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EFFECTS OF COMPUTER ASSISTED INSTRUCTION ON GEOMETRY RETENTION AMONG SENIOR SECONDARY SCHOOL STUDENTS IN KANO STATE, NIGERIA

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ABSTRACT

This study examined the Effects of Computer Assisted Instruction (CAI) on Geometry Retention among Senior Secondary School Students in Kano State. The population of the study was all the 77,616 Senior Secondary students in Kano State. A sample size of 144 SSII students was used in the study. Three instruments, the Pre-Geometry Performance Test (PRE-GPT), Geometry Performance Test (GPT) and Geometry Retention Test (GRT) were developed and used by the researchers with reliability of 0.87 to test the students' retention ability in four areas of Geometry - angles, triangles, polygons and circles. Experimental group was taught the selected geometry concepts using CAI for six weeks while control the group was taught same geometry concepts for the same duration using the conventional method. Findings showed that the scores of the retention test (GRT) significantly favored the experimental group against control group as the mean score of 51.11 and 46.56 for the experimental and control group were respectively obtained in the Geometry Retention Test. This indicates a mean difference of 4.55 in favor of the experimental group. It is concluded that CAI was more effective in enhancing retention ability of secondary school students in Geometry than the Conventional method of Instruction. It is recommended that Ministries of Education should train and re-train secondary school mathematics teachers on the application of CAI in their classrooms in order to improve the retention ability of their students.

Key Words: Computer Assisted Instruction, Retention, Geometry

INTRODUCTION

Mathematics has been in use since the ancient civilization. The applications of mathematics in various aspects of life portray the importance attached to it. The application of mathematics in the ancient civilization as highlighted by Mati et al (2005) includes:

i. Domestic day-to-day affairs

ii. Measuring the boundaries of land/plot especially when it is subsided by floods.

iii. Predicting the seasons of sowing crops, harvest and religious festivals.

iv. Calculation of taxes, other government and commercial calculations, navigations on sea and on land.

v. Building domestic and public roads and bridge.

vi. Astronomy

While at present, mathematics has provided and continued to provide the computation processes and structures for new scientific principles/Concepts (e.g. Biology, Physics and other social Sciences). Mathematics is also applied in solar and nuclear energy, space navigation, discovery of new material resources, weather forecasting, social statistics, prediction of population growth etc.

Mathematics as a school subject has various branches. These include Number and Numeration, Algebra, Geometry, Trigonometry and Statistics. This study focused on Geometry. According to Odili (2006), the common view about the origin of Geometry was that it originated from the ancient Egypt where much practical knowledge was acquired from land measurement along the Nile, as well as the construction of pyramids. Therefore, Geometry studies space and spatial relationships. It is a way of reasoning and presentation used to conceptualize and analyze physical and imagined spatial environment. The importance of Geometry cannot be over-emphasized. Choi (2013) maintained that Geometry offers ways to interpret and reflect on our physical environment which allows students to link it to their daily lives. Also, Bruce in Odili (2006) concluded that Geometry is an essential part of the study of mathematics and its other branches at all levels.

Despite the importance of Mathematics and Geometry, students' performance in Mathematics and their ability to retain geometric concepts has continued to remain a source of concern among teachers, mathematics examiners and other stakeholders in education. Many secondary school students in Nigeria struggle with retention and understanding of geometry concepts. Traditional teaching methods often fail to engage students, necessitating innovative approaches to improve student outcomes. For instance, WAEC (2020) in the Chief Examiner's Report revealed that candidates had problems in Geometric area of mathematics and such problems had been traced to lack of visualization and spatial skills. Similarly, Awotunde and Bot (2003) reported that students are known to record very poor performance in both internal and external and internal examinations with greater deficiencies in Geometry. WAEC (2020) also reported that the percentage of students who failed mathematics at SSCE was due to poor attempt on trigonometry and geometry related questions. However, Uyuota (2006) linked ability to perform well in mathematics to one's ability to retain. This implies that poor retention could lead to poor performance in mathematics.

Retention is the ability to keep and consequently remember things experienced or what is learnt by an individual at a later time (Bichi 2002). Retention can also be described as a form of reaction to what has been presented in the past. So many reasons have been advanced for students' difficulty and poor retention ability in mathematics and Geometry in particular. However, the common reason cited by scholars is the use of poor teaching strategy. For instance, Inekwe (2003) described the magnanimity of students' geometrical difficulties as a strong curriculum and pedagogical problem which needs the attention of mathematics educators. Also, Uyuota (2006) maintained that if concepts learnt must be retained for problem solving, then, methods by which the learner and the teacher will interact with materials should be given adequate consideration.

The integration of technology in education has transformed teaching and learning. Computer- Assisted Instruction (CAI) has emerged as a promising tool to enhance student outcomes in various subjects, including mathematics. This study explores the effects of CAI on geometry retention among senior secondary school students in Kano State, Nigeria.

Computer Assisted Instruction (CAI) or Computer Aided Instruction (CAI) is a method of instruction in which the computer is designed to teach, guide and test, until a desired level of mastery is attained. It also refers to an interactive instructional technique whereby a computer is used to present an instructional material and monitor the learning that takes place. It is a self – regulated learning involving interaction of students with computer programmed instructional materials (Yakubu, 2022). These materials could be tutorials, drills, games or particular software used to present lessons and test students' understanding.

Many educational computer programmes are available online and from computer software shops and they enhance teacher instruction in several ways. Some excellent dynamic geometry programs that support students in developing mathematics concepts were developed such as the Geometry sketching software, (Furner & Marinas 2007), logo & Geometry, (Clements, Battista &Sarama 2001), Geometer's Sketchpad

(Hannafin, Burruss & Little, 2001), 3D software application (Christou & James 2007), These programs allow learners to construct 'classical' geometric objects such as points, segments, lines, circles etc., measure distances, angles, areas, and manipulate shapes on screen. The programs also let learners to change the objects which are displayed on screen dynamically by dragging and re-sizing them. Clement (2001) stated that geometry software provides a very good environment for teaching geometry because they can be used to perform geometric experiments. Hence, use of these computer programmes involves the use of students' senses actively which could lead to retention of learnt concepts as rightly concluded by Newcomb in Kajuru and Popoola (2010) that a learner retains 10% of what he read alone, 20% of what he heard, 30% of what he saw and heard while the percentage increase for those who read see and do things in a practical situation. Based on this postulation, it is hoped that CAI could enhance retention in geometry as it was reported to enhance performance and retention in other areas of mathematics and different locations or environments like simultaneous equations in Edo state, Nigeria (Ebhomien 2017), algebraic word problems in Kaduna state, Nigeria (Ayuba & Timayi, 2018) and quantitative reasoning in Enugu state, Nigeria (Eneze, Alio and Nneji, 2022). Therefore, the problem of this study is to explore the effectiveness of CAI on enhancing the retention ability of SSS students in geometrical concepts in Kano state, Nigeria.

The study sought to achieve the following objective:

1. Examine the effect of CAI on retention of Geometrical concepts among Senior Secondary School students.

To achieve the stated objectives, the following **research question** was raised to guide the study:

1. What is the mean difference between the retention score of students exposed to CAI and those exposed to Conventional Method?

On the other hand, the following ***null hypothesis*** was formulated and tested at $\alpha = 0.05$ level of significance

Ho_1: There is no significant difference between the mean retention score of students exposed to CAI and those exposed to Conventional Method.

METHODOLOGY

In this study, Quasi-experimental design was employed. According to Sambo (2001), Quasi-experimental design is usually used when there is no full laboratory isolation.

The population for the study was all the 626 public and private Senior Secondary School Students in Kano Central Senatorial District with a total of 77,616 students (Kano State Senior Secondary Schools Management Board and Kano State Private and Voluntary Institution Board 2022).

Dawakin Kudu zone was purposively selected out of the educational zones in the study area. The selection was based on the fact that it has some common characteristics of urban and rural settlements with students from different background. The selected zone has a total of 30 public Senior Secondary Schools (girls and boys secondary school). Two schools out of these 30 schools (one girls' school and one boys' school) were selected; the selection was based on their geographical locations, student population and parental background of the student. Two SS II intact classes in each school were selected through flip of coin random sampling techniques. One class in each school was randomly assigned to experimental group and the other to control group. Thus, a total of 144 students formed the sample of the research, where 74 (38 boys, 36 girls) stand for experimental group and 70 (36 boys and 34 girls) stand for the control group.

The instruments used for the study were Pre-Geometry Performance Test (PRE-GPT), Geometry Performance Test (GPT) and Geometry Retention Test (GRT). PRE-GPT contained twenty (20) short

answer type questions. Each question carried 5 marks, giving a total of 100 marks. This instrument served as a pre-test and administered before the commencement of the experiment. The purpose was to measure the group equivalence. After the pre-test, the experimental group was taught the selected Geometry topics for six weeks, (two periods per week) using CAI approach. On the other hand, the control group was taught the same Geometry topics for the same duration but using the conventional method of teaching. Regular mathematics teachers of the selected schools, with comparable teaching experience and qualification, were trained and used as research assistants in teaching the two groups. After the exposure to the different methods of teaching, both groups took GPT. GPT is the posttest and contained 25 multiple choice questions. Each question carried 4 marks, giving a total of 100 marks. The reliability of GPT was found to be 0.87. Two weeks after taking the posttest (GPT), GRT was administered. The choice of two weeks interval to measure retention was based on the recommendation of Tuckman (1975) that a minimum of two weeks interval between posttest and retention test was acceptable. Items in GRT were developed by swapping the items of GPT. GRT was taken to measure the retention ability of the students. Mean, standard deviation and t-test were employed to analyze the collected data. The null hypothesis was tested at α=0.05 level of significance.

Result

Ho_1: There is no significant difference between the mean retention scores of students exposed to Computer Assisted Instruction and those exposed to Conventional Method.

This hypothesis was tested using t-test statistic at $\alpha \leq 0.05$ and df = 142. Table 1 shows the results obtained for Ho_1.

Table 1: Summary of t-test Analysis for Experimental and Control Group in Geometry Retention Test

GROUP	N	Mean	SD	Mean Diff.	df	t-cal	t-crit	P	Decision
Experimental	74	51.11	13.61						
				4.55	142	2.12	1.98	0.00	Significant
Control	70	46.56	12.16						

P = 0.00 < 0.05, t computed = 2.12 > 1.96 t-crit at df 142

According to the Independent t test statistics from table 1, significant difference exist between the mean retention scores of the students exposed to CAI and those exposed to conventional method. Reasons being that the p-calculated value of 0.00 is below the 0.05 alpha level of significance and the computed t value of 2.12 is higher than the 1.96 t-critical at df 142. Their mean retention scores are 51.11 and 45.56 for students exposed to CAI and those exposed to conventional method, respectively with a mean performance difference of 4.55 in favour of those students exposed to CAI. Therefore the null hypothesis which states that there is no significant difference between the mean retention scores of the students exposed to CAI and those exposed to conventional method is hereby rejected.

Summary of the Finding

1. Experimental group taught using CAI retain Geometry concepts better than the control group taught using conventional method of instruction.

DISCUSSIONS

Finding from this study (Table 1) indicated that CAI significantly improved the retention of Geometry concepts among senior secondary school students in Kano State better than the conventional method. Hence, CAI proved to be more effective than the traditional method in enhancing retention ability of secondary school students in geometry. The difference could be attributed to the fact that CAI actively engages students with practical materials, using computer, which leads to learning by doing. No doubt, learning by doing aids memory. This result could also be linked to the fact that geometry software can help students to explore, conjecture, construct and explain geometrical relationships using their various senses and reasoning which could also lead to enhanced retention. This finding confirmed the assertion of Bunkure (2007) that according to some comparative studies of retention, students' scores on delayed tests indicated that the retention of contents learned using CAI is superior to retention under traditional instruction alone. The finding also supported the conclusion of Newcomb in Kajuru and Popoola (2010) that a learner retains 10% of what he read alone, 20% of what he heard, 30% of what he saw and heard while the percentage increase for those who read, see and do things in a practical situation. This finding is also in line with that of Ayuba and Timayi (2018) who found that Computer Based Instruction (CBI) promotes retention in algebraic word problems more than the conventional method.

CONCLUSION

Based on the findings, the study revealed that Computer Assisted Instruction significantly improves retention in geometry concepts among senior secondary school students than the conventional method.

Recommendations

1. Ministries of Education (MOEs) and other Mathematics professional bodies such as Mathematical Association of Nigeria (MAN) should adequately train and re-train secondary school mathematics teachers on the use of CAI in their classrooms.
2. Necessary equipment and facilities for CAI implementation should be made available to schools by MOEs.
3. Mathematics textbooks authors should incorporate CAI in their future publications so as to improve students' retention ability in Geometry.
4. Integrate CAI into mathematics curricula to enhance student retention and understanding.
5. Conduct further research on CAI's long-term effects on student outcomes and its applications in other subjects

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