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THE GEOGEBRA INTERACTIVE SOFTWARE AND SENIOR SECONDARY SCHOOL THREE (SSS3) STUDENTS' INTEREST AND ACHIEVEMENT IN MATHEMATICS

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ABSTRACT: *The exploration adopted a descriptive survey design and quasi-experimental designs using a sample size of sixty (60) SSS3 students in a study that lasted four weeks. A questionnaire tagged "Students' Interest on Geogebra (SIG)", and an achievement test was used for data collection. The Experimental Group (EG) were taught using Geogebra and while the Control Group(CG) had their lesson without Geogebra. One research question and a hypothesis guided the study. The mean was used to answer the research questions while independent sample t-test was used to test the hypothesis. A mean value of 2.85 above the criterion mean of 2.50 showed that the software increases students' interest in mathematics. Also, a post-test result showed values (62.20 ± 2.52) and (61.34 ± 2.61) for the EG and CG respectively, hence, the null hypothesis (H_0) was rejected as the t-cal (3.394) > t –crit (2.002). On this premise, a major recommendation was that teachers should not pay lip service to technology integration but ensure that applications that would support learning should always be integrated into their lessons.*

KEYWORDS: Interactivity, learner-friendly, passion, improve performance.

INTRODUCTION

Technology has revolutionised the world and the affairs of man in general, the teacher and learner in particular. It has in no small wise influenced teaching and learning and has equally altered the conventional role of both the teacher and learner, a paradigm shift from a teacher-centred to a learner-centred learning environment, hence the emphasis placed on learning rather than teaching. The latest definition of educational technology lead credence to this claim as a core element of its domains is "facilitating learning" (AECT, 2010).

Application software, the geogebra to be specific is dynamic geometric software which provides active, exploratory instruction with the help of symbolic links and offers alternative opportunities to users (Hohenwarter, 2006). It is more or less a bridge between computer algebra systems and dynamic geometry software (Hohenwarter & Preiner, 2007). The software offers deep learning by overcoming the challenges of abstract presentation of concepts and offering representations of concepts, showing interrelations among geometrical shapes. This is the essence of meaningful

learning offered by the software (Van de Wale, Karp & Bar- Willaims, 2010). Meaningful learning has a direct bearing on students' interest in a subject. The mean value of 4.26 in a 9-item questionnaire used on a sample of 62 students exposed to the geogebra software was obtained (Arbain & Shukor, 2015). This outcome is also in line with the findings of the software influence on students' interest (Emeikwu, Iji & Abari, 2015).

A review of related literature in the most recent shows ample proofs of the potentials of the geogebra software on learners' academic achievement in related mathematical concepts. A study by Royati, Ahmad and Rohani (2010) which focused on enlightening coordinate geometry learning, and a quasi-experimental type that adopted the non-equivalent control group post-test design, lends credence to this claim. In the study which was based on Additional Mathematics KBSM syllabus, independent samples t-test result showed that there was a significant difference in mean mathematical achievement between the geogebra group and the non- geogebra group, which stood at (65.23 ± 19.292) and (54.7 ± 15.660), respectively. In a related study, Zengin, Furkan and Kutluca (2011), confirming the effect of dynamic mathematics software geogebra in the teaching of trigonometry, also showed a difference in favour of the experimental group which has the lesson with geogebra. The sample of the referred study was 51 students in two groups, experimental and control. While the experimental group was subjected to the lessons arranged with the geogebra software, the control group was subjected to the lesson shaped with constructivist instruction. However, both lessons lasted for five (5) weeks (Zengin et al, 2011).

A study on Van Hiele geometry understanding levels of students with the application of geometry instruction using dynamic geometry software on 11^{th} graders also showed a positive result in favour of the experimental group (Kutluea, 2013). The study which was conducted in the spring of 2011 to 2012 educational year had 42 eleventh grade students grouped into experimental and control groups. A result of the study showed that there was a significant difference between pre-test and post-test scores of the students of the experimental group favouring the posttest ($Z = -3.655$; $p<0.01$).

The finding on the effectiveness of using geogebra on students' understanding in learning circles was also in favour of the experimental group (Shanahan & Kwan –Eu, 2014). The study lasted for one week using two intact classes consisting of 53 students on the whole. The experimental group had 28 while the control group had 25 students and the researchers personally taught both groups. The mean scores for both the post-test stood at (experimental: 16.46 ± 3.28) as against (control: 12.24 ± 4.40). The t-value of (3.983) at α - the level of 0.05 when compared to the t-crit value (2.008), indicated that there was a significant difference in the mean values of both groups.

In the same vein, a four-phase experimental study showed no significant difference in the first phase of a pre-achievement test of both groups. However, after the second phase of learning statistics with geogebra software and without geogebra software by both experimental and control

group respectively, the post – achievement test result was in favour of the former and not the latter (Arbain, & Shukor, 2014).

Geogebra and its effect on third graders' academic achievement were reported by Mehmet, Hanife and Gurcan (2015). The study was conducted with 40 students in two intact classes, made up of 19 and 21 in experimental and control groups respectively. Independent t-test, mean and standard deviation of both groups' post-test scores were computed. The result, however, was in favour of the experimental group, confirming the influence of the geogebra software. This finding is in no way different from the effect of geogebra on senior secondary school students' interest and achievement in statistics, a study conducted in Benue state, Nigeria (Emaikwu, Iji and Abaric, 2015). The quasi-experimental study had two hundred and forty-two (242) students collapsed into experimental and control groups and it lasted for four weeks. The post-test results at the end of the day were in favour of the experimental group over the control, confirming the strength of the geogebra software (Emaikwu, et al. 2015).

In summary, the review of the aforementioned studies attests to the potency of the geogebra software on students' interest and academic achievement. It is therefore based on these outcomes that the researchers were interested in confirming whether these claims hold or not. The outcome of the study invariably will influence the recommendations to be made at the end of this empirical investigation.

Statement of the problem

There is a growing concern on the poor performance of students in mathematics over the years in West African Senior Secondary Certificate Examination (WASSCE). The record as shown in the table below covering 2010 – 2012 report is ample proof to corroborate this position.

Table 1: Performance of students in WASSCE in mathematics 2010 – 2012

Year	Total sat	Credit (A1 –C6)	%	Pass (D7-E8)	%	Fail (F9)	%
2010	1,306,535	548,382	41.95	363,920	27.85	394,550	30.20
2011	1,508,965	608,866	40.35	474,664	31.46	425,435	28.19
2012	1,658,357	328,879	50.58	478,519	28.86	340,959	20.54

Score: WAEC, Lagos (2012)

The case above is not different in other public examination, NECO, GCE and other standardised examination. The influence of teaching materials, classroom management, teacher content knowledge and personality, contextualising mathematical concepts, and others in promoting the learning of mathematics are quite obvious (Yilmaz, Altun & Olkun, 2010). Hence the position of this interactive software, the geogebra in promoting students' interest and achievement, if any, are what this study intends to establish.

Research question: How might we describe the interest of students taught geometry geogebra software package?

Research hypothesis: There is no significant difference between the mean achievement scores of students taught with geogebra and those taught without such application.

METHODOLOGY

Research design: The descriptive survey and pretest –post-test design quasi-experimental were used in the study. The first design, a survey design is a questionnaire that contained items addressed on interest as inherent components. The second design had the experimental group (EG) and a control group (EG), and while the EG was exposed to the treatment (geogebra), the CG was denied the treatment (geogebra).

Population and sample and sampling technique: The study consisted of all 120 senior secondary school (SSS3) students in Hallmark Academy, Omoku, Rivers State, Nigeria in the 2015/2016 academic year. A total of sixty (60) students were used for the study. This number was purposively selected and used for the study due to the availability of functional computers in the laboratory.

Instrumentation: Two instruments were used for data collection, a questionnaire tagged "Students' Interest on geogebra (SIG)", and an achievement test. The SIG is a questionnaire designed by the researchers and used to ascertain students' level of interest in the use of the software package. The SIG, a 10-item questionnaire was structured in the like-like fashion with four options and their scales (Very High 4; High 3, Low 2, and Very Low 1). A criterion mean value of 2.50 was adopted based on the scales. The achievement test was used to quantify students' achievement in geometry.

The validity and reliability were achieved by peers' constructive observation and via a test-retest application of the instrument, respectively. Test reliability measures of both instruments gave reliability coefficient of 0.72 and 0.61 for SIG and the achievement test respectively.

Experimental procedure

The lesson with geogebra lasted for four (4) weeks, handled by two mathematics teachers, each for the EG and CG. However, there were two tests, a pretest and a post-test for both groups. A four-phase approach similar to Arbain and Shukor (2014) was used in the study.

Table 2: Phases of instrument administration

Phase	EG	Parameters	CG
1	+	Pre-achievement test	+
2	+	Lesson with geogebra software	-
3	+	Post-achievement test	+
4	+	Questionnaire (SIG)	-

Data analysis: Mean, Standard Deviation and t-test were used to analyse data in the study.

Research Question 1: How might we describe the interest of students taught geometry geogebra software package?

Table 3: Students interest parameter

S/N	Description	VH	H	L	VL	N	Mean
1.	Geogebra increased my passion for mathematics	4(12)48	3(11)33	2(6)12	1(3)3	96	3.00
2.	Geogebra increased my understanding of mathematics concepts.	4(10)40	3(12)36	2(4)0	1(6)6	90	2,81
3.	It makes me spend more time learning mathematics	4(9)36	3(13)39	2(4)8	1(6)6	87	2.72
4.	Geogebra is a learner-centred software	4(11)44	3(12)36	2(5)10	1(4)4	94	2.94
5.	It also supports interactivity among class members.	4(9) 36	3(12)36	2(4)8	1(7)7	87	2.72
6.	It supports teacher-students interactivity	4(12)48	3(10)33	2(4)8	1(4)4	93	2.91
7.	My attention span is enhanced	4(10)40	3(11)33	2(2)4	1(9)9	86	2.69
8.	The software dymistitics difficult concepts	4(11)44	3(11)36	2(3)6	1(4)4	90	2.81
9.	It is a learner-friendly software	4(12)48	3(9)27	2(4)8	1(7)7	98	3.06
10.	I can learn mathematics unaided	4(11)44	3(10)30	2(5)10	1(7)7	91	2.84
Grand Mean							**2.85**

The phase 4 questionnaire administration of Table 2 as evident in Table 3 showed that geogebra software arouses the interest of students in a mathematics class. The grade mean of 2.85, in this case, is above the criterion mean of 2.50, a clear indication that students showed a preference for a mathematics lesson with such application software as the geogebra. The questionnaire was administered to the EG only who were exposed to the software.

Research hypothesis: There is no significant difference between the mean achievement scores of students taught with geogebra and those taught without such application.

Table 4: Pre-test achievement mean of both values groups

Group	N	Mean	SD	df	α	t-cal	t-crit
Experimental	32	51.21	1.41				
Control	28	51.11	1.44	58	0.05	0.710	2.002

Mean values here are not significant on further analysis, using the SD, and t-values. The meaning is that both groups have similar ability prior to the treatment proper.

Table 5: Post-test achievement mean of both groups

Group	N	Mean	SD	df	α	t-cal	t-crit
Experimental	32	62.20	2.52				
Control	28	61.34	2.61	58	0.05	3.394	2.002

Decision: Rejection of H_0 (tcal, 3.394 > t-crit., 2.002). Table 5 above shows that a significant difference exists between the EG and CG mean values, even though the difference is only 1. The SD, the df and t-values attest to this significant difference.

DISCUSSION OF FINDINGS

The first finding is that geogebra software application increased students' interest in mathematics. This finding also lends credence to the place of information and communication technology in education in general and teaching and learning in particular. A succinct look at Table 3, reveals the strength of geogebra software on students' passion, understanding, quality time, learner-centred and enhanced interactivity, amongst others. This position is in alignment with the findings of Shadaan and Kwan-Eu (2013), and also specially on students, perception on GeoGebra in the learning of circles, mean interest rating in statistics of male and female students in the use of geogebra (Emaikwu, Iji & Abari, 2015; Arbain & Shukor, 2015). The study has also shown the worth and usefulness of geogebra in improving students' achievement in mathematics. The outcome of this study is exactly in tandem with earlier studies reviewed in this work. The likes of Royati, Ahmad and Rohan (2010); Zengin, Furkan and Kutluea (2011); Kutluca (2013); Shadaan and Kwan-Eu (2014) and Arbain and Shukor (2015), amongst others, are related studies. The pre-test (Table 4) scores of both groups, did not show any gain in achievement of either group prior to the exposure of the EG. However, the result of the post-test (Table 5) indicates a significant influence of the geogebra software on the academic achievement of the EG. Their gain in achievement can be attributed to the effect of the treatment, confirming the advantage such application offers over non-beneficiaries.

CONCLUSION

In consideration of the immeasurable value of application software, the geogebra in particular in arousing the interest and improving the academic achievement of learners for a given subject, we can submit that it is high time the software is integrated into our lessons. By its integration in the teaching and learning of mathematics, it has become obvious that complex and difficult concepts that ordinarily would cause students a serious migraine will be overcome by the presence of the geogebra software application, thus making mathematics an easy subject to learn.

RECOMMENDATIONS

Two recommendation directly tied to the findings shall be made.

1. There is a need for the presence of functional computer laboratories in our schools to enhance the software integration, as such, all stakeholders in education should not pay lip service to ICT integration.

2. Teachers of today should be ICT literate and strive to integrate them into every lesson. In fact, the place and role of ICT should always be defined in every instructional process, hence teachers should serve as models in ICT usage.

REFERENCES

AECT (2010). *Educational technology: A definition with commentary.* NY: Routedge

Arbain, N. & Shukor, N.A. (2015). The effects of geogebra on students achievement. *Procedia Social and Behavioral Sciences 172,* 208 – 214.

Emaikwu, S.O., Iji, C.O. & Abari, M.T. (2015). Effect of geogebra on senior secondary school students' interest and achievement on statistics in Makurdi local government area of Benue state, Nigeria. *IOSR Journal of Mathematics, 11*(3), 14 – 21

Hohenwarter, M. (2006). Dynamic investigation of functions using geogebra. In proceedings of Dresden Int symposium on technology and its integration into mathematics education. Dresden: Germany. Retrieved www.geogebra.org

Hohenwarter, M. & Preiner, J. (2007). Dynamic mathematics with geogebra. *Journal of Online Mathematics And its Application, 7,* 1448

Kutluca, T. (2013). The effect of geometry instruction with dynamic geometry software: Geogebra on Vanttiese geometry understanding levels of students. *Academic Journal, 8* (17), 1509 – 18

Mehmet, B. Hanife, U.A. & Gurcan, K. (2015). The effect of geogebra in third grade primary students' academic achievement in fraction, *Mathematics Education*, 11(2), 347 – 355

Nazan, S.Y. & Sema, C. (2015). The impacts of dynamic geometry software on graphing abilities of prospective physics teachers' geogebra sample. *European Journal of Physics and Chemistry Education, 7* (1), 46 – 61.

Royati, A.S., Ahmad, F.M.A., & Rohani, A.T. (2010). The effects of geogebra on mathematics achievement: enlightening coordinate geometry learning. *Procedia Social and Behavioral Sciences, 8,* 686 – 693.

Shadaan, P. & Kwan-Eu, L. (2014). Effectiveness of using geogebra on students' understanding in learning circles. *The Malaysian Online Journal of Educational Technology, 1* (4), 1 – 11.

Van de Walle, J.A., Karp, K.S. & Bar-Williams, J.M. (2010). *Elementary and middle school mathematics teaching development* (7th ed.). USA: Pearson Pub,

WAEC (2012). *Chief examiner's report (2009 – 2012):* Lagos Sidmach Technologies Nig Ltd.

Yilmaz, C., Altun, S.A. & Olkun, s. (2010). Factors attracting students' attitude towards math: ABC theory and its reflection on practice. *Procedia-Social and Behavioral Sciences. 2* (2), 4502 – 06

Zengin, Y., Furkan, H. & Kutluca, T. (2011). The effect of dynamic mathematics

software geogebra on student achievement in teaching of trigonometry *Procedia Social and Behavioral Sciences, 31.,* 183 – 187.