EFFECTS OF COMPUTER ASSISTED INSTRUCTIONAL SOFTWARE ON SENIOR SECOUNDARY SCHOOL STUDENTS' ACHIEVEMENT AND RETENTION IN GEOMETRY IN DELTA STATE

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Abstract
The study examined the effect of Computer Assisted Instruction software known as Frizbi Mathematics 4 software on senior secondary school students' achievement and retention in Geometry in Delta State. Pre-test, Post- test quasi-experimental research design was adopted in the study. The population of the study comprises all the SS2 students in Public secondary schools for 2018/2019 session. Purposive sampling technique was used to select two schools based on the fact that they are the only schools with computer laboratory. Thereafter, simple random sampling technique was used to select sample size of 110 which was divided into Experimental and control groups. Students in experimental group were exposed to CAI software while those in the control were taught Geometry with traditional method of teaching. The period of the instruction lasted for four weeks. Thereafter the research instrument tagged Geometry Achievement Retention Test, was administered on both groups. The scores obtained were analyzed using mean, standard deviation and t-test at 0.05 level of significance. The result shows that there exists a significant difference in the mean achievement and retention scores of the experimental and the control groups. The observed difference was in favour of the experimental group. The study further revealed that there is no significant difference between the mean achievement and retention scores of male and female students who were exposed to CAI software irrespective of genders. This implies that CAI is not gender bias. The study therefore concludes that CAI-Frizbi Mathematics 4 software has positive significant effects on senior school students' achievement and retention in Geometry. Hence, it recommends among other things that Mathematics teachers be encouraged to use the CAI Frizbi Mathematics 4 software in the teaching of Geometry in secondary school.

Keywords: *Computer Assisted Instruction, Instructional Software, Geometry, Achievement, Retention.*

1.1 Introduction

Mathematics as a subject stands out among all other science subjects. This is based on the scope of its usefulness and applicability. It is applicable in all spheres of life and to all field of human endeavour. Okwuoza , Gimba and Durojaiye (2018) emphasis that Mathematics does not only prepare man for life, but that it involves life itself. According to them, it is indispensible in all human endeavours. Ehiwario, Aghamie and Azagbaekwue (2018) view Mathematics as an activity subject which demands that the Mathematics teacher helps the students acquire basic Mathematics knowledge, skills and attitude to solving life problem. This, (he) Mathematics teacher can achieve by using highly student-centered and activity teaching method. Unodiaku (2018) noted that activity based teaching method appears to be invoking in recent times especially in the teaching of Mathematics. According to him, the philosophy of activity-based

learning is precipitated on the fact that learning can be best when it is initiated by the surrounding environment and motivated by providing optimum opportunities to learn. A Mathematics student is an inquisitive and active mind who needs motivation and an enabling environment to operate. Probably this could be the reason why Blogger(2012) and Unodiaku (2018), opined that students need to be provided with data and materials needed to focus on their thinking and interaction in the lesson for the process of analyzing information, while the teacher's primary duty is to guide and direct the student in the analysis of the information.

Olga (2008) opined that integrating technology into the teaching of school subjects has many advantages, namely, it helps students gain new concepts for instance, in Mathematics, it provides an enjoyable learning environment for students and they may also develop computer usage skills. This way, integration can be obtained by employing educational software in teaching activities. Students are usually excited when using computers, so turning this joy into effective learning outcome causes the raise in the positive results. In trying to buttress the benefits accruing to the integration of technology in teaching Olga, emphasizes that computer is an integral part of life and as such, there is the need for learners to be literate in not only basic skills but in computers too. According to him, the best way to making students skillful in computers is by empowering the learner to use computers and to communicate with it.

Computer is generally defined as an electronic device which accepts data, process data, store data and produces the result as information. Previously, computer was used mainly in education sector for administrative purposes like typing of documents and maintaining of students' and staff's record but as noted by Ughamadu (2006), the advent of microcomputer in recent times, had led to a rapid increase in the application of computers to direct instruction. According to him, Computer, when combined with electronic transmission system can find use in an almost unlimited variety of instructional situations and setting. Okwuoza et al (2018) in citing Parveen (2003), stated that the use of computer in instruction could help to transform educational system, prepare students for the information age and speed up national development. They added that the use of computer as a means of instruction could help students to retain what was learnt, improve on the attitude and interest of students to understand Mathematics more.

Computer Assisted Instruction (CAI) is both student-centered and activity-based teaching approach. Ughamadu (2006) defined CAI as an instructional design whereby computer system delivers instruction directly to learners by allowing them to interact or relate with the designed lessons that have been programmed into the system. Similarly, Ash (2005) views CAI as an interactive instructional method whereby a computer is employed in as an instructional material and monitors the learning that takes place. It is the combination of text, graphs, sound and video in enhancing the learning process.

Olga (2008) explains that CAI is one of the applications of the forms of computers and there are different modes, such as Drill and Practice, Tutorials, or Simulations. McCoy (1996) added that Drill and Practice Mathematics Software presents exercises in an interesting real-life based context in the form of computer games or activities. Ndiforchu (2003) cited in Olga (2008) stated that the drill and practice administration through a computer is less time consuming than drill and practice through a paper-and-pencil. According to Olga (2008), the Frizbi Mathematics 4 is the form of drill and practice software and oriented around the general problem solving strategies, interactive exercises about Mathematical problems and solution based on adventure activities.

There exists a robust literature on the computer assisted instruction in the teaching and learning of Mathematics. According to Lou, Abrami and Appollonia (2001) and Olga (2008), research on the effectiveness of computers on students' achievement can be traced back to Skinner's programmed instruction in 1960s. According to them, the result of such early studies revealed that computer has significant positive effects on the achievement of students' Mathematics test scores.

According to the study conducted by Domoroty (2003) to investigate the effect of CAI on 5th grade students' Mathematics achievement. It was revealed that there is significant differences between the mean scores of students who were exposed to CAI and the students who were exposed to traditional method of teaching fractions. It was further noted that the observed difference was in favour of those exposed to CAI. Studies with similar result include Origumor (2007) and Ikeke (2008).

1.2 Statement of Problem

In recent times, the declining achievement of Secondary school students in both internal and external examinations has been a source of worry to stakeholders in education. The authors observed that for many Mathematics teachers, there is persistent struggle associated with making choices related to both curriculum content and method of teaching the subject. The selection of teaching method is not so easy. The reason being that no single teaching technique is good enough to work for all the teachers and for all the topics in Mathematics. The ability of the Mathematics teacher to identify the appropriate method in relation to the nature of the subject matter, level of the students and the cost of using such a method. The need to find a reliable way of improving students' achievement and retention in Mathematics and in Geometry in particular is becoming a national issue. Abakpa (2018) submitted that appropriate and effective teaching method enhances students' achievement and retention in learning task. Okwuoza et al (2018) consistently emphases that Computer based instruction has the capacity to help students retain what have been learnt, improve on students' attitude and interest which cumulate to an improve achievement in Mathematics. It is on this note that the current study investigates the effects of CAI-Software on students' achievement and retention in Geometry.

1.3 Objective of the Study

The general objective of the study is to ascertain the effects of CAI software on Secondary School Students' achievement and retention in Geometry in Delta State. While the specific objectives include:

- To compare the effect of CAI software and traditional methods of teaching Geometry in secondary schools.
- To ascertain whether there is exist any significant difference between the mean achievement and retention scores of male and female students who were taught Geometry using CAI-software.

1.4 Research Questions

The following questions are drawn to guide the study:

Research Question 1: What is the difference in the mean achievement and retention scores of students taught Geometry with *CAI-Frizbi* Mathematics 4 software and students taught Geometry with traditional teaching method?

Research Question 2: Is there any difference in the mean achievement and retention scores of male and female who were taught Geometry using *CAI-Frizbi* Mathematics 4 Software?

1.5 Research Hypotheses

To guide study, the following hypotheses are also constructed:

H_{01}: There is no significant difference in the mean scores of the experimental and control groups in the pre-test.

H_{02}: There is no significant difference in the mean achievement and retention scores of students taught Geometry using *CAI-Frizbi* Mathematics 4 software and the students taught with the traditional teaching method.

H_{03}: There is no significant difference in the mean achievement and retention scores of male and female students taught Geometry using *CAI-Frizbi* Mathematics 4 software.

Research Method and Procedure

2.1 Research Design

The study adopted pre-test, post-test quasi- experimental design in order to examine the effect of computer assisted instructional software on Senior Secondary School students' achievement and retention in Geometry in Delta State. A quasi-experimental design was adopted since it is not possible to randomly assign the subject to the experimental and control groups. The CAI used on the experimental group form the independent variable while the Mathematics achievement and retention in geometry were the dependent variables.

In the study, the computer assisted, drill-and-practice software known as Frizbi Mathematics 4 was used as an instructional strategy in the experimental group while in the control group, students were taught Geometry using the traditional teaching method.

2.2 Population of the Study

The population consists of all the students in SSS 2 that registered for 2018/2019 academic session in public secondary schools in Ika South local government area of Delta State. The total population was 1897, comprising 877male and 1020 female students. The population had a mean age of $\pm$ 16 years.

2.3 Sample and Sampling Technique

Purposive sampling technique was used to select two co-educational schools from the population. These schools were chosen deliberately because they were the only public secondary schools in the study area with computer laboratory. Thereafter, simple random sampling technique was adopted to select 55 students each school. Making a total sample size of 110.

2.4 Instrument of the Study

A research instrument tagged: Geometry Achievement-Retention Test (GART) which consist of thirty (30) multiple choice items with four options letter A-D were constructed from line geometry, solid geometry and circle geometry. The GART was to measure students' achievement and retention ability in geometry.

2.5 Validation of the Instrument

The GART was subjected to face and content validation scrutiny by two specialists from the Department of Curriculum and Instruction and Department of Measurement and Evaluation from

Delta state University, Abraka. A table of Specification was also constructed on the items to further validate the content of the instrument.

2.6 Reliability of the Instrument

The reliability of the research instrument was carried out using the split-half method. The correlation coefficient of the half test was obtained using the Pearson Product Moment Correlation, usually denoted by $r^{\frac{1}{2}}$. In order to ascertain the reliability of the full length of the test items, Spearman Brown formula was adopted. The correlation coefficient of 0.78 index score was obtained. Thus, the instrument was judged to be reliable and useable.

2.7 Procedure for Data Collection

A statistical frame was constructed by assigning serial numbers to the subjects from 1 to 110. Thereafter, students with even numbers were assigned to the experimental group while students with odd numbers were assigned to the control group. Prior to the commencement of the treatment, a pre-test drawn from the topics: line geometry, solid geometry and circle geometry was administered to both the experimental and control groups. The scores of the pre-test was analyzed using t-test to ascertain if there is any significant difference between the achievement of students in the experimental and control groups.

The treatment group (with even numbers) was taught geometry using the CAI package called Frizbi Mathematics 4 software while the students in the control group (with odd numbers) were taught same geometry using traditional geometry instruction with materials like compass, protractor, straightedge etc. the study lasted for four weeks during the long vacation. The students in both groups were taught based on the researcher's prepared lesson in collaboration with the students' regular Mathematics teachers

At the end of the 4 weeks of instruction students were allowed for one week revision. Thereafter, Geometry Achievement and Retention Tests were administered on both the experimental and control groups.

2.8 Method of Data Analysis

The scores from the pre-test and post-test form the data. The research questions were answered using descriptive statistics such as mean, and standard deviation. While the hypotheses were tested using students't-test at 0.05 level of significance.

Results

3.1 Interpretation of Pre-test Scores

As mentioned earlier, the pre-test was administered to both the experimental and control groups prior to the commencement of the treatment. This was to ascertain the homogeneity of the class. To achieve this, we put a hypothesis as follow

H_{01}: There is no significant difference in the mean scores of the experimental and control groups in the pre-test.

Table 1: Comparison of the Mean Achievement Score of the Experimental and Control Groups in the Pre-test

Group	N	Mean	STD	Df	t-cal	t-tab	Decision
Experimental	55	48.2	3.01	108	0.950	1.645	No sig.
Control	55	46.7	2.94				

The result presented in table 1 shows that there is no significant difference in the mean scores of the experimental and control groups in the pre-test administered at 0.05 level of significance. This by implication means that the subjects are homogenous. That is both groups have equal knowledge of Geometry before the treatment.

3.2 Analysis of the Research Questions

Research Question 1: What is the difference in the mean achievement and retention scores of students taught Geometry with *CAI-Frizbi* Mathematics 4 software and students taught Geometry with traditional teaching method?

Table 2: Comparative Mean Achievement and Retention in GART of Experimental and Control Groups

Group		**Pre-test**	**Post-test**	**Mean Gain**
Experimental	**N**	**55**	**55**	
	Mean	40.80	70.64	29.89
	STD	8.04	4.98	
Control	N	55	55	
	Mean	42.01	48.60	6.59
	STD	7.22	5.21	

Table 2 shows the comparative mean achievement and retention scores of students who were taught Geometry using *CAI-Frizbi* Mathematics 4 software and those taught with traditional method of teaching. It was revealed that before the treatment, the students' mean achievement and retention scores in the GART was 40.80 with standard deviation 8.04. The mean score increased to 70.64 with standard deviation 4.98 after exposing the same students to the use of *CAI-Frizbi* Mathematics 4 software. On the other hand, in the control group, the mean score in GART pre-test was 42.01 with standard deviation 7.22. Meanwhile, the mean scores in GART in the post-test also increased to 48.60.

Comparing the mean gain of the experimental and control groups, we observed that the mean gain in the experimental (26.84) is far higher that the mean gain of the control group (6.59). This implies that the CAI-software has greater and positive effect on students' achievement and retention in the learning of Geometry than the traditional method of teaching Geometry using compass, protractor, straightedge materials etc.

Research Question 2: Is there any difference in the Mean Achievement and Retention scores of male and female who were taught Geometry using *CAI-Frizbi* Mathematics 4 Software?

Table 3: Mean Achievement and Retention scores Difference of Male and Female who were taught Geometry using *CAI-Frizbi* Mathematics 4 Software

Group	Sex		Pre-test	Post-test	Mean Gain Difference
Experimental	Male	N	25	25	35.02
		Mean	45.01	80.03	
		STD	9.62	8.05	
	Female	N	30	30	
		Mean	35.00	70.00	35.00
		STD	9.82	8.72	

Table 3 shows Mean Achievement and Retention scores Difference of Male and Female students who were taught Geometry mainly with CAI-Frizbi Mathematics 4 Software. The mean score for the male increased from 45.01 to 80.03 giving rise to mean gain of 35.02. Similarly, the mean score for the female students increased from 35.00 to 70.00 leading to a mean gain of 35.00. the implication of this result is that the use of the CAI software in the teaching of Geometry tends to yield equal or similar effect on students' achievement and retention Geometry irrespective of the gender. That is the use of *CAI-Frizbi* Mathematics 4 software is not gender bias.

3.3 Test of Hypotheses

The two null hypotheses formulated to guide the study were tested at 0.05 level of significant using the student t-test statistic.

H_{02} : There is no significant difference in the mean achievement and retention scores of students taught Geometry using *CAI-Frizbi* Mathematics 4 software and the students taught with the traditional teaching method.

Table 4: Statistical Comparison of the post-test mean Achievement and Retention Scores of the Experimental (with CAI-Software) and Control (Traditional method)

Group	N	Mean	STD	Df	t-cal.	t-tab.	Decision
Experimental	55	70.64	4.98				
				108	7.894	1.645	Sig.
Control	55	48.60	5.21				

Table 4 shows Statistical Comparison of the post-test mean Achievement and Retention scores of students who were taught Geometry using CAI-Software (experimental group) and those taught with traditional method of teaching Geometry (control group). The result shows that the t-calculated and t-tabulated are 7.894 and 1.645 respectively. Since the t-calculated exceed the t-tabulated, we reject the null hypothesis (H_{01}) and infer that there exist a significant difference in the mean achievement and retention scores of students taught Geometry using *CAI-Frizbi* Mathematics 4 software and the students taught with the traditional teaching method. This result is in line with the result in table 2 which affirms that the observed difference was in favour of those taught with CAI-software. This by implication shows that

teaching Geometry using *CAI-Frizbi* Mathematics 4 software is preferred based on its positive effects on students' achievement and retention potentials.

H_{03}: There is no significant difference in the mean achievement and retention scores of male and female students taught Geometry using CAI-Frizbi Mathematics 4 software.

Table 5: Statistical Comparison of the post-test mean Achievement and Retention Scores of Male and Female students who were taught Geometry using CAI-Frizbi Mathematics 4 software

Group	Sex	N	Mean	STD	Df	t-cal.	t-tab	Decision
Experimental	Male	25	80.03	8.05	53	0.457	1.672	Non Sig.
	Female	30	70.00	8.72				

In Table 5, we attempt comparing the post-test mean Achievement and Retention Scores of Male and Female students who were taught Geometry using CAI-Frizbi Mathematics 4 software statistically at 0.05 level of significant via the student t-test statistic.

It was observed that t-calculated with value 0.457 is less than the t-tabulated (critical value) with value 1.672. Hence, we do not reject the null hypothesis (H_{02}). Based on this, we assert that there is no significant difference between the post-test achievement and retention scores of both the male and female students that were taught Geometry using the CAI-Software. This is in line with our result in table 3, which states that the CAI-Software has the same effect on both genders. That is to say, CAI is not gender bias.

3.4 Summary of Major Findings of the Study

1. The result of the study shows that before the treatment (pre-test) the students (subjects) in both experimental and control groups have equal knowledge of Geometry. In other words, there was no significant difference in the achievement and retention scores of the students in both experimental and control groups before the commencement of the treatment.
2. From the result of the post-test mean achievement and retention scores, it was revealed that there exists a significant difference in mean scores of students who were taught Geometry using CAI-Frizbi Mathematics 4 Software and those that were taught the same Geometry using the traditional method of teaching Geometry. The observed difference was in favour of those that were taught with CAI-software.
3. The study also revealed that there is no significant difference between the mean achievement and retention scores of both the male and female students who were taught Geometry using the CAI-software. This shows that the CAI-software is not gender bias.

3.5 Discussion of the Results

The present study revealed that before the treatment, the students in both the experimental and control groups show equal knowledge in Geometry. This was reflected in the fact that the Geometry achievement and retention test administered to both groups (pre-test), there was no significant difference between the scores of both groups. This is in line with studies of Ayuba and Timayi (2018) and Funkhouser (2003). The study revealed that there exists a consistent significant difference in the mean scores of students who were taught Geometry using *CAI-Frizb i*Mathematics 4 software and those that were taught the same Geometry using the traditional

method of teaching Geometry. It was further ascertained that the observed difference was in favour of those in the experimental group. That is those that were taught with CAI software. This result collaborated with the earlier findings of Ekwueme and Umedo (2018), Olga (2018), Okwuoza et al (2018) and Ash (2005). Ekwueme and Umedo (2018) asserted that students taught using computer based concept mapping achieved significantly better than those taught using problem based learning method. Studies with similar result include: Afolabi (2010) Gambari, Falode and Adegbewro (2014). This confirmed that the CAI has the ability to enhance students' achievement and retention in Geometry lessons. The high achievement and retention may be attributed to the fact that CAI could benefit students with the following: Self-sufficient learning. Independent learning, the exercising of various senses and the ability to represent in a variety of media.

The study also revealed that there is no significant difference between the mean achievement and retention scores of both the male and females that were taught Geometry using the CAI software. This inferred that CAI-Software is not gender bias. This result is in agreement with Ikeke (2008) and Okwuoza, et al (2018).

Conclusion

The study concludes that the use of Computer Assisted Instructional software (*CAI-Frizbi* Mathematics 4) enhances students' achievement and retention in Geometry and Mathematics in general. It was also concluded that Mathematics instruction combined with CAI software has significant effects on students' achievement and retention than the traditional instructional strategies.

Recommendations

Based on the results of the study and the conclusions, the following recommendations were made:

- The government at all levels should as a matter of urgency, provide the enabling environment for the inclusion of CAI software in the teaching and learning of mathematics in secondary schools in the state. This will help to reduce the abstract nature of Mathematics and Mathematics phobia among secondary school students.
- Efforts should be made to provide functional mathematics/computer laboratory to all our secondary schools in order to reap the benefit of CAI.
- Workshop and in-service training for mathematics teachers on how to integrate CAI in the teaching and learning of mathematics. This will help to upgrade their knowledge and experiences.
- Government and school heads should endeavour to provide alternative source of power supply to all the schools in order to solve the problem of power supply that has become a canker worm that has destroy the system

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