EFFECTS OF TEACHING GEOMETRY USING MOBILE APP INSTRUCTIONAL TECHNIQUE ON STUDENTS INTEREST IN BAYELSA STATE

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Abstract

The study investigated the effect of teaching geometry using mobile application instructional technique on senior secondary students' interest in Geometry in Bayelsa State. A quasi-experimental, non-equivalent control group design was used in the study. All the 506 SS2 mathematics students in the three federal unity schools formed the population of the study. One hundred and seventy nine (179) students from two schools formed the sample of the study. Intact classes were assigned by flipping of coin to either experimental or control group; and separately taught by their regular mathematics teachers who had earlier been trained for the purpose. All the groups were pre and post-tested. Geometry Interest Inventory (GII) was used as instruments for both the control and experimental groups. Three research questions and three hypotheses guided the study. The mean and standard deviation were used to answer the research questions, while Analysis of Covariance (ANCOVA) was used in testing the hypotheses at .05 levels of significance. The result showed that the use of mobile application instructional technique as a medium of teaching improves students' interest in geometry. Also there was no significant effect between teaching method, gender and choice of discipline on students' interest in Geometry. The study recommended that the use of mobile application should be integrated into the teaching and learning of mathematics generally.

Keywords: *Mobile App Instructional Technique, Interest, Geometry*

Introduction

Mathematics in general is linked with the development of any nation in the world. Mathematics as a discipline opens and shuts more doors for men and women than any other content area. Whether it is in business, science, engineering or technology, it is tremendously important that a person be well-armed with mathematics if they are going to have options in their lives (Charles-Owaba & Omeodu, 2018). Mathematics represents the superb and sublime product of reason as well as the upper limits of what one hopes to attain in all rational domain. Charles-Owaba and Omeodu, (2018) citing Adenegan (2012) described mathematics as a model of thinking, for developing scientific structure, for drawing conclusions and for problem-solving. The supremacy of mathematics over other subjects is extolled by the National Policy on Education (NPE, 2014), where it stated that mathematics should be made a core subject in the primary and secondary

education levels. The policy strongly emphasized an effective teaching and learning of subject through the use of variety of strategies and this has consistently generated interest amongst scholars over the years.

Geometry is one of the most important branches of mathematics and it is concerned with the properties and relationships of lines, angles, curves, shapes, etc. The word *geometry* comes from two ancient Greek words, one meaning *earth* and the other meaning *measure*. Keith (2017) defined geometry as the branch of mathematics that exploits visual intuition (the most dominant of our senses) to remember theorems, understand proof, inspire conjecture, perceive reality and give global insight. He further asserts that these skills are transferable and are needed in all other branches of mathematics. In another vein, Sumzuma (2017) refers to geometry as that which helps us to acquire abilities such as making new discoveries, analyzing problems and making connections between mathematics and real life situations.

Throughout history, geometry has had a great importance in peoples' lives, originating with the need of human beings to specify quantities, to measure figures, land and earth and make maps. In other to represent and solve problems in survey and geo-informatics, sound geometry knowledge is necessary. Geometry is also used in other disciplines such as science of light (optics), geography (map design), music (note pattern design), art (model design), construction, and architecture, gardening and traffic signs. Artists, builders, draftsmen, masons, machinist, structural engineers and writers all make use of geometry daily.

The elements of geometry form an integral part of mathematics and further mathematics curriculum. The teaching and learning of geometry starts from the primary school, where it is an integral part of the primary school mathematics curriculum. The first element of geometry is introduced in Primary 5 under the heading *"plane shapes"*. The objectives at this early stage is to teach pupils how to;

i. Identify various plane figures.

ii. Calculate the perimeter and area of plane figures.

In Primary 6, the pupils do further work on the objectives at this level to teach the pupils how to calculate the area of some compound two-dimensional shapes.

At the secondary school, the elements of geometry are integrated into the mathematics and further mathematics curriculum. The geometric concepts taught at the primary school are usually revised at the Junior Secondary School level. The following topics are studied under geometry content as contained in the Senior Secondary School Mathematics Curriculum (2007);

a. Plane Geometry

b. Geometric construction

c. Mensuration

d. Trigonometry

e. Coordinate Geometry

By learning geometry students may be able to identify shapes and space around them. Geometry can also help them represent their surroundings. The comprehension of geometry models and their properties may give students a new perspective in their ability to analyze and communicate geometry-related things in their daily lives. The National Council of Teachers of Mathematics (NCTM, 2014), have emphasized the importance of geometry in school mathematics by stating that; geometry and spatial sense are fundamental components of mathematics learning. They offer ways to interpret and reflect on our physical environment. Geometry allows students to develop insight to understand other mathematical concepts and connect ideas across different areas of mathematics (Sunzuma, 2017). Furthermore, many ideas like symmetry or generalizations can help students increase insights into the nature and beauty of mathematics (NCTM, 2014). The importance of geometry is best stated by an inscription above the door of Plato's school; *"Let no one destitute of geometry enter my doors"* (Sunzuma, 2017).

Regardless of the importance of geometry in real life situations and the subsequent action of making it a content in mathematics curriculum, students have continued to dislike it and hence, poor performance has always been the outcome. Analysis of school certificate mathematics examinations results in Bayelsa State, reveals that students' earn consistently low scores, as less than 42% of registered candidates obtain credit pass. West African Senior School Certificate Examination Council, Chief Examiner's Report on students' areas of deficiency in school certificate examinations for eight (8) years (2010-2018), revealed that geometry content has consistently been termed as an area of weakness in terms of their achievement. Abakpa and Iji (2011) reported that students often avoid geometry questions or haphazardly attempt them. Mammana and Villiani (2018) also discovered that students' geometry achievement was always lower than the other areas of mathematics. They further noted that students shy away from the study of geometry. Zeynep (2010) reported that students have difficulties in learning geometry and in thinking geometrically. He further asserted that many geometrical problems require certain visualization in problem solving and students generally find it difficult to construct three-dimensional spaces.

Research reports have revealed that many reasons account for students' poor achievement in geometry. Among these are poor teaching approach (Olunoye, 2010), lack of interest and confidence in the subject (Arbain, 2015), poor learning environment (Olunoye, 2010). Similarly, Somalia (2019), Bilesanmi and Afuwape (2017), Ado (2018) reported that gender differences and students' choice of discipline are latent factors that affects students achievement in geometry.

Ado (2018) defined interest as a subjective feeling of concentration or persisting tendency to pay attention and enjoy some activity or content. Imoko and Agwagah (2016) defined interest as the

feeling of one whose attention or curiosity is particularly engaged by something. Interest is an important variable in learning because when one becomes interested in an activity, one is likely to be more deeply involved in that activity. Relating it to this study, interest is the motivation of student to like circle theorem concepts through the use of mobile application instructional technique in teaching and learning process. One is likely to do well in a discipline of interest. Abdulcarismo (2009) submitted that some children may be intellectually and physically capable they may never learn until their interest is stimulated. Once the students' interest is stimulated, they will continue to learn as long as the teacher is capable of sustaining their interest in the subject matter. McPhan (2018) opined that interest is the mother of attention; once there is direct interest, attention is guaranteed and learning is assured. Ebele and Sam (2015) reported that low interest in mathematics emanates from anxiety and phobia. Phobia has been observed by Abdulcarismo (2009) to be an academic sickness whose virus has not yet been fully diagnosed for an effective treatment in the class and the symptoms of this phobia are usually expressed on the faces of mathematics students in their classes.

Gender and mean interest scores are factors that have not produced conclusive results in sciences and mathematics. Okigbo and Okeke (2013) carried out a study on the influence of gender on mean interest scores of students taught mathematics using games and analogies as advanced organizers and reported a no significant difference on the mean interest scores of male and female students in mathematics. The study also established that the interaction effect of gender and treatment on interest scores was not significant. On the contrary Ajaegba and Ekwueme (2019), Mman and Tukunkaya (2019) reported a significant difference in the mean interest rating and a significant interaction effect on interest in favour of males. Thus, there is need for more studies on the instructional strategies that can enhance equal achievement and interest among male and female students in geometry which necessitates this study.

In Nigeria, there are two categories of public secondary schools, when schools are been classified based on ownership; those owned by the Federal Government and those owned by the state government (Akpe, 2016). The secondary schools owned by the Federal Government are also called Federal Unity Schools and there are one hundred and four (104) across the nation. Learners' choice of discipline has to do with science/engineering and arts/commercial classes that students belong to depending on their future career (Bilesanmi & Afuwape, 2017). Science students refers to students offering science subjects such as Physics, Chemistry, Biology as their core subject, while arts students are those offering Literature-in-English, Government, Economics, Commerce, Christian Religious Study (CRS) as their core subjects. In Federal Government Colleges, students are usually divided into four streams, two sciences and two arts classes The choice of discipline on students' achievement in mathematics is a major issue that has not produced conclusive results. So, many studies on science and arts students' performance in mathematics exist, but there is scarce research evidence on issues relating to differences in the interest of Arts and Science students in geometry content only. Somalia (2019) researched on the influence of choice of discipline on the performance of secondary school students in mathematics and reported that

science students performed better than their arts counterparts. Bilesanmi and Afuwape (2017) reported that when the right teaching strategy is adopted, learning outcome of both science and arts students will improve. It is worthwhile to check how the achievement and interest of science and arts students will be in geometry, when mobile app instructional technique is utilized.

Different teaching and learning methods have been experimented to motivate and increase learners' interest in geometry. Examples of such learning method are, Mastery Learning Approach (Abakpa & Iji, 2011), the Use of GeoGebra (Arbain, 2015), the Use of Geometry Learning Media based on Augmented Reality (Rohendi, 2018), Geometers Sketchpad (Dimakos, 2010), Digital Geometric Software (Hasan, 2012), Cabri Geometry Plus II (Derya, 2012), Digital Daily Life Photograph (Zeycep, 2010), Daily-Life Story Using Dynamic Geometry Software (Abdelfatah, 2010), Personal Math Concept Chart (Rhonda, 2017).

Teachers have the potential of exerting strong influence on students' learning. Uloko and Usman (2018) reported that there is a positive correlation between good teaching approach and students' learning in geometry. Also, Abakpa and Iji (2011) stated that good strategy improves both low and high ability students in geometry at upper basic education class. That is good teaching approach produces high achievement among learners, while poor teaching approach will lead to poor learning and low achievement. Roosing (2012) submitted that changes in technology will continue to alter possibilities for learning and create new challenges for pedagogy. Also Ectuban (2018) opined that increased development in technology coupled with a range of needs and expectations from a range of stakeholders have made it imperative for educational organizations to constantly upgrade their strategies and policies in teaching and learning as a way to remain effective and competitive. Ectuban (2018) noted that students all over the world are very much comfortable with electronic gadgets and equipment and the need to use these gadgets and equipment in teaching is highly evident. Also mobile computing is explored primarily because many of the learners spend more time with their mobile devices than any other toy or learning materials. Some of the learners have even become addictive to the use of their Mobile devices for other activities such as games.

Mobile application instructional techniques also known as *mobile application instructional techniques* are a series of applications designed to assist learners in performing single or various related tasks with the purpose of creating learning. The use of mobile application instructional techniques represents a technology that is ubiquitous in nature, wireless, highly portable and endowed with multimedia capabilities bringing a new dimension to curriculum delivery, (Fuchs, 2014). The last ten years have witnessed an impressive increase in the use of mobile application instructional technique in schools (Ectuban, 2018). Although, created for non-educational environment, tools like tablets and smartphones have made their way into the classroom. These devices with learning applications have attracted interest from the educational communities mainly due to their gaming capabilities. The use of mobile application instructional technique allows students to engage in problem-solving based learning activities, permits students to work on tasks that are goal oriented and open-ended with a strong gaming component. They empower students to develop their own understanding through active involvement and sense-making. Furthermore,

learning experiences like digital simulations or manipulations have the capacity to bring interactivity, thus enhancing cognitive and affective processes (Barros & Marcos, 2010).

Ectuban (2018) observed that the use of mobile devices such as cell phones and tablets are among the six new rising advances that have significantly affected instruction delivery. Particularly, in the subject matter of mathematics, Ruthven and Hennessy (2012) made a comparison between the learning outcomes of mobile-based teaching and mathematics thematic teaching; results revealed that mobile-based learning significantly improved the advancement of scientific aptitude and the development of a more profound perceptual ability for the students. The Nigerian government recognizes the importance of ICT as a tool for development of the country. It has stressed that ICT has a role to play in education both directly as a subject and indirectly as a tool to assist in instruction delivery and management (NMC, 2015). As a way to match actions with words, the School Based Knowledge Centre Project, launched in 2014 by the Federal Government, through the Nigerian Communication Commission (NCC), supplied smartphones to all Federal Unity schools and some state owned secondary schools (NMC, 2015). This marked the advent of the use of mobile devices as an instructional aide in teaching and learning in Government owned secondary schools across the country.

Mobile app designed specifically for geometry used in this study is Apollonius which is an interactive, measurement, and simulation app. It allows you to create geometric constructions, such as those that can be made using a ruler and a compass and subsequently move parts of your constructions to explore the relationship between the geometric objects on the screen. Its interface is especially designed for touch screen, providing one of the smoothest experiences of any existing interactive geometry app (Handal & Herrington, 2013). It is inspired by software such as GeoGebra, the Geometer's Sketchpad and Cabri. The choice of Apollonius was predicated on the fact that it can be installed on every kind of smartphone (both Android OS and IOS devices) and can be used in the teaching and learning of mathematics without internet connections and it is designed specifically for geometry.

Purpose of the Study

The aim of this study is to determine the effects of teaching geometry using mobile application instructional techniques on secondary school students' interest in Bayelsa State. Specifically, the study sought to:

i. Determine the mean interest scores of students taught geometry using mobile application instructional technique and those taught using lecture method.

ii. Determine the mean interest scores of male and female students taught geometry using mobile application instructional techniques.

iii. Determine the mean interest scores of science and arts students taught geometry using mobile application instructional techniques.

Research Questions

The following research questions were formulated to guide the study;

1. What are the mean interest scores of students taught geometry using mobile application instructional technique and those taught using lecture method?

2. What are mean interest scores of male and female students taught geometry using mobile application instructional techniques?

3. What are the mean interest scores of science and arts students taught geometry using mobile application instructional techniques?

Research Hypotheses

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

Ho_1: There is no significant difference between the mean interest scores of students taught geometry using mobile application instructional techniques and those taught using lecture method.

Ho_2: There is no significant difference between the mean interest scores of male and female students taught geometry using mobile application instructional techniques.

Ho_3: There is no significant difference between the mean interest scores of science and arts students taught geometry using mobile application instructional techniques.

METHODOLOGY

A pre-test, post-test, non-equivalent control group quasi–experimental design was adopted for the study. The choice of this design, allows investigation of intact groups in real-life classroom setting, since it was not possible to randomly assemble students for any intervention during school hours

so as to avoid artificial conditions. The population for this study was all the mathematics students in Bayelsa State. A sample of one hundred and seventy nine (179) second year senior secondary school (SS2) students were used for the study. The two co-educational Federal Government Colleges (FGC, Odi and FSTC, Tungbo) were purposively selected, because they are the only schools with the Knowledge-Based Centers, where the mobile devices are available. Also, SS2 class was purposively selected because there was no impending external examination that could distract students from full participation in the study and the content used was meant for them as contained in the senior secondary mathematics curriculum. In each school, there are 4 classes (2 science classes and 2 arts classes) making a total of 8 classes in both schools selected for the study. Simple random sampling by flipping of the coin was used to select one out of the two science classes and one out of the two arts classes from each school, thereby making it a total of four classes to participate in the study. Allocation of the classes into experimental and control group was done by random sampling through balloting, which resulted to two (2) classes assigned to experimental group and the other two (2) to the control group. All the one hundred and seventy nine (179) SS2 students in the four streams of the selected schools formed the sample of the study. The instruments for data collection was Geometry Interest Inventory (GII) developed by the researcher from vocational interest (Creswell, 2018) and other interest inventories. The GII was used to help students express their feelings towards geometry. It consists of two sections. Section A sought general information about respondents, while Section B bothered on their interest in geometry. The GII is a 30-item inventory with a five-point response type of *"Highly Interested",* if you like it very much to engage in the activity; *"Interested",* if you like to engage in it; *"undecided"*, if you like to neither like nor dislike it; *"Not interested",* if you dislike engaging in the activity and "*Highly Not Interested"*, if you very much dislike engaging in it. Like very much, like, neither like nor dislike, dislike and dislike very much all had values of 5, 4, 3, 2 and 1 respectively. The instruments were validated by two (2) mathematics educators in Science Education Department and one (1) measurement and evaluation expert. The reliability index of the GII was established using Cronbach Alpha reliability estimate. Cronbach alpha was used because the GII items were polytomously scored. The reliability index was found to be 0.80. Statistical Package for Social Science (SPSS) software version 23 was used to analyze the data. The research questions were answered using mean ($\bar{x}$) and standard deviation (SD). The research hypotheses were tested at 0.05 levels of significance using Analysis of Covariance (ANCOVA). ANCOVA is an extension of Analysis of Variance that allows for the exploration of the differences between groups, while statistically controlling for an additional variable called the Covariate (Pallant, 2018). The pre-GII scores served as the covariates. The pre-GII scores were also subjected to independent t-test analysis to determine the equivalence of the groups.

Analysis and Results

Research Question 1: What are the mean interest scores of students taught geometry using mobile app instructional technique and those taught using lecture method?

Table 1: Mean Interest Scores, Standard Deviations and Mean Gain of Students Taught Using MAIT and Lecture Method

Groups	N	Pre-GII		Post-GII		Mean Gain
		$\bar{x}$	SD	$\bar{x}$	SD	
Experimental	86	1.77	0.66	3.26	1.04	1.49
Control	93	1.72	1.55	2.31	0.76	0.59

The result in Table 1 shows that the students in the experimental group had a mean interest score of 1.77 and standard deviation of 0.66 in the Pre-GII, while students in control group had a mean interest score and standard deviation of 1.72 and 1.55 respectively. Similarly, in Post-GII, mean interest score of 3.26 and standard deviation of 1.04 students in experimental group respectively, while mean achievement score and standard deviation of students in control group are 2.31 and 0.76 respectively. The standard deviations of students taught geometry using MAIT increased from pre-GII to post-GII indicating that the scattering of the scores increases as the mean increased, while the students taught with lecture method decreased from pre-GII to post-GII indicating that the scattering of the scores decreases as the mean increased. The scattering of the scores was higher for those taught geometry using MAIT when compared to those taught geometry using lecture method. The mean interest gain between Pre-GII and Post-GII for students taught in experimental and control group are 1.49 and 0.59 respectively. This implies that the mean interest gain of students taught geometry using MAIT was higher than those taught using Lecture method.

Research Question 2: What are the mean interest scores of male and female students taught geometry using mobile application instructional techniques?

Table 2: Mean Achievement Scores and Standard Deviation of Male and Female Students Taught Geometry Using Mobile application instructional techniques

Sex	N	Pre GII		Post-GII		Mean Gain
		$\bar{x}$	SD	$\bar{x}$	SD	
Male	43	1.89	1.55	2.27	1.31	0.38
Female	43	1.73	0.61	2.31	1.26	0.58

Table 2 shows that the male students in the experimental group had a mean interest score of 1.73 and standard deviation of 1.55 in the Pre-GII and a mean interest score of 2.27 and standard deviation of 1.31 in the Post-GII. It was also revealed that the female students in the experimental group obtained a mean interest score of 1.73 and standard deviation of 0.61 in the Pre-GII and a mean interest score of 2.31 and standard deviation of 1.26 in the Post-GII. The standard deviations of female students taught geometry using MAIT increased from pre-GII to post-GII indicating that

the scattering of the scores increases as the mean increased, while the male students taught with MAIT decreased from pre-GII to post-GII indicating that the scattering of the scores decreases as the mean increased. The scattering of the scores was higher for females taught geometry using MAIT when compared to their male counterparts. The mean interest gain between Pre-GII and Post-GII of male and female students taught geometry using mobile application-based instructional techniques is 0.38 and 0.58 respectively. This implies that the mean interest gain for female was higher than their male counterparts.

Research Question 3: What are the mean interest scores of science and arts students taught geometry using mobile application instructional techniques?

Table 3: Mean interest Scores and Standard Deviation of Arts and Science Students Taught Using Mobile Application

Choice of discipline	N	Pre GII		Post-GII		Mean Gain
		$\bar{x}$	SD	$\bar{x}$	SD	
Science students	52	1.73	0.63	2.61	1.28	0.88
Arts students	34	1.73	1.57	2.30	1.23	0.57

The Table 3 above shows that the science students in the experimental group had a mean interest score of 1.73 and standard deviation of 0.63 in the Pre-GII and a mean interest score of 2.61 and standard deviation of 1.28 in the Post-GII. It was also revealed that the arts students in the experimental group obtained a mean interest score of 1.73 and standard deviation of 1.57 in the Pre-GII and a mean interest score of 2.30 and standard deviation of 1.23 in the Post-GII. The standard deviations of science students taught geometry using MAIT increased from pre-GII to post-GII indicating that the scattering of the scores increases as the mean increased, while the arts students taught with MAIT decreased from pre-GII to post-GII indicating that the scattering of the scores decreases as the mean increased. The scattering of the scores was higher for those science students taught geometry using MAIT when compared to their arts counterparts. The mean interest gain between Pre-GII and Post-GII of science and arts students taught geometry using mobile application-based instructional techniques is 0.88 and 0.57 respectively. This implies that the mean interest gain of science students taught using MAIT was higher than the mean interest gain of arts students taught with MAIT.

Ho_1: There is no significant difference between the mean interest scores of students taught geometry using mobile app instructional techniques and those taught using lecture method.

Table 4: Analysis of Co-variance (ANCOVA) for Students' Mean Interest Scores by Mobile Application Instructional Technique and lecture method

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	149.020[a]	2	74.510	91.168	.000	.509
Intercept	310.434	1	310.434	379.839	.000	.683
PREGII	.087	1	.087	.106	.745	.001
APPROACH	148.501	1	148.501	181.702	.000	.508
Error	143.841	176	.817			
Total	1245.760	179				
Corrected Total	292.861	178				

Summary of data analysis presented in Table 4 shows that the Pre-GII scores for both groups (Control and Experimental) has f-calculated value of 0.106 and a p-value of 0.745 which is greater than the critical p-value of 0.05 which implies that they are equivalent and that both groups have the same baseline knowledge before the treatment was implemented. It also shows that the main effect, teaching approach has f-calculated value of 178.749 and a p-value of 0.00 which is less than the critical p-value of 0.05. This is based on 1 degree of freedom for numerator and 178-degree of freedom for denominator. This implies that the null hypothesis is rejected. That is the difference between the mean interest scores of students taught geometry, using mobile app instructional techniques and those taught using lecture method is statistically significant.

Ho_2: There is no significant difference between the mean interest scores of male and female students taught geometry using mobile application instructional technique.

Table 5: ANCOVA Analysis of Mean Interest Scores of Male and Female Students in Experimental Group

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	149.048[a]	4	37.262	45.084	.000	.509
Intercept	305.030	1	305.030	369.059	.000	.680
PREGII	.103	1	.103	.124	.725	.001
METHOD	147.738	1	147.738	178.749	.000	.507

GENDER	.022	1	.022	.026	.871	.000
METHOD * GENDER	.006	1	.006	.008	.931	.000
Error	143.812	174	.827			
Total	1245.760	179				
Corrected Total	292.861	178				

The results presented in Table 5 above shows that the Pre-GII scores for both groups (Male and Female) has f-calculated value of 0.124 and a p-value of 0.725 which is greater than the critical p-value of 0.05 which implies that they are equivalent and that both groups have the same baseline knowledge before the treatment was implemented. It also shows that the main effect, gender, has f-calculated value of .026 and a p-value of .871 which is greater than the critical p-value of 0.05. This means that the null hypothesis is not rejected. That is, the difference between the mean interest scores of male and female students taught geometry using mobile app instructional technique is not statistically significant.

Ho_3: There is no significant difference in the mean interest scores of science and arts students taught geometry using mobile application instructional techniques.

Table 6: ANCOVA Analysis of Mean Interest Scores of Science and Arts Students in Experimental Group

Source	**Type III Sum of Squares**	**Df**	**Mean Square**	**F**	**Sig.**	**Partial Eta Squared**
Corrected Model	152.384[a]	4	38.096	47.187	.000	.520
Intercept	312.097	1	312.097	386.576	.000	.690
PREGII	.164	1	.164	.203	.653	.001
METHOD	134.632	1	134.632	166.761	.000	.489
CHOICE	1.625	1	1.625	2.013	.158	.011
METHOD * CHOICE	1.621	1	1.621	2.008	.158	.011
Error	140.477	174	.807			
Total	1245.760	179				
Corrected Total	292.861	178				

The result presented in Table 6 above shows that the Pre-GII scores for both groups (Arts and Sciences) has f-calculated value of 0.203 and a p-value of 0.653 which is greater than the critical p-value of 0.05 which implies that they are equivalent and that both groups have the same baseline knowledge before the treatment was implemented. It also shows that the main effect, choice of discipline, has f-calculated value of 2.013 and a p-value of .158 which is greater than the critical p-value of 0.05. This means that the null hypothesis is not rejected. Therefore, the difference in the mean interest scores of science and arts students taught geometry using mobile app instructional techniques is not, statistically significant

Discussion of Findings

Method, and interest scores in geometry

The findings of this study show that the mobile app instructional technique increases the interest of students in geometry. Result from research question 4 shows that there was a higher mean interest score for the group taught using mobile app instructional technique over the group taught using the lecture method. This was further confirmed by the result from research hypothesis 4 which intends to find out if there exists a significant difference between the mean interest scores of the two groups. This could be attributed to the use of mobile application instructional technique which is a platform that can sustain the interest of learners. This finding aligns with Ectuban (2018) who reported that mobile devices used for teaching mathematics attracted the interest of students. It also supports the findings of Khristin, Keith and Barron (2018),Yeng and Chieng(2019) and Grant (2015) who reported that the use of mobile apps improved students' interest scores significantly.

Method, gender and interest scores in geometry

Analysis of result from research question 5 revealed that the mean interest scores of male and female students taught geometry using mobile application instructional technique. The result revealed that both male and female students in the experimental group gained from the method used. This was further confirmed by the result from hypothesis 5 which intends to find out if there exists a significant difference between the mean interest scores of male and female students in the experimental group. Analysis shows that gender was not significant to students' interest in geometry. This could be attributed to the use of mobile app instructional technique (MAIT) which help students to modify and build on their view points as well as create avenues for brainstorming exercise that allows the exchange of ideas between students. This indicated that the use of mobile application instructional technique bridged gender gap of students' interest in mathematics. This finding supports Khristin & Barron, (2015), Hilao & Wichadee(2017), Mman & Tukandaya(2019) who reported non-significant difference in the mean interest scores of male and female students when mobile application and devices was used as a medium of instruction. This finding disagrees with Chung and Rong-Chil (2017) who reported that mean interest scores does not interact with gender.

Method, choice of discipline and interest scores in geometry

Analysis of result from research question 6 revealed the mean interest scores of Science and Arts students taught geometry using mobile application instructional technique. The result revealed that both Science and Arts students in the experimental group gained from the method used. This was further confirmed by the result from hypothesis 6 which intends to find out if there exists a significant difference between the mean interest scores of Science and Arts students in the experimental group. Analysis confirmed that choice of discipline was not significant to students' interest in geometry. This could be attributed to the use of mobile application instructional technique (MAIT) which creates an avenue for students irrespective of their choice of discipline to learn geometry by practice during classroom activities. This indicated that the use of mobile app instructional technique bridged the gap that existed between science and arts students' interest in mathematics. This finding aligns with Al-Takhyneh (2018) who reported that the use of mobile applications enables the students in arts, science and commercial to interact directly with the educational content thereby increasing their interest in geometry. This finding also supports Bilesanmi and Afuwape (2017), who reported that the use of mobile devices enabled students to represent construction graphically, carry out suitable and over lapping geometric transformations, and control the properties of the angles and lines on the contrary. This finding contradicts Somalia (2019), Ado (2019) who reported a significant difference in the mean achievement in mathematics in favour of science students, when compared with their arts counterparts.

Conclusion

The study established that mobile application instructional technique improved the interest of students, bridged the gap resulting from the difference in interest of male and female students as well as difference in the interest of science and arts students in geometry.

Recommendations

Considering the above findings, of the following recommendations were made;

1. Mobile Application Instructional Technique should be implemented in the teaching and learning of geometry and mathematics in Nigerian secondary schools in order to enhance students' achievement and interest.

2. Government and other stakeholders should ensure that teachers are trained adequately to enable them utilize mobile devices for teaching and learning purpose.

3. Students must have regular access to technologies that support learning so as to advance their mathematical thinking, reasoning, problem-solving, and communication skills.

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