EFFECT OF ICT-DRIVEN PEDAGOGY ON THE ACADEMIC ACHIEVEMENT OF SECONDARY SCHOOL STUDENTS WITHIN GOMBE METROPOLIS IN GEOMETRY

by

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Abstract

This study determined the effectiveness of Information communication Technology (ICT) driven pedagogy in improving SS11 students' achievement in geometry. The study employed a non equivalent control group quasi experimental design. The study was carried out in Gombe State of Nigeria. Two schools were used for the study. The treatment group was taught topics in geometry using Information communication Technology (ICT) driven pedagogy while control group was taught the same topics using Conventional Teaching Method. At the onset of the experiment pre-test (Geometry Achievement Test) was administered to the students in the two groups while at the end of the treatment session that lasted for two weeks the same Geometry Achievement Test was administered to the students as post-test. Two research questions and two Null hypotheses guided the study. The research questions were answered using mean and standard deviation while the Null hypotheses were tested at an alpha level of 0.05 using Analysis of Covariance (ANCOVA). The Results of the study show that ICT driven pedagogy is superior to the conventional approach in fostering students' achievement in geometry. The study further revealed that male students taught geometry using the ICT driven pedagogy performed better than their female counterparts and that there is no interaction between method and gender on students' achievement in geometry. Part of the recommendations and suggestions drawn from the study is that Mathematics teachers should be encouraged to use ICT-driven pedagogy when teaching Geometry in order to improve learners' academic achievement. Furthermore, schools that are equipped with ICT facilities should be encouraged to secure GSP software in order to enhance teaching and understanding of Geometry topics. .

Key words: ICT driven pedagogy, student achievement, Mathematics.

INTRODUCTION

Mathematics occupies a central place in the Nigerian educational system. This is because mathematics knowledge plays an important role in enhancing the country's social economic development. The Nigerian Mathematics curriculum comprises of many topics, including Geometry which is taught from primary to secondary levels. It is regarded as "a unifying topic to the entire Mathematics curriculum and it is a rich source of visualization for arithmetical, algebraic, and statistical concepts" (Idris, 2009). Sub-topics covered under Geometry at the senior secondary level include geometrical constructions, symmetry, angles and its properties and locus. Tsoho (2011) pointed out that presenting geometry in a way that stimulates curiosity encourages exploration that can support learners' intuition; thus enhancing communication, students' learning and interest in mathematics. This would further encourage students to discuss problems in geometry, articulate their ideas and develop clearly structured arguments, skills and recognition of the importance of proofs in mathematics. As important as this aspect of mathematics is however, students' achievement in this area has not been encouraging. For instance, the report of the Chief Examiners of the West African Examination Council (WAEC) for 2015 had shown that many students avoided or skipped answering certain questions especially those involving geometry in the SSCE. Another study by Woodard (2004) affirmed that students who lack mastery in mathematics are less

successful in mathematics examination. Furthermore, students' performance in mathematics was found below average in the Senior Secondary School Certificate Examination (SSSCE) in Nigeria. West African Examination Council (WAEC) revealed that less than 40% of the registered candidates passed at credit level from 2008 to 2016.

The WAEC Chief Examiners (2016) report revealed that candidates lack interpretation and handling of geometrical construction and its application to angles and triangles, this shows that the candidates did not show any firm grasp of detail needed to answer the questions. These problems emanate as a result of a lot of problems facing the effective teaching and learning of mathematics at all levels of Nigerian educational institution (Bankolere, 2006). Okafor (2002) and Okeke (2006) identified poor teaching methods as the major factor contributing to the poor performance of students in mathematics. The instructional method employed by the teacher plays an important role in the acquisition of skills and meaningful learning. It is one of the factors that make students become passive and have less interaction with each other in doing tasks. Another study conducted at the Federal Capital Territory (FCT) Abuja investigated the effect of mathematical games and simulations on Senior Secondary School Students' interest in Geometry (Umoru & Ubom, 2013), found that students who were taught using games and simulations technique gain more interest in the learning of geometry than their counterparts taught using Conventional Teachers Method, CTM.

Also, Kurumeh (2007) opined that generally, students' fear and hate for mathematics results in lack of interest and poor achievement in mathematics, particularly geometry and menstruation. Studies on the factors responsible for this poor achievement have identified poor teaching methods and non-usage of instructional materials among others (Badmus, 2002; Harbor-Peters & Iji, 2005). Most teachers adopt the conventional approach to teaching. Iji (2005) concluded that positive changes take place when a teacher changes his teaching method towards a more students-centered approach. Lecture method contribute to more than 85% of the instruction in schools in which students are isolated from one another and forbidden to interact.

The potential benefits of Information and Communication Technology (ICT) driven pedagogy cannot be underestimated in the contemporary world. There is a plethora of established findings on the instructional value of computer, particularly in advanced countries. There are several ICT driven pedagogies on different subjects. It is obvious that the current trend in research all over the world is the use of computer facilities and resources to enhance students' learning (Yusuf & Afolabi, 2010). Therefore, the position of mathematics makes it necessary for the use of innovative pedagogical strategy that will enable teachers meet the challenges of teaching and learning of the subject, especially in this era of information age.

Several researches have shown that using ICT-driven pedagogy has a positive effect on students' achievement ,compared to traditional methods. For instance, Studies conducted by Kanandjebo (2017) at Omusati Education region, Namibia, on the effect of ICT-driven pedagogy on Grade 12 learners revealed that, there was a statistically significant difference between the two groups (Control and Experimental) in terms of learner performance on geometrical topics. It implies that the use of ICT-driven pedagogy improved learners' performance. Positive attitude towards ICT-driven pedagogy by learners translated into learners courage for the adoption of ICT-driven pedagogy.

Gender bias in Nigeria and Africa as a whole is still very prevalent (Arigbabu & Mji, 2004). However, some researchers still found that there are still significant differences in the cognitive, affective and psychomotor skill achievements of students in respect of gender (Aguele and Uhumniah (2008); Croxford (2002); Kolawole, (2007). Viann (2004) found no significant gender related differences, but female students achieved slightly higher grades than male students. However, Kolawole (2007) found that boys performed better than girls in both cooperative and competitive learning strategies when he conducted a research on the effects of competitive and cooperative learning strategies on Nigerian students' academic performance in mathematics. Contrarily, Aguele & Uhumniah (2008) found in their studies at various times, that male students achieved significantly better than female students in science education. Garduno (2001) found no statistically significant differences in achievement or self-efficacy in seventh and eighth-grade students in mathematics in single-or-mixed-gender groups. Fajola (2000), Gambari (2010) and Yusuf and Afolabi (2010) reported that gender had no effect on academic performance of students in computer-assisted cooperative learning.

Evidences from studies in Nigeria indicated that very little research efforts had been directed at ICT-driven pedagogy. This approach has been highly recommended for teaching at all levels, as stated by the Federal Government of Nigeria (2004) in the National Policy on Education. Kanandjebo (2017) stated that despite significant researches, using innovative strategies in the teaching and learning of mathematics, students' performance in mathematics is still low, especially in the aspects of geometry. Therefore, there is need for more simulation as an approach to the teaching of geometry so as to improve students' academic achievement in mathematics. If ICT-driven pedagogy is used to teach geometric concepts, what would be their effects on students' academic achievement in geometry? In view of this, the effect of ICT-driven pedagogy on senior secondary school students' academic achievement in geometry is investigated in this study.

Purpose of the study
The purpose of this study is to determine whether Information and Communication Technology (ICT)- driven pedagogy would enhance understanding of geometrical concepts. Specifically, the study examined:
(i)   The effect of ICT driven pedagogy on students' mean achievement scores in geometry.
(ii)   The difference between the mean achievement scores of male and female students taught geometry, using ICT driven pedagogy.

Research questions
The following research questions guide the study:
(i)   What are the differences between the mean achievement scores of students taught geometry using ICT driven pedagogy and CTM?
(ii)   Is there any difference between the mean achievement scores of male and female students taught geometry using ICT?

Research hypotheses
The following hypotheses were raised in this study:
(i)   There are no significant difference between the mean achievement scores of students taught geometry using ICT-driven pedagogy and the Conventional teaching method.

(ii)   There is no significant difference between the mean achievement scores of male and female students taught geometry using ICT-driven pedagogy.

METHODOLOGY

The research design adopted for the study was non-equivalent pre-test-post-test quasi-experimental design. The population for the study was made up of all senior secondary schools in Gombe metropolis, Gombe State. The sample constitutes 40 (20 males and 20 females) students randomly selected from two secondary schools. In each school,20 students were randomly selected for the study and gender was considered in the selection. Geometry Achievement Test (GAT) was used as a test instrument, while ICT-driven pedagogy was used as a treatment which, was jointly developed by the researchers and a programmer. The program was written in mathematics programming language.

The Geometry Achievement Test (GAT) used in collecting data for the study consists of 20 multiple choice objective items with five options (A–E) was adopted from past examination questions of West African Examination Council (WAEC, May/June) and National Examination Council (NECO, June/July) on angles and its properties and symmetry. Geometry Achievement Test was validated by experts in Mathematics, and test and measurement experts with its reliability coefficient determined as 0.87, using Pearson Product Moment Correlation Coefficient. The teaching was done for two weeks with control group being taught with conventional method (Chalk and talk) method and the experimental group with the ICT- driven pedagogy.The test questions were administered to the students before and after the treatment as pre-test and post –test respectively. Each of the test was scored and marked accordingly.The research questions and hypotheses were answered using Scheffe's test, t-test and ANOVA respectively.

Results

To test for the hypotheses, the data were analysed using Analysis of Variance (ANOVA) and Scheffe's test using Statistical Package for Social Sciences (SPSS) version 11 at 0.05 alpha level. The results are presented based on the research hypotheses.

Table 1: **ANOVA pre-test on experimental and control groups**

Sources of variable	Sum of square	df	mean	F-calclated	P-value
Between groups	7900	2	3.950	0.967	0.387

Table 1 shows the result of ANOVA comparison of experimental and control group. From the table, the calculated F-calculated (0.967, p = 0.387) was not significant at 0.05 alpha level. This implies that there was no significant difference among the mean scores of the experimental group and the control group at 0.05 level of significance. This results shows that students in the experimental group and control group have the same entry level with regards to previous knowledge of the topic treated. Thus, they are compatible groups.

Hypothesis one: *There are no significant differences in the performance of secondary school students taught geometry using ICT driven pedagogy and conventional teaching method.*
To determine whether there were significant differences in the post-test mean scores of the experimental and control groups, data were analyzed using the analysis of variance (ANOVA).
Table 2: ANOVA post-test on experimental and control groups

Sources of variables	Sum of square	df	Mean square	F- ratio	P-value
Between groups	17823.333	2	28911.667	33.049	0.000

Significant at 0.05 level

Table 2 present the result of ANOVA comparison of the experimental and control group. From the table, the calculated F-calculated (33.049, p = 0.000) was significant at 0.05 alpha level. This indicates that statistically significant difference was established among the experimental groups and control group. Hence the null hypothesis one (HO$_1$) was rejected.

Based on the established significant difference in the post-test achievement scores of the groups, Scheffe's test was used for post-hoc analysis. The results of this post-hoc analysis are as shown in Table 3.

Table 3: Scheffe's post-hoc analyses of the groups mean scores

Groups	Mean Score	Group 1	Group 11
Group 1	84.50	0.574	0.000
Group 11	45.50	0.000	

The mean difference is significant at the 0.05 level.
The result in Table 3 indicates significant difference in the posttest mean scores of students exposed to ICT driven pedagogy (X = 84.50) and those exposed to conventional lecture method (45.50).

Hypothesis two: *There is no significant difference in the mean achievement scores of male and female students exposed to ICT driven pedagogy.*

To test this hypothesis, t-test statistic was also used to analyze the mean scores. The summary of this analysis is shown in table 4.

Table 4: t-test analysis on achievement scores of male and female students exposed to IDP

Variable	N	df	Mean (x)	SD	t-value	p-value
Male	10	18	84.00	8.111	0.113	0.912
Female	10		85.00	8.445		

 ns: Not Significant at 0.05 level

Table 4 presents the t-test of male and female students of experimental group (IDP). The mean scores of the male students were (84.00) and (85.00) for female. The calculated t-value of 0.113 was not significant at the 0.05 level. This indicates that there is statistically no significant difference between the male and female students taught with IDP, (t= 0.113, df = 18,P = 0.912). Hence, HO$_2$ was not rejected. Therefore, there is no significant difference between male and female students taught geometry with ICT driven pedagogy package.

Discussion
The results of the analysis of ANOVA on the performance of students taught geometry using ICT driven pedagogy and those taught using conventional method of instruction indicate a significant difference in favor of the students taught with ICT driven pedagogy. The students exposed to ICT driven pedagogy performed better than those exposed to conventional method of instruction respectively. The findings agree with Idris (2009) and (Umoru & Ubom, 2012) who found a statistically significant difference between post-test Geometry performances of learners who had been taught using GSP and those who were not. Similarly Fajola (2000) and Dalton, Hannafin and Hooper (1989) found that students taught with ICT

in physics, biology, and mathematics performed better than those taught using the conventional method of instruction.

The influence of gender on the academic performance of student

The results of analysis of t-test on the performance of male and female students taught using ICT driven pedagogy indicate no significant difference. The finding disagrees with the findings of Viann (2004) who reported that females achieved slightly higher grades than males. Contrarily, Kolawole (2007) found out that boys performed better than girls in mathematics. Similarly, Aguele and Uhumniah (2008) and Croxford (2002), found out that male students achieved significantly better than female students in science education. Furthermore, this study agrees with the findings of Fajola (2000), Gambari (2010), Garduno (2001) and Yusuf and Afolabi (2010), Yusuf, Gambari and Olumorin (2012) who reported that gender had no effect on academic performance of students in computer-assisted cooperative learning. Thus, this shows that computer- assisted instruction enhanced the performance of both male and female students.

Conclusion

The paper has critically examined mathematics and its problems especially within the secondary school level in a rapidly changing world. There is still a wide gap to be bridged in the area of teaching and learning using innovative technology such as ICT driven pedagogy. The use of computer-assisted instruction in ICT driven pedagogy seems to be the answer. ICT driven pedagogy is more effective in teaching the mathematical concepts of geometry and are also gender friendly.

Recommendations

Based on the findings of this study, the following recommendations are made.
1. Mathematics teachers should be encouraged to use ICT-driven pedagogy when teaching geometrical topics i.e. angles and its properties and symmetry, in other to improve the academic achievement of their learners.
2. Teachers should be encouraged to use visual media in teaching since visual media strengthens understanding by simplifying abstract concepts.
3. Government should provide adequate ICT facilities in all levels of education as it might enhance learning.
4. Schools that are equipped with ICT facilities should be encouraged to secure GSP software in order to enhance teaching and understanding of geometrical terms, relationships, angle properties and symmetry.
5. Further detailed studies should be conducted to investigate the effectiveness of ICT-driven pedagogy on performance of learners in geometry in other areas.

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