EFFECT OF COMPUTER GAME ON STUDENTS' RETENTION IN MATHEMATICS: IMPERATIVES FOR IMPROVING THE QUALITY OF SECONDARY EDUCATION IN NIGERIA.

BY
DR. SAMUEL ONYINYECHI NNEJI

DEPARTMENT OF SCIENCE AND COMPUTER EDUCATION
FACULTY OF EDUCATION
ENUGU STATE UNIVERSITY OF SCIENCE AND TECHNOLOGY (ESUT), ENUGU, ENUGU STATE.

Abstract

This study was designed to investigate the effect of Computer Game, a computer aided instruction strategy on secondary school students' retention in mathematics. It was a quasi-experimental study, pretest-posttest, non equivalent groups design. A total of 152 SSII students were sampled from two secondary schools in Agbani education zone. The schools were made up of one rural and one urban schools drawn by purposive sampling while four intact classes were randomly sampled and assigned experimental and control groups. Mathematics Achievement Test (MAT) was used for data collection. The instrument was validated by experts. A reliability of 0 .65 was obtained for MAT using Kuder Richardson 20 (KR-20) formula. Two research Questions and three hypotheses guided the study. Mean and standard deviation were used to answer the research questions while the hypotheses were tested at 0 .05 level of significance using analysis of covariance (ANCOVA). Major findings of the study revealed that students in the experimental group taught mathematics with computer game retained higher than their counterparts who were taught with expository method. There was no significant interaction between teaching strategy and school location with regards to students' retention in mathematics. The findings of this study have vital implications, hence imperative for improving the quality of secondary education in Nigeria were highlighted
Specifically, it was recommended among other things, that mathematics teachers should use computer game for teaching mathematics in secondary schools.

Introduction

Secondary education is the education children receive after primary education and before the tertiary stage. The broad goal for secondary education in Nigeria is to prepare the individual for useful living within the society and higher education. Two major specific objectives of secondary education as stipulated in the National Policy on Education are (1) to provide trained manpower in the applied science, technology and commerce at sub-professional grades and (2) to raise a generation of people who can think for themselves, respect the views and feelings of others, respect the dignity of labour, appreciate those values specified under our broad national goals and live as good citizens, (Adegbenro, 2006).

Undoubtedly, only functional secondary education can achieve these laudable goals and objectives. One cannot talk of functional education without science and technology. The role of science and technology in the achievement of Nigeria's or any nation's educational

objectives and aspirations is, to say the least, most vital. Frankly, one cannot speak realistically of a sound science curriculum without considering the important role of mathematics just as science itself would not have developed to its present stage without mathematics. Summarily, it is unrealistic to think that true character of science can be portrayed without mathematical thinking.

Considering the important role of mathematics as a core and compulsory subject through all levels of educational systems in Nigeria and the worrisome deteriorating state of students' poor retention and their consequent poor achievement in secondary school mathematics, something serious need to be done at no other better time than now. Obviously, students do not achieve high in mathematics because they do not retain very well.

Retention is the noun form of the verb "Retain". Stuz (2005) defined retain as "keep"; "continue to have or hold" or "keep in place". In the same vein, Kulik (2009) defined retain as "keep possession of", "absorb and hold" or "keep in place". It follows, therefore, that retention, which is the act of retaining, maybe defined as the act of "absorbing and holding" or "to continue having or holding". In the context of this work, retention refers to the act of absorbing, holding, or continuing to hold or have facts or things learned.

Several studies have been undertaken to ascertain factors that could enhance or hamper students' retention ability especially in the sciences. Eze and Egbo (2007) investigated the effect of concept mapping method of instruction on students' achievement and retention in chemistry. Pretest – posttest non-equivalent, control groups quasi-experimental design was used for the study. Their findings showed that the students taught with concept mapping method achieved better and retained more of chemistry than those taught with expository method. On problems of retention, Dulton (2000) in Ezeamenyi (2004) asserted that failure to provide enough applications to real life activity and social usage cum poor teaching techniques are strong limiting factors to students' retention in mathematics. Similarly, Gagne (2001) in Ezeamenyi (2004) contended that for improvement of retention of learned materials in mathematics, programmed learning is indispensable. Retention, thus, depends mainly on teaching strategy adopted by the teacher.

Umar (2006) investigated the effect of computer aided drill and practice on students' achievement and retention in mathematics. Results from that quasi-experimental design revealed that students taught through computer aided drill and practice achieved better and retained more of the learned mathematics than those taught with the traditional lecture method. Drill and practice also happens to be one of the characteristics of Computer Game. Ukeje and Obioma (2002) stated that systematic drills and practical applications are attributes of a good mathematical game. In the same vein, Azuka (2009) made a case for the adoption of instructional methods that promote students' involvement and activity in the teaching of secondary school mathematics so as to enhance students' retentiveness.

Finally Obodo (2004) and Ezeamenyi (2004) on relevance of laboratory techniques in mathematics education hinted that such techniques help students in better retention of information and in the development of positive attitude towards mathematics. Both authors further

objectives and aspirations is, to say the least, most vital. Frankly, one cannot speak realistically of a sound science curriculum without considering the important role of mathematics just as science itself would not have developed to its present stage without mathematics. Summarily, it is unrealistic to think that true character of science can be portrayed without mathematical thinking.

Considering the important role of mathematics as a core and compulsory subject through all levels of educational systems in Nigeria and the worrisome deteriorating state of students' poor retention and their consequent poor achievement in secondary school mathematics, something serious need to be done at no other better time than now. Obviously, students do not achieve high in mathematics because they do not retain very well.

Retention is the noun form of the verb "Retain". Stuz (2005) defined retain as "keep"; "continue to have or hold" or "keep in place". In the same vein, Kulik (2009) defined retain as "keep possession of", "absorb and hold" or "keep in place". It follows, therefore, that retention, which is the act of retaining, maybe defined as the act of "absorbing and holding" or "to continue having or holding". In the context of this work, retention refers to the act of absorbing, holding, or continuing to hold or have facts or things learned.

Several studies have been undertaken to ascertain factors that could enhance or hamper students' retention ability especially in the sciences. Eze and Egbo (2007) investigated the effect of concept mapping method of instruction on students' achievement and retention in chemistry. Pretest – posttest non-equivalent, control groups quasi-experimental design was used for the study. Their findings showed that the students taught with concept mapping method achieved better and retained more of chemistry than those taught with expository method. On problems of retention, Dulton (2000) in Ezeamenyi (2004) asserted that failure to provide enough applications to real life activity and social usage cum poor teaching techniques are strong limiting factors to students' retention in mathematics. Similarly, Gagne (2001) in Ezeamenyi (2004) contended that for improvement of retention of learned materials in mathematics, programmed learning is indispensable. Retention, thus, depends mainly on teaching strategy adopted by the teacher.

Umar (2006) investigated the effect of computer aided drill and practice on students' achievement and retention in mathematics. Results from that quasi-experimental design revealed that students taught through computer aided drill and practice achieved better and retained more of the learned mathematics than those taught with the traditional lecture method. Drill and practice also happens to be one of the characteristics of Computer Game. Ukeje and Obioma (2002) stated that systematic drills and practical applications are attributes of a good mathematical game. In the same vein, Azuka (2009) made a case for the adoption of instructional methods that promote students' involvement and activity in the teaching of secondary school mathematics so as to enhance students' retentiveness.

Finally Obodo (2004) and Ezeamenyi (2004) on relevance of laboratory techniques in mathematics education hinted that such techniques help students in better retention of information and in the development of positive attitude towards mathematics. Both authors further

The researcher trained the two regular mathematics teachers in the two secondary schools used in the study for a period of two weeks on the use of computer game. Fore-most, the MAT was administered to all the subjects of the study as pretest. Thereafter, the treatment was administered for a period of six weeks. The experimental group in each school were taught mathematics using the Computer Game, while the control group in each school were taught the same topics with expository method.

At the expiration of the treatment period, the MAT was re-administered to all the subjects as posttest. After two weeks of posttest, MAT was further reshuffled and re-administrated to the subjects of the study for retention scores. The prettest, posttest and the retention tests were all scored by allotting one mark to each correct answer. The total scores were later converted to percentage. The computer game used in this study was a puzzle in which various mathematical shapes were displayed and students were required to name the shapes within ten seconds. The students were shared into two groups. Each group elected two representatives to avoid chorus answer. The group that had higher scores after fifteen attempts won the game.

Results
Research Question One:
What are the mean mathematics retention scores of students in the experimental and control groups?

Table 1: Mean Retention Scores and Standard Deviations of the Experimental and Control groups.

Group	N	Mean	St. Dev.
Experimental	77	66.47	2.10
Control	75	47.03	4.62

The mean retention score and standard deviation for the experimental group were 66.47 and 2.10 respectively. Those of the control groups were 47.03 and 4.62 for mean retention score and standard deviation respectively. By simple face inspection, experimental group seems to have retained more than the control group.

Research Question Two:
What are the mean mathematics retention scores of urban and rural schools' students?
Table 2: Mean Retention Scores and Standard Deviations of Urban and Rural Schools' Students.

Group	N	MEAN	St. Dev.
Urban (Experimental)	42	65.82	2.31
Rural (Experimental)	35	66.01	2.16
Urban (control)	44	46.82	4.18
Rural (control)	31	46.13	4.53

From Table 2, in the experimental group, urban students had mean retention scores of 65.82 and standard deviation of 2.31 while rural students had mean retention score of 66.01 and standard deviation of 2.16. Similarly, in the control group urban students had mean retention score of 46.82 and standard deviation of 4.18 while rural students had mean retention scores of 46.13 and standard deviation of 4.53.

Table 3: ANCOVA Results of the students retention scores with regard to teaching strategy and location.

Sources of variation	Sum of square	DF	Mean Square	F	Sig.	Decision
Intercept	401	1	401	3.111	0.001	S
Covariates	599	1	599	2.101	0.331	S
Strategy	660.900	1	660.900	4.006	0.214	S
Location	51.222	1	51.222	0.342	0.487	NS
Strategy * location	63.400	1	63.400	0.423	0.701	NS
Error	22350.000	149	150.000			
Total	24125.522	152				

8

Where 3 = significant, NS = not significant

From Table 3, the effect of computer game on student's retention in mathematics proved significant while there was no significant interaction between strategy and school location on students retention in mathematics. There was also no significant difference between the mean retention scores of urban and rural schools' students.

The results of this study revealed the following:

1. The students taught mathematics with computer game retained more than their counterparts taught the same topics with expository strategy
2. There was no significant difference between the mean mathematics retention scores of urban and rural schools' students taught mathematics with computer game.
3. There was no significant interaction between teaching strategy and location of schools on students' retention in mathematics.

Discussion of Findings

Findings of this study show that the experimental group retained far better than the control group. Computer game strategy enhanced the retention ability of the students better than the expository strategy. This result agrees with the famous

Chinese proverb which stated "what I hear I forget, what I see I remember, what I do I understand." In the same vein, this result further authenticates the findings of Umar, (2006) and that of Eze and Egbo (2007) whose reports revealed that students taught through computer-aided drill and practice retained better than those taught with the traditional lecture method.

Also, Ukeje and Obioma (2002); Ezeamenyi (2004); Obodo (2004) and Azuka (2009) all made cases for the adoption of instructional methods that promote students' involvement in activity in the teaching of secondary school mathematics so as to enhance students' retentiveness.

Retention is indispensable in the teaching and learning process. People who retain poorly are usually judged as poor learners. Learning as defined by Agbo (2004) is a relatively permanent change in potential behavior which is acquired through practice or experience.Agbo argue that "relatively permanent" in the definition connotes something stored or locked up somewhere, in other words, something retained. Furthermore, "potential behavior" in the definition implies something for a later use and this is the retrieval of something retained.

On problems in retention, Miller (2010) wrote that two major problems exist concerning learners' effort to retrieve learned material. They are Tip-of-th-Tongue phenomenon and confabulation. In Tip-of-the-Tongue phenomenon, sometimes the learner tries to remember something such as a name, a formular, etc. such name or formular he has at the tip of his tongue but not in his memory. Part of the name or formular may be remembered but the rest keep going back. Confabulation is due to over-excitement or high motivation to remember something. In the process he excitedly manufactures a report that seems appropriate and he tends to believe it to be true, whereas it in false or wrong. Infact everyone confabulates to some extent. It therefore follows that any CAI mode such as the computer game used in this study, that elicits higher retention is carefully designed and well utilized to avoid the above problems of retention.

Imperatives for improving the Quality of Secondary Education in Nigeria.

Mathematics has been described variously as "the most perfect of all sciences"; "the mother of all sciences and a science in its own right"; "Queen of all sciences"; "the gate and key to the sciences" and "the science of numbers" (Lakatos, 1986; Mura, 1995; McGinnis, 1996; and Obi, 2001 all in Miller, 2010). According to Kulik (2009), Galileo Galilei (1564-1642) posited that "perfect knowledge is always mathematical".

The federal government of Nigeria on realization of the significance of mathematics made it a core and compulsory subject all through our educational systems. Most importantly, mathematics is not just a pre-requisite for progress through the educational system. It is also a tool for educating the mind. Mathematics develops in her learners, the habit of precise and logical thought, it is used for thinking about and facilitating the learning of all other subjects. It gives the individual a fuller understanding of world around him and this understanding can be applied in solving our day to day problems.

Mathematics do not only deal with rules and properties of numbers. It also reveals how those rules and properties can be applied to solving day to day practical life problems. Good skills and competences in mathematics is, therefore, a great asset to secondary school students.

Chinese proverb which stated "what I hear I forget, what I see I remember, what I do I understand." In the same vein, this result further authenticates the findings of Umar, (2006) and that of Eze and Egbo (2007) whose reports revealed that students taught through computer-aided drill and practice retained better than those taught with the traditional lecture method.

Also, Ukeje and Obioma (2002); Ezeamenyi (2004); Obodo (2004) and Azuka (2009) all made cases for the adoption of instructional methods that promote students' involvement in activity in the teaching of secondary school mathematics so as to enhance students' retentiveness.

Retention is indispensable in the teaching and learning process. People who retain poorly are usually judged as poor learners. Learning as defined by Agbo (2004) is a relatively permanent change in potential behavior which is acquired through practice or experience.Agbo argue that "relatively permanent" in the definition connotes something stored or locked up somewhere, in other words, something retained. Furthermore, "potential behavior" in the definition implies something for a later use and this is the retrieval of something retained.

On problems in retention, Miller (2010) wrote that two major problems exist concerning learners' effort to retrieve learned material. They are Tip-of-th-Tongue phenomenon and confabulation. In Tip-of-the-Tongue phenomenon, sometimes the learner tries to remember something such as a name, a formular, etc. such name or formular he has at the tip of his tongue but not in his memory. Part of the name or formular may be remembered but the rest keep going back. Confabulation is due to over-excitement or high motivation to remember something. In the process he excitedly manufactures a report that seems appropriate and he tends to believe it to be true, whereas it in false or wrong. Infact everyone confabulates to some extent. It therefore follows that any CAI mode such as the computer game used in this study, that elicits higher retention is carefully designed and well utilized to avoid the above problems of retention.

Imperatives for improving the Quality of Secondary Education in Nigeria.

Mathematics has been described variously as "the most perfect of all sciences"; "the mother of all sciences and a science in its own right"; "Queen of all sciences"; "the gate and key to the sciences" and "the science of numbers" (Lakatos, 1986; Mura, 1995; McGinnis, 1996; and Obi, 2001 all in Miller, 2010). According to Kulik (2009), Galileo Galilei (1564-1642) posited that "perfect knowledge is always mathematical".

The federal government of Nigeria on realization of the significance of mathematics made it a core and compulsory subject all through our educational systems. Most importantly, mathematics is not just a pre-requisite for progress through the educational system. It is also a tool for educating the mind. Mathematics develops in her learners, the habit of precise and logical thought, it is used for thinking about and facilitating the learning of all other subjects. It gives the individual a fuller understanding of world around him and this understanding can be applied in solving our day to day problems.

Mathematics do not only deal with rules and properties of numbers. It also reveals how those rules and properties can be applied to solving day to day practical life problems. Good skills and competences in mathematics is, therefore, a great asset to secondary school students.

References

Adegbenro, D. K. (2006). Relative Effectiveness of Models and Computer Assisted Instruction Software in Teaching and Learning of Mathematics in Junior Secondary Schools. *Unpublished M.Sc. (Ed) Thesis,* Federal University of Technology, Minna.

Agbo,c.m. (2004) Effect of Trigoludo on students' Interest in Physics in Enugu State. www. mathscorner.edu.com. retrieved 11/05/15.

Azuka, B. F. (2009) Active Learning in the Mathematics classroom. *Training manual for capacity building workshop for secondary and primary schools' Mathematical Science Teachers.* Abuja: National Mathematical Centre.

Eze, A. E. & Egbo, J. J. (2007) Effect of concept mapping method of instruction on students' achievement and retention in Chemistry. *Nigerian Journal of Functional Education 5 (1).* Nsukka: Ephrata Press Production.

Ezeamenyi, M. V. O. N. (2004) *Facing challenges of the third millennium through varieties in mathematics, science and computer Education.* Enugu: Royal ventures.

Kulik, J. A. (2009) Meta-analytic studies of findings on computer –based instruction. *Technology assessment in Education and training.* New Jersey: Lawrence Erlbaum Associates.

Miller, L. E. (2010) Computer Aided Instruction (CAI). *Journal of Mathematical Sciences.* http://www.mathsedu.org.com.

Obodo, G. C. (2004) *Principles and Practice of Mathematics Education in Nigeria.* Enugu: Academic Forum.

Stuz, M. (2005) Educational Technology. *Journal of Research in Science Teaching.*http://www3.interscience,wiley.com/cgi-bin/abstract/112608296/ABSTRACT.

Ukeje, B. O. and Obioma, G. (2002) *Mathematical Games.* Abuja: National Mathematical Centre.

Umar, A. (2006). *General Principles and methods in Education PDE 103.* Kaduna: National Teachers' Institute.