of 0.387 that is greater than the 0.05 level of significance. Thus, there was no substantial interaction between the Audio-Visual Instructional Strategy and gender on the mean of students' performance in geometry.

DISCUSSION OF RESULTS

Results revealed that the experimental group taught geometry using the Audio-Visual Instruction had a higher mean compared to the other group subjected to Conventional teaching method, the difference in means score 9.34 favor the experimental group. Moreover, the male students had a mean score 1.73 points higher than the female students' mean score in the experimental group. The ANCOVA revealed a significant difference between the academic performance of students taught with the Audio-Visual approach and those instructed with the Conventional Method, indicating that the Audio-Visual approach was more effectual in promoting students' learning of geometry. This finding aligns with the reports of Ojo (2015), Gimba (2014), Ubah and Uzoechi (2018), Iji, Abakpa & Takor (2015), Olga (2008), Olusi (2008) that computer-aided instruction positively affects students' performance in mathematics. This, corroborates the observation of Usman and Ezeh (2011), where they reported a palpable difference in the mean achievement scores of students taught with the aid of two kinds of computer-assisted instruction.

ANCOVA also revealed a no significant difference in mathematics performance between male and female students

taught using the Audio-Visual Instructional Strategy. No significant interaction effect of method of instruction and gender on the mean academic performance of the students in geometry was also observed. This finding is consistent with Sinnes (2006) opined that males and female, performance outcomes are the same when given the same opportunities in scientific learning environments. This shows that Audio-Visual method has the potential to improve students' performance in geometry irrespective of gender.

CONCLUSION

The Audio-Visual Instructional Strategy significantly enhances students' performance in mathematics. The findings provide empirical evidence of its efficacy as a pedagogy in the teaching of geometry at secondary school level. Not only does the approach enhance students' performance but also offers an interactive and stimulating learning experience. Therefore, the study concludes that the Audio-Visual technique is a potent learning strategy that may be integrated in mathematics education to augment quality learning.

Conflict of Interest Statement

We write to declare no conflict of interest in relation to the paper titled *"Effect of Audio-Visual Aided Instruction on Senior Secondary School Students' Academic Achievement in Geometry in Akure South Local Government Area of Ondo State, Nigeria."*

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