EFFECTS OF COMPUTER ASSISTED INSTRUCTION ON ACHIEVEMENT IN MATHEMATICS AMONG JUNIOR SECONDARY SCHOOL STUDENTS IN FCT ABUJA

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Abstract
The study investigated the effects of computer assisted instruction on achievement in mathematics among junior secondary school students in FCT Abuja. Two objectives with corresponding research questions and hypotheses formulated to guide the study. Quasi-experimental was used as research design. Two co-educational schools were selected and designated as Experimental with 18 males and 18 females and Control groups with 17 males and 18 females. Reliability coefficient of 0.98 was obtained for Teachers Made Algebra Achievement Test (TMAAT). Computer Assisted Instruction was developed, validated and used to teach the experimental group and thereafter Teachers Made Algebra Achievement Test (TMAAT) was administered to the students. Statistical Package for Social Sciences (SPSS) Version 20 was used to analysis using t-test. The study revealed that there was significant difference between the mean achievement scores of students taught Algebra using Computer Assisted Instruction and those taught using lecture method but there was no significant difference in achievement with regard to gender. Based on the findings, it was recommended that Computer Assisted Instruction should be used in junior secondary schools in Mathematics to enhance teaching and learning processes of both male and female students.

Keywords: Computer, Achievement, Junior Secondary School Students, Mathematics

Introduction

Mathematics is a very crucial subject as it is applied to all fields of human endeavour. It is one of the most important subjects in schools, hence it is a core subject in primary and secondary school levels in Nigeria. Mathematics has all through the years been an important subject both in the role it plays in everyday activities and in its usefulness to other sciences. Mathematics is a body of knowledge centered on concepts such as quantity, structure, space, change and also the academic discipline that studies them (Pierce, 2007). Mathematics is further defined by Pierce as the science that draws necessary conclusions. Other practitioners of mathematics such as Sowmya (2005), maintains that Mathematics is a science of pattern and highly needed in everyday life. According to Agwagah (2008), Mathematics is the study of numbers, shapes, quantity, structure, and change or describe things (Macmillan Dictionary, 2007). Carl Friedrich Gauss (1777-1855) known as the "Prince of Mathematicians" also refers to Mathematics as "the Queen of the Sciences" and the bedrock of other sciences. These definitions emphasize the importance of Mathematics.

However, any laudable achievement in technological development will be hampered if the potential Scientist, Engineers and technologists are not equipped with sound knowledge of mathematics (National Open University of Nigeria, 2006). Therefore, the growing importance of mathematics to Nigeria as a developing country cannot be overemphasized. This could account why one of the objectives of secondary education under the National Policy on Education (2013) is to equip the students with the skills to live effectively in a modern age of science and technology. The nation has therefore placed emphasis on the study of mathematics and technology. Despite the considerable relevance of mathematics to

human existence the enviable position it occupies in the community of disciplines, students achievement in the subject at public examination have continued to worsen year after year (Kolawole & Ilugbusi, 2007).

Poor achievement in mathematics in Nigerian secondary schools has assumed alarming proportions and caused a lot of concern for many years (Aburime, 2009). Over the years, mathematics educators have identified various causes of difficulties in learning mathematics. According to Kurummeh and Achor (2008), the difficulties of students in learning mathematics could be attributed to the approach to which the contents are being presented to the students, the abstractness of mathematical concepts, and poor foundation, among others. Korau (2006) opines several variables ranging from the teaching methods, learners themselves, the teachers, textbooks, the curricula and school environment. However, the poor performance in mathematics according to Nurudeen (2014) is due to the methods of teaching, attitude of the teachers that teach the subject and students' lack of interest in the subject.

Similarly, Adeleke (2007), observed that the rate of students' poor achievement is alarming and equally disturbing and it is most likely that most students have some mathematical knowledge but they may have almost no understanding of the basic structure of mathematics, thereby making them to resort to memorization of mathematical facts and concepts. Adeleke further stressed that one particular area which students' problems have been documented is algebra. Perhaps, this is so because historically, algebra represent students' first exposure to abstraction and symbolism that makes mathematics powerful. It then becomes the duty of the teacher to teach mathematics in a way to encourage the understanding of the required basic structure of mathematics. One way of achieving this is through a careful and thoughtful selection of appropriate teaching strategy that will help students in understanding mathematical concepts, especially in algebra rather than passive reception of ideas.

However, research studies attributed the poor performance of students in examinations mostly to the teaching approach adopted by mathematics teachers in presenting instructions and poor reasoning skills (Gambari & Adegbenro, 2014). Also, according to Nwagbo (2006) lack of interest and inability to visualise mathematics as not complex but logical due to wrong orientation in mathematics. Unavailability of instructional aids and inability of teachers to use them in teaching mathematics at secondary schools in Nigeria is another problem that has resulted to poor performance of students in mathematics (Gambari, 2010). To challenge these factors, various attempts have been made to improve on the students' achievement and poor retentive level of secondary school students in mathematics (Rahmat, 2012). Among the several factors pointed out by Kurummeh et al (2008) as causes of students' poor achievement in mathematics, they seemed to anchor on the teaching method as a major factor hindering mathematics achievement. However, many instructional strategies have been proposed, such as learning by doing, guided inquiry, problem solving and so on.

In Nigeria emphasis is placed on the use of guided discovery instructional strategy (FME, 2013). This instructional strategy is activity oriented and involves practical demonstration. Students are guided by materials and leading questions from the teacher to discover mathematical concepts. Yet over the years, the result of this instructional strategy planned towards improving the quality of instruction in mathematics has been disappointing and seems ineffective. Current studies on how students learn science and science related subjects (mathematics) have proved effective. One of such innovative instructional strategies is the Computer Assisted Instruction approach (Tambade & Wagh, 2008).

The issues connected with the teaching and learning of mathematics has become importance to everyone involved in educational circle including the learners and teachers of mathematics (Meat, 2010). This was why Tokpah (2008) opined that computers could be used in the classrooms to improve students' acquisition of basic skills in specific subject areas, reduce the drudgery of learning by blending text with multimedia, broaden curriculum objective through the use of simulations to aid in problem-based and collaborative learning, enable teachers to strengthen their mode of content delivery, and prepare technology literate citizens for the workplace.

Bangert-Drown (2011) and Batey (2011) in their researches came out with definitions thus; Computer Assisted Instructions (CAI) is a well known and accepted method of teaching/learning and most often refers to drill and practice, tutorials, or simulation activities offered either by themselves or as supplement to traditional teacher directed instructions.
It is equally defined as an interactive instructional technique in which computer is used to present instructions, materials, monitors learning, select additional instructional materials in accordance with individual needs.

Batey (2011) defined Computer Assisted Instructions (CAI) as a teaching process directly involving the computer of instruction in an interactive mode to provide and control the individualized learning environment for each individual student. Computer based instruction has traditionally been composed of four main component (Bangert-drown, 2011).

According to Farooq (2007), during CAI, it is rather a device which provides students with interactive involvement with instructional materials. Therefore, the students might be give various degrees of control over their own learning, instruction could be tailored according to individual student's needs and Feedback on student performance could be stored for further reference. Pedagogic experience has shown that the didactic functions of the computer are by no means limited to simple presentation of information, enabling students to acquire and understand a body of knowledge.

Crowl et al. (2007), Robbyer et al. (2013) and Lepper and Gurtner (2010) revealed that when used in addition to regular instruction, CAI improves academic achievement besides influencing students' attitudes and motivation. Kankaanranta (2005) identified that active participation in the information society presumes novel knowledge, skills, and work approaches from children and teachers alike. CAI approach refers to the use of computer to give course content instruction in the form of drill and practice, tutorials and simulations.

CAI learning also uses a combination of text, graphics, sound and video in the leaning process. It is an interactive instructional technique whereby a computer is used to present the instructional material and monitor the learning that takes place. CAI allows the students to direct their own progress.

Computer Assisted Instruction has been observed to be capable of activating the senses of sight, hearing and touch of the user. This indicates that the computer has the capacity to provide higher interactive potential for users to develop their individual intellect and creative abilities (Ede & Aduwa, 2007). Usman (2014) opined that Computer Assisted Instruction can be used in teaching mathematics in three ways namely: As tutor, tool and tutee. As a tutor, the computer acts as tutor by performing a teaching role. The student is tutored by the computer to increase their skills and knowledge. This application is often referred to as Computer Based Instruction (CBI), Computer Assisted Instruction (CAI) or Computer – Assisted Learning (CAL). The general process is as follows: Presentation of information,

students response, evaluation of the students response by the computer, and determination of what to do next.

The essence of carrying out research is to provide solutions to certain observed problems, this has been done by several scholars in mathematics to enhance academic achievement of students and as knowledge is gained, it is important to consider how students can retain what they have learnt. Retention is remembering what you have learnt after a period of time (Ogbonna, 2007).

Modern psychological studies have shown that gender as a variable relates to performance (Ezeugo & Agwagah, 2000). For instance, Thomas, (2005) observed that boys choose science courses in high schools than girls especially mathematics, chemistry and physics. This is due to the long held view that women are weaker vessels who cannot stand the stress and strain involved in problem solving. However, Spencer (2004), Osemmwinyen (2009) and Iwendi, (2009) found no gender difference in the performance of male and female students in school mathematics. To this end, Ugwu (2005) argued that presently, female are struggling to fight the oppression, suppression and domination by their male counterparts. Thus, there is also the need for further investigation on whether male and female students would respond differently on Algebra when Computer Assisted Instruction is used.

The attempt to take care of poor achievement of students in mathematics inspired some researchers to use computer technology in the classroom. Such researchers include: Mansil and Wiln (2011), Odogwu (2013), Ifeakor (2010), Ezeh (2009). Mansil and Wiln (2011) observed that learners are happier when they engage in mathematics with a sense of personal accessibility, coalescence and application rather than just a body of knowledge and skill. Odogwu (2013) in his own view noted that the computer in teaching creates room for self-checking and that the visual pictures enhance visualization and sensory perception.

Statement of the Problem

The poor achievement of students and lack of retention in mathematics is a great concern to educators, researchers and mathematicians. This is the more reason why researchers are making efforts to see if there will be improvement on students' achievement in mathematics by adopting various methods of teaching mathematics. Their aim of using various methods is because poor method of teaching mathematics has been identified as one of the reasons for poor achievement of students in mathematics. Students equally perform poorly in quadratic equation. There are problems associated with solving quadratic equations like inability to find factors, wrong units, incorrect value of constants, and reading of scales incorrectly and finally the abstract nature of quadratic equation that brings confusion to quadratic expressions. It is in an attempt to remedy this situation that made researchers to suggest the use of methods like- inquiry method, delayed formalization, expository, laboratory and computer in teaching quadratic equation and other areas of mathematics. The use of computer in teaching could be as a tutor, tool or tutee. These modes have been identified as the various modes of using computer in teaching mathematics but the mode that is more effective in teaching and learning of mathematics especially quadratic equation is yet to be ascertained, hence the need to carry out this study to investigate if Computer Assisted Instruction could enhance achievement among Junior Secondary School Students in FCT, Abuja.

Research Questions

The following research questions guided this study:

(i). What is the difference in the mean achievement scores of students taught mathematics using Computer Assisted Instruction and those taught with lecture method?
(ii). What is the influence of gender on Mathematics students' achievement in mathematics when taught using Computer Assisted Instruction?

Research Hypotheses

The following hypotheses were tested at the 0.05 level of significance:

Ho_1. There is no significant difference between the mean achievement scores of students taught mathematics with Computer Assisted Instruction and those taught with lecture method.

Ho_2. There is no significant difference between the mean achievement scores of male and female students taught mathematics with Computer Assisted Instruction.

Methodology

The design for this study was Quasi experimental design. Most importantly, pretest-posttest experimental and control group design was used. It is a non-randomised, non-equivalent experimental and control group design. In this case, intact class was used for the study. The independent variable is the Computer Assisted Instruction, the dependent variables are the students' academic achievement and retention while the moderating variable is gender.

The population of the study comprised all the Junior Secondary School students in Bwari Local Government Area Educational Zone of FCT Abuja. It is made up of 4,343 junior secondary school students in Bwari LGA Educational Zone of FCT, Abuja 2016/2017 sessions. The target population was JSS II students from the selected schools. JSS II was chosen as the target based on the fact that the concept taught was contained in JSS II newly improved syllabus and scheme of work.

The sample for the study was intact classes of the JSS II students of 2017/2018 academic session. Purposive sampling technique was employed to sample two schools. The reason for purposively selecting two schools was because only the two schools have computer facilities and electricity. The two schools selected had up to two streams of JSS II students and from each school, one class was chosen through simple random sampling. Again simple random sampling technique was used to select two intact classes from the schools selected. The researcher with a flip of a coin determined which of the intact classes the experimental group becomes and the one that became the control group. The sample size in this study was 71 male and female students. The Experimental group was 36 students (18 Male & 18 Female) while that of Control was 35 students (17 Male & 18 Female).

Two instruments were used in this study. They are:
(i) Computer Assisted Instructional package
(ii) Teacher Made Algebra Achievement Test (TMAAT)

Computer Assisted Instructional package was written in "Macromedia Dreamweaver 8" as the overall platform. Macromedia Flash utilizes the script symbolic instructional code (language) and presentation that accommodates the interactive instructional process. Other computer programmers and applications that were also utilized during the development process were Microsoft Word 2007 and Macromedia Fireworks 8. Macromedia Flash 8 was used for texts and graphics and for buttons while Macromedia Flash was used for the presentation. The package was developed for junior secondary school mathematics students who used the experimental group. It was developed by the researcher with the support of a computer programmer and it package. It is an interactive self-study format. The Computer

Assisted Instruction was structured to teach three Mathematics concepts. The concepts are: Opening Bracket, Algebraic Expansion and Algebraic Fraction.

The instrument used for this study; is the Teacher Made Algebra Achievement Test (TMAAT). The Algebra Achievement Test was developed by the researcher following the table of specification. The TMAAT consisted of 20 multiple choice test items covering the three methods of Solving Equations. Out of the 20 questions, 7 were of higher order while 13 were of lower order. The pretest was administered before the experiment while the posttest was administered immediately after the treatment.

The Teacher Made Algebra Achievement Test (TMAAT) was subjected to content and face validation. Two lecturers in the Department of Educational Technology, Federal University of Technology validated the test instrument. The content validation of TMAAT was ensured through strict adherence to the test blue print. The test blue print and the unit lesson plans were also validated by experts in Mathematics Education in Department of Science Education from Federal University of Technology, Minna.

The researcher carried out a trial testing of the Teacher Made Algebra Achievement Test and Algebra for reliability coefficient of the instruments. The instruments were administered to a class of JSS II students from a school that is part of the population but not part of the sample size selected for the study. One intact class of 44 JSS II students was used for the trial testing.

The internal consistency of the Algebra Achievement Test was determined using Kuder Richardson Formula 20 (K-R 20) method. Kuder Richardson was used because the test items involved multiple-choice items. The internal consistency coefficient was $r = 0.98$.

The researcher visited the selected school before the commencement of the study to obtain official permission from the school authority. During the visit, the subject teacher were selected for induction as research assistants in the use of Computer Assisted Instruction. This was done a week before the actual study, the study covered a period of eight weeks. The experimental group was taught using Computer Assisted Instruction while the control group was taught the same topic using conventional method.

The pretest was administered before the actual treatment to determine the entry behaviour of the experimental and control groups. Instruction commenced in all the groups in the second week of the experiment. The experimental group was taught using Computer Assisted Instruction by projecting the presentation in the classroom while the control group was taught using the lecture method. After a period of four weeks of treatment, one week was used for revision after which posttest was administered.

The data collected was analysed using descriptive and inferential statistics. The research questions were answered using means (x) and standard deviation (SD). The data collected from the pretest was analysed using t-test to determine entry level of the students. The t-test statistics was also used to analysed the data collected for the posttest at 0.05 level of significance. Statistical Package for Social Sciences (SPSS 20 Version) was used for the analyses.

Results

Research Question One: What is the difference in the mean achievement scores of Mathematics students taught Algebra using Computer Assisted Instruction and those taught with lecture method?

Table 1: Mean and standard deviation of students taught mathematics using computer assisted instruction and those taught with lecture method

Group	N	Mean	Std. dev	Mean diff
Computer Assisted Instruction	36	79.22	4.93	
Lecture Method	35	53.94	12.16	7.2

Table 1 shows that the students taught Mathematics using Computer Assisted Instruction had a mean score of 79.22 with standard deviation of 4.93 while those students taught using lecture method had mean score of 53.94 with standard deviation of 12.16. This implies that the students taught using Computer Assisted Instruction performed better than those taught using lecture method.

Research Question Two: Does gender has any influence on Mathematics students' achievement in Algebra when taught using Computer Assisted Instruction?

Table2: Mean and standard deviation of male and female students taught mathematics using computer assisted instruction and those taught with lecture method

Group	N	Mean	Std. dev	Mean diff
Male	18	78.00	4.90	
Female	18	80.44	4.78	0.12

Table 2 shows that the male students taught Mathematics using Computer Assisted Instruction had a mean score of 78.00 with standard deviation of 4.90 while the female students had mean score of 80.44 with standard deviation of 4.78. This implies that the female students taught using Computer Assisted Instruction performed better than their male counterparts, although the little difference shows that the instructional package is gender friendly.

Hypothesis One: There is no significant difference in the mean achievement scores of Mathematics students taught with Computer Assisted Instruction and those taught with traditional method.

Table 3: t-test analysis of mean achievement scores of mathematics students taught with computer assisted instruction and those taught with traditional method

Group	Variable	N	df	$\bar{X}$	SD	t-value	p-value
Pre-Test	Experimental	36		31.35	6.69		
	Control	35		30.50	5.86	0.63	0.53^{NS}
			69				
Post-Test	Experimental	36		79.22	4.93	11.54	0.00*
	Control	35		53.94	12.16		

* - Significant at 0.05
- NS not significant at 0.5

Table 3 shows the t-test analysis of pretest of experimental and control group (t-value = 0.63, df = 69, P-value >0.05) was not significant. The mean score of the experimental group for posttest was 79.22 and standard deviation was 4.93 while the mean score of control for posttest was 53.94 and the standard deviation was 12.16. This implies that using Computer Assisted Instruction to teach students Mathematics improved their academic achievement compared to using only traditional method. This was why t-test was used to

analysed the posttest of the experimental and control group and the outcome (t-value = 11.54, df = 69, p-value <0.05) was significant, as such hypothesis one was rejected

Hypothesis Two: There is no significant difference in the mean achievement scores of male and female Mathematics students taught with Computer Assisted Instruction in Algebra.

Table 4: t-test analysis of mean achievement scores of male and female mathematics students taught with computer assisted instruction

Group	Variable	N	df	$\bar{X}$	SD	t-value	p-value
Post-Test	Male	18		78.00	4.90		
			34			1.52	0.78^{NS}
	Female	18		80.44	4.78		

NS: Not Significance at 0.05.

Table 4 shows. The mean score of the male group was 78.00 and standard deviation was 4.90 while the mean score of female was 80.44 and the standard deviation was 4.78. the t-value was 1.52 and the P-value was 0.78 (t-value = 1.52, df=69, P-value >0.05), this means it was not significant as such hypothesis two was retained. This implies that using Computer Assisted Instruction to teach students Mathematics have the same effects on both gender.

Discussion

The finding from this study revealed that using Computer Assisted Instruction to teach students Mathematics improved their academic achievement compared to using traditional method. This finding was supported by Tambade and Wagh (2008) who students are better placed in interpretation of formula, graphical computer assisted instruction and interpretation of physics in given situations as compared to the control group students. This finding corroborates the finding of Oladejo, Olosunde Ojebisi and Isola (2011) who observed that student taught with improvised instructional materials obtained the highest achievement score at posttest followed by those with standard instructional materials, while the control group score the lowest.

The finding revealed that there was a significant difference in the mathematics achievement of students taught with the Computer Assisted Instructional package performed better in the Mathematics Achievement Test compared with those who were taught with conventional method. The result would seemingly agree with earlier studies which concluded that students taught mathematics with computer achieved higher cognitively than those taught with conventional method (Adeniyi, 2012). Computer could, therefore, be seen as a tool for effective teaching and learning of Science subjects. CAI can also be seen as effective tool for developing individual cognitive structure, psychomotor and affective abilities.

The findings indicated that there was no significant difference between the performances of male and female students who were taught mathematics with the computer Assisted Instructional package. The male and female students performed equally well. The result agrees with the findings of Abdullahi (2015) who found that gender did not influence students' performance in Science generally.

This was also supported by Gambari and Falode (2011) who revealed that the students taught geometry using computer animation performed significantly better in posttest and retention test than their counterparts taught geometry using instructional model and conventional method respectively.

In the same vein, it was supported by Gambari, Falode and Adegbenro (2014) who found out that there was no significant difference reported in the post-test performance scores of male and female students taught geometry using computer animation and instructional model respectively. These findings indicated that geometry concept in mathematics could be taught and learnt meaningfully through the use of computer animation to both male and female students.But the study contradicts the findings of Bassey, Joshua and Asim (2008) who observed the existence of significant gender achievement gap in favour of the rural male students.

Conclusion

Based on the findings from this study it can be concluded that the use of Computer Assisted Instruction enhanced students' academic achievement in Mathematics at junior secondary school level better than the use of traditional method. It goes to say that the use of Computer Assisted Instruction should be encouraged for use at this level of education. Although, Computer Assisted Instruction does not have any effect as regards to gender.

Recommendations

The following recommendations were made based on the findings of this study:

(i) Since the use of Computer Assisted Instruction enhanced achievement in Mathematics, the Mathematics teachers should use it as one of the strategies to be employed in teaching Mathematics in our schools.

(ii) Workshops/seminars should be organized by Government for Mathematics teachers to enable teachers learn how to use computer in teaching Mathematics.

(iii) Government and Non-Governmental Organizations (NGOs) should provide computers to schools so that every student will have access to computer.

(iv) Parents should equally encourage to buy computers for students to use at home after school hours. This will help students to practice what they have learnt in the school and equally discourage them from engaging in unnecessary activities after school.

(v) Computer programmers and software developers should be encouraged to use mathematics curriculum in the production of software and arranged them according to classes for teaching and learning mathematics.

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