Comparative effects of hands-on activities and ICT-Based approach on student's interest in Geometry

Omotayo Stephen Akinyemi
Institute of Education, University of Ibadan, Ibadan, Nigeria

Abstract
Students' lack of interest in some difficult aspects of mathematics, such as Geometry, and how it affects their performance in mathematics had been established. This study, therefore, investigated the effects of three approaches (Hands-on activities, ICT based and conventional) on students' interest in geometry. The study adopted pre-test post-test control group quasi-experimental design. 269 senior secondary school students (156 males and 113 females) *were selected for the study from six co-educational schools in Oyo State, using simple random sampling technique. Geometry Interest Inventory was used for data collection. Data was analysed using ANCOVA. The findings showed that there was a significant main effect of treatment on students' interest in geometry ($F_{(2,262)} = 22.139, p < .05$,) Partial Eta Square ($\eta^2 = .15$) which implies that the treatments accounted for 15% variance observed in students' interest in geometry. The ICT group had the highest performance ($\bar{X} = 66.03, S.D = 1.10$) followed by Hands – on group ($\bar{X} = 63.86, S.D = 1.15$) and lastly Control group ($\bar{X} = 55.88$ S.D = 1.14) The main effect of gender on students' interest was not statistically significant ($F_{(1,262)} = 1.016, p$? .05). The interaction effect of treatment and gender ($F_{(2,262)} = 0.815, p$?.05,) was not statistically significant. It was therefore recommended that mathematics teachers should endeavour to get the students fully engaged during the course of instruction delivery, in order to engender their interest in geometry mostly with the use of ICT.*

Key Words: Hands-on activities, Interest, ICT-Based Approach

Introduction

Interest is a feeling that causes special attention to an object or class of objects (Merriam-Webster Dictionary 2010). It is a psychological state of mind to engage with particular classes of objects, events, or ideas. Interest is a motivational variable which has been directly linked with educational achievement. According to (Schunk, Pintrich & Meece, 2008) there is every tendency for students to engage in an academic activity, pay more attention, and have better performances if they are interested in the topic. The level of a person's interest has repeatedly been found to have a powerful influence on learning.

Despite the fact that interest has been recognized as an important condition for learning, educators continue to wrestle with the difficulties of working with academically unmotivated students (Hidi & Harackiewicz, 2000). They probably do not have a clear understanding of their potential role in helping students to develop interest. Teachers at times think that students either have or do not have interest, and might not recognize that they could make a significant contribution to the development of students' academic interest (Lipstein & Renninger, 2006). It is believed that depending on the method of instruction adopted by the teacher; students' interest in a particular subject can either be marred or made. Although, teachers have little or no control over individual interest, but they can help students to develop situational interest, since this is linked to the learning environment. Therefore, teachers can facilitate the development of students' academic interest if they understand how to stimulate situational interest. Situational interest can be enhanced through the modification of certain aspects of the learning environment and contextual factors such as teaching strategies, task presentation, and structuring of learning experiences (Durik &

Harackiewicz, 2007; Shen & Chen, 2007).
Interest according to Hidi and Renniger (2006) is described as a phenomenon that emerges from an individual's interaction with ones' environment. In educational research, the primary focus has always been on situational and individual interest. Individual interest is understood to develop gradually and affect ones' knowledge and values over time, while situational interest appears suddenly as a response to something in the environment and is more emotional in nature. Situational interest is thought to have only short term impact, whereas individual interest is believed to be more stable. Students' interest is important in part because it facilitates effective teaching and creates a more favourable environment (Adam & Gary, 2011). According to Schunk, Pintrich and Meece, (2008) pupils are more likely to engage in academic activities, pay more attention and generate higher performance if they are interested in a topic or subject. Adeyemo and Kuye (2006) reiterated that there is a very strong connection between interest and effort which implies that the more a person becomes interested in a subject, the more effort he will put in it. Leeherman (2004) was of the opinion that a teacher is more effective in teaching when he/she manages to incorporate students' interest in the lecture.

However, literature had shown that many students are not interested in mathematics and what it can offer, particularly some strands of mathematics such as Geometry. Students are full of fear, phobia and hatred for this subject. The students' lack of interest in mathematics according to Usman and Nwabeze (2011) was caused by the teachers' use of inadequate, monotonous way of exposing or imparting mathematics to students using conventional strategy and this is one of the major causes of massive failure in mathematics examinations (NCCA, 2006; Odili, 2006; WAEC, 2009). Attempt to improve on students' interest in geometry has given rise to the adoption of some approaches such as, Cooperative Learning Approach (Chianson, Kurumeh & Obida, 2011), Montessori Approach (Kurumeh, Agogo & Usman, 2010), Games and Simulation Technique Method (Achor, Imoko & Ajai 2010).

Imoko and Agwagah (2006) conducted a study on interest and achievement. The participants were 297 senior secondary school two (SSSII) students' from eight classes randomly selected from four (4) co-educational secondary schools. Data was collected using trigonometry interest inventory and Mean standard deviation, as well as ANCOVA were used for analyses. Results revealed that students' in the experimental group which was exposed to concept mapping techniques gained more interest in trigonometry content than the control group that was exposed to the conventional method.

Also, Sumbabi and Bassey (2013) carried out a study to investigate the effect of mathematical games and simulations on Senior Secondary School Students' interest in geometry. The research design adopted was pre –test, post – test quasi – experimental design and simple random sampling technique was used to select 287 senior secondary school students in five Area Councils in Federal Capital Territory (F.C.T), Abuja, Nigeria. The result showed that the differences in the mean interest scores on geometry favoured the experimental group. It further revealed that method of teaching was a significant factor on students' interest in geometry. This simply implies that with appropriate instructional approaches, students' interest in geometry can be engendered. This present study is a comparative study, trying to find out the comparative effect of the use of modern technology (DMS) and Hands - on activities in addressing the abstract nature of geometry and in engendering students' interest in the topic.

Dynamic Mathematics Software (DMS) is a computer programme for interactive creation and manipulation of mathematical constructions. It enables the use of mouse to construct geometric objects, draw graph and other diagrammatic representation of mathematics concepts. It is a tool that can be exploited in the classroom instructional processes to develop formal reasoning in students. Hands-on activities involve the use of constructional materials to construct geometrical concepts. This will allow students to see and have a clear understanding of the concept under discussion.

Addressing students' interest in geometry, the influence of students' gender cannot be ruled out. Gender issue in mathematics is gradually becoming no issue. Although some studies such as Fredricks and Eccle (2002); Watt (2004); Kurumeh, Achor, Akume, and Mohammed (2012) established from their various studies that male are more interested in mathematics than female which portrays mathematics as male domain. But, the current trend in research has proof that with appropriate teaching technique, gender effect is likely to be neutralized. For instance, Achor, Imoko and Ajai (2010), in their study titled sex differentials in students' achievement and interest in geometry using Games and Simulation technique, used simple random sampling technique to sample 287 senior secondary school one (SSS1) students comprising 158 boys and 129 girls from Gwer-West Local Government Area of Benue State. The study adopted a pretest-posttest control group quasi-experimental design, data generated using Geometry Achievement Test (GAT) and Geometry Interest Inventory (GII) which were analyzed using ANCOVA. Findings revealed that, Games and Simulation aroused students' interest and enhanced achievement in geometry, however with no gender difference.

Actually, the finding reveals that female students gained interest more than the male students, but the difference in the mean interest rating of male and female students exposed to games and simulations instruction is however not significant. The implication of this is that there is tendency of neutralizing gender effect on students' interest in geometry if student – centred instructional strategy can be adopted. Imoko & Agwagah (2006) examined the use of concept mapping technique for improving the students' interest in mathematics. The design of their study was pretest – posttest control group quasi experimental which used a sample of 297 SS2 students. The analysis of the study was done using Analysis of Covariance (ANCOVA). The results revealed that concept mapping technique improved male and female students' interest in trigonometry equally.

In Nigeria, the policy on information technology envisaged the integration of Information and Communication Technology (ICT) at all levels of education (FRN2004). In this fas-moving era of technology, it is expedient to keep up with the current interventions and innovations in relation to technology, to meet its relevance for the present and future. Oyelekan and Aderogba (2011) asserted that the effective use of ICT in education is an important factor in determining which country will succeed in the future. Adako (2006) specifically charged the nation builders (teachers) to be abreast of all new development around the world now that the world is becoming a global village. According to Adako this became necessary if Nigeria must catch up with other developing countries at a very reasonable pace. Hence, there is the need to expose the stakeholders of education, (especially mathematics teachers) to exploit the vast benefits of technology in dealing with the abstractness of a concept like Circle geometry using Dynamic Geometry Software.

Hypotheses

1. There is no significant main effect of treatment on students' interest in geometry.
2. There is no significant main effect of gender on students' interest in geometry
3. There is no significant interaction effect of treatment and gender on students' interest in geometry

Methodology

The study adopted a pretest-posttest, control group quasi-experimental design method. The outlay of the design is shown below:-

$O_1 X_1 O_2$,	Experimental Group 1 (ICT-Based Approach)
$O_1 X_2 O_2$,	Experimental Group 2 (Hands-on Activities Approach
$O_1 X_3 O_2$,	Control Group (Traditional Method)

Where

O_1 – represents pr-test measure
O_2 – represent post-test measure
X_1 – (ICT-Based Approach)
X_2 – (Hands -on Activities Approach)
X_3 – (Traditional Method)

The target population for this study comprised all senior secondary school students in public schools that have functioning computer laboratory in Ibadan, Oyo State, Nigeria.

Simple random sampling technique was used to select six (6) public schools from the schools

with functioning computer laboratories and adequate number of Personal Computer. The selected schools were randomly assigned to treatment: two schools were assigned to each of the groups (ICT-based, Hands–on Activities and Control groups). Lastly, in each of the selected schools, simple random sampling was adopted to select one arm of senior secondary school class two (SS II), where an intact class was engaged for the study. In all 269 (156 males and 113 females) participated in the study.

Instrumentation

The following instruments were used for this study

(a) Geometry Interest Inventory (GII)
(b) Treatment Package (TP)

Geometry Interest Inventory (GII)

GII consisted of two sections; section A and B. Section A was on the bio-data of the students while section B consisted of 20 items of Likert-type scale with five options; Like very much, Like, Indifferent, Dislike and Dislike very much. The instrument was given to experts in ICT, psychology and of Educational Evaluation in order to establish its content validity. The instrument was thereafter pilot tested on 60 students from schools similar to the target sample for the study. The reliability coefficient of the instrument was established using Cronbach Alpha which yielded a value of .92. This shows that the instrument was highly reliable.

Treatment Package (TP)

This refers to the training manual and the instructional guide for the research assistants (mathematics teachers) who participated in the study. This was packaged by the researcher in line with the suggestion and contribution of experienced computer tutors and mathematics teachers as well as experts in research.

Research Procedure

The researcher met with the principal and mathematics teachers of the selected six schools, created rapport with them, got them fully informed about the purpose and how to go about the research work. Both the researcher and the teachers agreed on time and value for training for those who fell into the experimental group (ICT Based Approach). Six research assistants were used for the study. The students of the selected schools were also made to realize the purpose and the advantage of the study. This was done in collaboration with their mathematics teachers to encourage them to participate in the study.

Data Collection

A week before the commencement of the treatment, Geometry Interest Inventory (GII), was administered on participants. Both the instrument and the participants' responses were collected immediately because the same instruments were used as post-test. The treatment commenced a week after and was carried out by the trained research assistants (mathematics teachers of selected schools). The researcher did not participate in the teaching but monitored the proper execution of the experiment package. The treatment lasted for six weeks, thereafter; GII was administered on the participants as post-test.

Results

Table 1: Summary of Analysis of Covariance (ANCOVA) of Students' Interest in Geometry by Treatment and Gender

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	9048.359a	6	1508.06	14.288	0.000	0.247
Intercept	20329.07	1	20329.07	192.601	0.000	0.424
Pre-Interest	2137.479	1	2137.479	20.251	0.000	0.072
Treatments	4673.642	2	2336.821	22.139	0.000	0.145
Gender	107.257	1	107.257	1.016	0.314	0.004
Treatments * Gender	172.025	2	86.012	0.815	0.444	0.006
Error	27654.09	262	105.55			
Total	1075083	269				
Corrected Total	36702.45	268				

a R Squared = .247 (Adjusted R Squared = .229)

$F_{(2,262)} = 0.815$ $p < .05$

Hypothesis 1: There is no significant effect of Treatment on students' Interest in Geometry.

Table 1 shows the summary of Analysis of Covariance (ANCOVA) of students' post – test Interest scores in geometry by treatment and gender. The result revealed that the effect of treatment on students' interest in geometry was statistically significant($F_{(2,262)} = 22.139, p < .05$); therefore, the null hypothesis which stated that there is no significant main effect of treatment on students' interest in Geometry was therefore rejected. Table 1 further showed that the Partial Eta Square (η^2) = .14.5, which was considered to be a moderate effect size, according to Cohen (1988). The implication of this is that the treatments accounted for 14.5% variance observed in students' interest in geometry.

In order to determine which group differs significantly among the three treatment groups, Sidak Post-hoc analysis was done. The results are presented in Table 2

Table 2 Sidak Post-hoc Analysis of Dependent Variable: Post-Interest

Treatments	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bo
ICT Group	66.028a	1.1	63.862	68.194
Hands-on Group	63.864a	1.148	61.603	66.125
Control Group	55.877a	1.135	53.643	58.112

a Covariates appearing in the model are evaluated at the following values: Pre-Interest = 45.5651.

(I) Treatments	(J) Treatments	Mean Difference (I-J)	Std. Error	Sig. b	95% Confidence Interval for Difference b	
					Lower Bound	Upper Bound
ICT Group	5E Group	2.163	1.600	0.443	-1.68	6.007
	Control Group	10.150*	1.604	0.000	6.296	14.005
Hands-on Group	ICT Group	-2.163	1.600	0.443	-6.007	1.68
	Control Group	7.987*	1.608	0.000	4.122	11.851
Control Group	ICT Group	-10.150*	1.604	0.000	-14.005	-6.296
	5E Group	-7.987*	1.608	0.000	-11.851	-4.122

Based on estimated marginal means

* The mean difference is significant at the .05 level.

b Adjustment for multiple comparisons: Sidak.

Table 2 shows that participants in experimental group 1 (ICT group) had the highest mean score of (X= 66.028) followed by participants in experimental group II (Hands-on group) with the mean score of (X= 63.864) while those in control group had the least mean score of (X= 55.877). Table 3 confirmed that the difference between experimental group I (ICT group) and group II (Hands-on group) was not statistically significant while the differences between the experimental groups (ICT and Hands-on group) and the control group were statistically significant.

Discussion

The results showed that there was significant main effect of treatment (ICT Based, Hands-on and Control groups) on students' interest in geometry. It was further revealed that participants in ICT Based group had the highest mean gain in interest followed by those in Hands on group, while those in control group had the least mean gain in interest. This finding was in line with Roberts and Stephens (1999) who

compared students of average ability in three high school geometry classes that utilized computer software Geometry Inventor in varying amounts. The first class used it twice a week; the second class, once a week; and the third class did not use the software at all during a year-long geometry course. They observed that using the software improved the interest and participation of students. This may be attributed to the fact that the students in ICT based group were using computer system to aid their discoveries which may likely engender their interest. Also, the finding corroborates the assertion of Ogunlade (2008), who submitted that, the adoption of ICT in education would arouse a new interest among students, educators and educationists and possibly influence, if not change the attitude of teachers and students to learning.

Likewise, the participants in Hands-on group developed more interest in geometry than those in control group. This may not be unconnected with the fact that students were practically involved in the construction of the theorems which may arouse their interest in the topic. This corroborates the findings of **Leung (2011) from a** study on the implementation of geometric construction workshops among junior secondary students in Hong Kong where he concluded that students enjoyed the construction tasks during the workshops. Analysis implied that geometric constructions helped improve students' ability in constructing geometric proofs and to raise their interests in geometry, a learning approach that brings students' high interest and a deeper understanding in geometry. This finding indicates that if an appropriate instructional strategy is adopted by the teacher, learners' interest in learning geometry can be stimulated. This finding supports Allen (2007) who affirmed that students increased their skills and showed more interest and enjoyment when learning was done through the use of manipulatives. This finding was in line with that of Imoko &Agwagah (2006) and Sumbabi and Bassey (2013) who concluded from their various studies that students tend to gain more interest when exposed to concept mapping techniques and game and stimulation method respectively.

The effect of gender as reported from the analysis carried out was not significant on students' interest in geometry. This shows that there was no much disparity between male and female students when it comes to interest in geometry. This finding is in conformity with that of Achor, Imoko and Ajai, (2010) in their study titled sex differentials in students' achievement and interest in geometry using Games and Simulation technique. Actually, the finding revealed that female students gained interest more than the male students, but the difference in the mean interest rating of male and female students exposed to games and simulations instruction was however not significant. The indication of this is that there is tendency of neutralizing gender effect on students' interest in geometry if a student – centred instructional strategy can be adopted.

On the interaction effects of treatment and gender on students' interest in geometry, the result showed that there was no significant interaction effect of treatment and gender on students' interest in geometry. Based on the fact that the sampling technique did not give room for gender discrepancy, that is, participants were randomly assigned to treatment irrespective of their sexes; this may be the reason why no significant interaction effect of treatment and gender was felt on students' interest in geometry. This may not be unconnected with the fact that a well implemented instructional strategy may neutralize gender effect. That is when students were provided with a level play ground to operate without any preferential treatment, they tend to benefit equally.

Conclusion

The main inference drawn from the study is that the treatment (ICT Based and Hand-on Activities) positively influenced students' interest in Geometry. It could be concluded, therefore, that when appropriate instructional strategy is well implemented the students' learning outcomes could be enhanced. It was also discovered from this study that full integration of modern technology into our

educational system in teaching mathematics will be more beneficial to the educational system. At the same time, students should be encouraged to develop their own understanding rather than rote memory, this will engender their interest. Gender differences were not a barrier in this study. No significant effect of gender was recorded on students' achievement, interest and retention in geometry. This is a clear indication that an appropriate instructional strategy is capable of neutralizing gender effect.

Recommendations

Arising from the findings of this study, the following recommendations were made; Students should endeavour to make judicious use of the advancement in technology. Mathematics teachers need to be dynamic in their instructional delivery. They should see the need to embrace constructivism approach to teaching. They should also maximize the advantages of technology to ease their lesson delivery and promote learning. The relevant authorities should try and make every necessary facility that can aid teaching and learning available in schools, especially ICT facilities. Both students and teachers should be allowed to have more access to computer room; this will afford them the opportunity to maximize the advantages of these facilities for teaching and learning. Government should provide adequate training through workshops and seminar to serving teachers, so as to equip them with relevant and up to date knowledge about innovative approaches to teaching.

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