EFFECTIVENESS OF COMPUTER APPLICATION PACKAGE (CAP) ON STUDENTS ACHIEVEMENT IN MATHEMATICS IN SECONDARY SCHOOL

Oluwatomi Modupeola ALADE, Olaotan Oladele KUKU & Oluwakemi Abosede FOLUSHO
[1]Department of Educational Foundations, University of Lagos
[2]Department of Educational Psychology, Federal College of Education (Technical), Akoka

Abstract
The purpose of this study was to determine the effect of the computer-assisted instructional package on the performance of students' in Mathematics in Lagos State. The quasi-experimental pretest-posttest control group research design was used for the study. Sixty (60) students were randomly selected from two Schools, 30 from School A which was the control group and 30 students from School B which was the treatment group. The topics in the treatment group were taught using computer-assisted application package (CAP) while the control group were taught using the conventional method. The treatment for the study was the CAI package while Mathematics Achievement Test (MAT) was used to collect data. Two hypotheses were raised and tested at 0.05 level of significance. Data collected were analysed using mean, standard deviation, mean deviation and analysis of covariance (ANCOVA). The result of the findings revealed that there was a significant difference in the Computer Assisted Instruction (CAI) over the conventional method. More so, the study revealed that gender is a significant factor when planning to improve students' achievement in mathematics. In light of this, it was recommended among others that Mathematics teachers should be encouraged to use the CAP for teaching relevant concepts in Mathematics.

Keywords: Computer-Aided Instruction, Gender, Achievement in Mathematics.

Introduction

The benefit of technology to the world today became possible through the study of science and mathematics. Mathematics is a fundamental part of human knowledge and one of the central planks of the modern technological revolution (Ernest, 2015). Mathematics is widely used throughout the world, in human life and many fields. It is a vital tool in science, commerce and technology. The importance of mathematics to nation-building led the Federal Government of Nigeria to make it a core subject to be offered by students at all levels of education in Nigeria (the Federal Republic of Nigeria, 2013). Furthermore, Okafor (2002) notes that mathematics is compulsory for entry requirement for university education. Intending students into the universities are expected to have credit passes in mathematics to qualify for admission. Some of the roles of mathematics according to Nurudeen (2007), includes its ability to enhance the thinking capabilities of individuals by making them more creative, reasonable, and rational as well as imaginative. Mathematics, therefore, can be said to be the bedrock of technology.

Mathematics is essential in everyday life activities and holds an important position in the curriculum of the Nigerian school system. Despite the relevance and importance of mathematics as a school subject, there is research evidence to show that it is one of the most poorly taught, most hated and least understood subjects in schools (Asikhia, 2010). Studies such as Obodo, (2004), Alade & Kuku (2017) have also shown that Nigerian students' achievement in secondary school mathematics has been relatively low over the years. The low achievement of students in the subject is also evident in their West African Secondary School Certificate Examination (WASSCE). Data from Table 1 shows that out of the average enrolment over 1.6 million candidates between 2012 and 2016, only 38% could achievement a credit pass. These results could be seen as situations where the learners did not

optimally benefit from instructions. This may harm the students who need to apply the benefits of mathematics in their daily encounters as well as those seeking further education.

Table 1: Statistics of May/June (Senior Secondary Certificate Examination) Mathematics Performance (Nigeria) From 2012 to 2016

YEAR	Total no. who Sat for	No. of Students that Obtained	% of Students with	No. of Students	% of Students
2012	1,675,224	819,390	48.91%	852,834	50.91%
2013	1,543,683	555,726	36.00%	987,957	64.00%
2014	1,692,435	529,732	31.30%	1,162,703	68.70%
2015	1,593,442	544,638	34.18%	1,048,804	65.82%
2016	1,544,234	597,310	38.68%	946,924	61.32%
	1,609,804	**Mean (%)**	**38.00%**	**Mean (%)**	**62.00%**

Source: Test Development Division, West African Examination Council (WAEC) Lagos, Nigeria.

As a way out of this ugly situation, the use of microcomputer in the Nigerian classroom for teaching and learning (Mathematics) is gradually gaining recognition as a result of the great educational appropriateness it offers. Abramovich (2013) observes that computer as a teaching tool makes it possible to communicate the presence of momentous mathematical ideas within a seemingly mundane curricular topic and, by the same token, to study traditionally difficult and conceptually rich topics in a new way.

The computer can be used to assist instruction, manage instruction and aid design. However, when a computer is used to assist instruction, it is referred to as 'Computer Assisted Instruction' (CAI). It is an instructional programme presented using a computer or computer system (Ekiregwo, 2001). CAI according to Fakomogbon (2002) is a set of materials put on an audio-visual disk that can be displayed on the computer screen whenever there is a need for students to use them. Ekiregwo (2001) stated some of the benefits of CAI to include making learning exciting, interesting and challenging; encouraging flexibility and individualized learning; as well as automating abilities to give instructions, feedback, evaluation and assessment facilitation. Sanni and Osungbemiro (2004) assert that what makes CAI most interesting is the degree of information between the users and the machine as facilitated by colourful and attractive machine interphase.

Also, with CAI, students can be brought into a computerized environment. Students need to learn to navigate them by practising or playing games on the computer to develop skill with the peripheral devices. To create active learning using CAI, students' must understand them as serials and see how the concepts fit together, combine the information in their minds, apply the information in a useful way, receive feedback and act on the feedback. Since Mathematics is one of the compulsory subjects in Nigerian secondary schools, students need varieties of innovative media to aid perfect understanding of the abstract concepts in the subject. The use of CAI could be one of the innovative means in the teaching of mathematics that would improve their achievement in the subject.

Statement of the problem

The low performance of students in Mathematics at the secondary school level continues to be a crucial problem to the mathematics teachers and this can be attributed to the abstract nature of the subject. The poor achievement of students and their lack of retention skills in mathematics are known facts and are of great concern to educators. Researchers are making a great effort to see if there will be an improvement in students' achievement in mathematics by adopting various methods of teaching the subject. Their aim of using various methods is because a poor method of teaching mathematics has

been identified as one of the reasons for poor achievement of students in mathematics. The use of Computer-assisted instruction (CAI) could bring about improvement in students' achievement by speeding up learning rate, enhancing better retention, and encouraging the development of a better attitude. However, the question is "What could be the effectiveness of computer-assisted instructional package on students' achievement when adopted in teaching mathematics?" The need to find out, whether the use of the computer-assisted instructional package in mathematics could produce any significant difference in the performance of students. It is on this background that the researchers sought to find out, the effectiveness of computer application package on the performance of students in Mathematics.

Purpose

The study examined the effectiveness of computer application package on student's achievement in mathematics in senior secondary school. The study specifically found out:

1. The achievements mean score of students taught with computer application package (CAP) and those taught with the traditional methods of teaching.
2. The difference in the achievements means a score of students taught with computer application package (CAP) and those taught with the traditional methods of teaching based on gender.

Research Questions

1. What are the achievements mean score of students taught with computer application package (CAP) and those taught with the traditional methods of teaching?
2. What is the difference in the achievements mean score of students taught with computer application package (CAP) and those taught with the traditional methods of teaching based on gender?

Research Hypotheses

The following Hypothesis guided the study:

1. The achievements mean score of students will not significantly differ between students taught with computer application package (CAP) and those taught with the traditional methods of teaching.
2. The achievements mean score of students will not significantly differ between students taught with computer application package (CAP) and those taught with traditional methods of teaching due to gender.

Methodology

A quasi-experimental pre-test/post-test control group research design was used for this study. The population of the study consisted of all Senior Secondary 2 students in public senior secondary schools in Lagos State. A multistage sampling process was used to select the sample for this study. The first stage involved using the simple random sampling method to select one of the six Education Districts (or strata) in Lagos State (i.e., Education District 1, 2, 3, 4, 5 and 6). At the end of this stage, Education District 1 was randomly selected. The next stage involved using simple random sampling to select two Local Government Areas out of the three in Education District 1. Alimosho and Ifako/Ijaye Local Government Areas were those chosen. Afterwards, one co-educational secondary school was randomly selected from each of the two Local Government Areas earlier selected. The two schools were named A and B. Random selection was also done between the two schools to choose the

treatment group and the control group. Thirty (30) students from school A were used as the control group while Thirty (30) students from school B were used as the treatment group. These students were randomly selected among those who qualified for participation in the schools after the SS 2 students were pretested.

A major criterion was met by the participants before they were deemed qualified for selection into the experiment. The criterion was that the students who scored below 40% in the pre-test administered using the Mathematics Achievement Test (MAT) was considered eligible for the experiment.

The Mathematics Achievement Test (MAT) was used to obtain relevant data for this study. Mathematics Achievement test was constructed and refined by the researchers. The instrument comprised two sections (Section A & B). Section A aimed at getting the students' background data while Section B comprised 30 multiple-choice items. To align the objectives and content covered with the assessments, a test blueprint was developed based on the students' third term scheme of work for Mathematics by the Lagos State Ministry of Education. Also, only topics of interest to the researchers were focused on. The MAT was content validated using the test blueprint in Table 2. The items in the MAT were given face and content validity by experts in Mathematics Education and Measurement & Evaluation. Item analysis was carried out after the pilot study and the indices of difficulty of the items ranged from 0.2 to 0.8. All discrimination indices were positive values (Ilogu, 2005). The MAT was administered on both the control and treatment groups for pre- and post-tests.

Table 2: Test Blueprint of 30- item multiple-choice Objective Mathematics Test.

Topics	***Weight***	***Knowledge (20%)***	***Comprehension (20%)***	***Application (20%)***	***Analysis (15%)***	***Synthesis (15%)***	***Evaluation (10%)***	***Total***
Mean, median and mode of ungrouped data	35%	2	2	2	2	2	1	11
Mean, median & mode of grouped data	35%	2	2	2	2	1	1	10
Bar charts of ungrouped and histograms of a grouped data	30%	2	2	2	1	1	1	9
Total	100%	6	6	6	5	4	3	30

It should be noted that content validity was established using the Test Blueprint in Table 2. The pilot study was conducted in a school that was selected from the third LGA in Education District I. A test-retest method was used to determine the stability of the instrument. It involved administering the MAT on 50 students twice at three weeks interval. The scores of the two administrations of the tests were correlated using Pearson Product Moment Correlation (PPMC). The correlation coefficient value generated was 0.75.

The main experiment and the tests lasted for four weeks and were carried out in three phases highlighted below.

Phase one (pre-testing period): The baseline assessment scores (from the MAT) made up the pretest scores of the participants in the two schools selected for the study. The MAT consisted of questions on Statistics developed by the researchers. At this pre-testing period, both groups had not been taught the intended topic. This ensured that both groups had not been taught or had an undue privilege that

may distort the experiment. The set criterion for qualification to participate further ensured that the participants would benefit from the experiment.

Phase two (Testing Period): At this stage, both the treatment and control groups were taught based on the topics in the Table of Specification. The treatment group was taught using the computer-aided instruction approach while the control group was taught in the regular traditional way in the classroom. The researchers used the computer room where the programme application software had been installed. The students were instructed using the CIA application to teach the topics. The control group was taught using the direct instruction method which involved the use of classroom and chalkboard. The periods of contact in the groups was 120 minutes per week. The experiment lasted for three weeks.

Phase three (Post testing period): After subjecting the two groups to the experimental conditions, the participants (control and treatment) were given the MAT (Mathematics achievement test) to find out what they had gained on the topics after subjecting them to the experimental conditions.

Descriptive and Inferential statistical tools were used to analyze the data collected. The mean, standard deviation and mean differences were the descriptive analysis tools used. The inferential statistics tool used was the Analysis of Covariance (ANCOVA). The Statistical Package for Social Sciences (SPSS) application was used for the analysis. All hypotheses were tested at 0.05 level of significance.

Results

Hypothesis 1: The achievements mean score of students will not significantly differ between students taught with computer-aided instructions and those taught with the traditional methods of teaching.

Table 3: Descriptive Data on Pre-test and Post-test Scores of Mathematics Achievement of Control and Treatment Groups.

Experimental Group	N	Pre-Test		Post-Test		Mean Difference
		Mean	SD	Mean	SD	
CAI Group	30	36.47	3.98	63.87	11.56	27.40
Traditional Method	30	37.67	4.65	50.50	5.68	12.83
Total	60	37.07	4.31	57.18	8.62	

The result in Table 3 shows that the mean score of the Computer-Aided Instruction (CAI) group was 36.47 while that of the Traditional (Control) Group was 37.67. It also shows that at post-test, the two groups recorded higher mean scores of 63.87 and 50.50 respectively. The result in the Table also shows that the Computer-Aided Instruction Group (CAI) has a higher mean difference (27.40) of the two groups. To determine whether there was a significant difference in their Mathematics achievement scores before and after treatment, and Analysis of Covariance (ANCOVA) was done and the results are presented in Table 4.

Table 4: Analysis of Covariance (ANCOVA) of Mathematics Achievement Scores of the Control and Treatment Groups.

Source	Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	3210.22	2	1605.11	21.38	.000
Intercept	763.68	1	763.68	10.17	.002
Covariate	530.21	1	530.21	7.06	.010
Experimental Group	2967.74	1	2967.74	39.53	.000
Error	4278.75	57	75.06		
Total	203685.00	60			
Corrected Total	7488.98	59			

*Significant, $p< 0.05$; F critical at 0.05 (1, 57) = 4.0

The data in Table 4, shows that a calculated F- value of 39.53 resulted as the difference in achievement in the Mathematics Achievement Test (MAT) among the two groups. Since the F – value of 39.53 greater than the critical value of 4.0 given 1 and 57 degrees of freedom at 0.05 level of Significance, we reject the null hypothesis. This indicates that Achievement mean Scores of Students do significantly differ between students taught with CAI Computer-Aided Instruction and those taught with a traditional method.

Hypothesis 2: The achievement mean scores of students will not significantly differ between students taught with computer-aided instruction (CAI) and those taught with traditional methods of teaching due to gender

Table 5: Descriptive Data on the Effect of Gender and Experimental Conditions on Mathematics Achievement among Participants

Group	Gender	N	Pre-test		Post-test		Mean Difference
			Mean	Std. Dev.	Mean	Std. Dev.	
CAI Group	Male	19	38.00	3.25	67.16	9.23	29.16
	Female	11	33.82	3.84	58.18	13.33	24.36
	Total	30	36.47	3.98	63.87	11.56	27.40
Control Group	Male	17	38.12	4.96	49.59	6.34	11.47
	Female	13	37.08	4.33	51.69	4.66	14.62
	Total	30	37.67	4.65	50.50	5.68	12.83
Total	Male	36	38.06	4.08	58.86	11.89	20.81
	Female	24	35.58	4.35	54.67	9.98	19.08
	Total	60	37.07	4.33	57.18	11.27	20.12

The figures from Table 5 show that the pre-test means value of Mathematics achievement for Male participants was 38 in the CAI group, while that of the Male in the control group was 38.12. In the post-test, the score of the male in the CAI group was 67.16 while the control group had 49.59. These results gave a mean difference of 29.16 and 11.47 for the Male participants in the CAI and Control groups respectively. This result shows that the Male participants in the CAI group have achieved

more than the Male participants in the control group with a mean difference 29.16 while that for the Male control group was 11.47.

For the Female CAI at pre-test level, the mean score was 33.82 while the Female control group at pre-test had 37.08. At the post-test, the Female CAI group had a mean score of 58.18 and the female control group had a mean score of 51.69. This result indicated a mean difference from 24.36 for the female CAI group and 14.62 for the female Control group. This result shows that the Female Participants in the CAI group achieved more than the Female participants in the control group. To determine if these differences are statistically significant, ANCOVA was used to analyze the data as presented in Table 6.

Table 6: Analysis of Covariance (ANCOVA) on the Effect of Gender and Experimental Conditions on Mathematics Achievement among Participants

Source	Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	3549.65	4	887.41	12.39	.000
Intercept	953.27	1	953.27	13.30	.001
Covariate	275.71	1	275.71	3.85	.055
Experimental Groups	2298.58	1	2298.58	32.09	.000
Gender	53.75	1	53.75	.75	.390
Experimental Groups * Gender	304.68	1	304.68	4.25	.044
Error	3939.33	55	71.62		
Total	203685.00	60			
Corrected Total	7488.98	59			

*Significant, $p>0.05$, F critical at 0.05 (1, 55) = 4.0

Evidence from Table 6 above shows that F-calculated value of 4.25 resulted as the interaction effect of gender and the experimental conditions. This calculated F-value is significant since it is greater than the critical F-critical of 4.0 given 1 and 55 degrees of freedom at 0.05 level of significance. Thus, the null hypothesis was rejected, indicating that there is a significant interaction effect of experimental conditions and gender on students Achievement in Mathematics.

Discussion of Findings

Hypotheses 1 stated that achievement means a score of students will not significantly differ between students taught with CAI (Computer Aided Instruction) and those taught with the traditional method. The result led to the rejection of the null hypothesis and accept the alternative hypothesis. This research showed that a significant difference exists in the students' mathematics mean scores when exposed to the Computer-Aided Instruction. There is a significant difference in the result when Computer-Aided Instruction (CAI) and the traditional method were used. The mean value score of the experimental group is higher than the mean value score of the control group in most of the cases. The study provides evidence to support the effectiveness of Computer-Aided Instruction (CAI) in improving the performances of students in Mathematics. This study is in line with the study of Fakomogbon, Adetayo, Oyebode, Enuwa (2014), whose result revealed that the students taught with the Computer Assisted Instructional package performed better in the Mathematics Achievement Test compared with those who were taught with Conventional method. More so, the result would seemingly agree with the studies of Nwanne, and Agommuoh (2017) which result showed that students taught physics with computer-assisted instruction achieved higher cognitively than those taught with the conventional method.

Hypothesis 2 stated that achievements mean score of students will not significantly differ between students taught with computer-aided instruction (CAI) and those taught with traditional method due to gender. This study led to the rejection of the null hypothesis and accept the alternative hypothesis

indicating that there is a significant interaction effect of experimental conditions and gender on students Achievement in Mathematics. The finding also showed several significant interaction effects between gender and experimental conditions among the students in the treatment group. More so, the findings align with that of Taylor, Muller and Vinjevold (2003) who summarized that gender is one of the factors affecting students' performance in Mathematics and that of Tella (2007), who observed a significant difference in academic achievement concerning gender. However, Devine, Fawcett, Szucs, and Dowkers' (2012) study on gender differences in mathematics anxiety and Ayodele (2011) who studied gender difference and performance of secondary students in mathematics were not in agreement. The researchers observed that there exists no difference between the performance of male and female students.

Conclusion

This study has found out that CAI improved achievement in mathematics among secondary school students. This has led credence to the efficacy of CAI in teaching mathematics as a viable alternative to the traditional teaching method. Moreover, CAI provides a powerful tool to support the shift to student-centred learning and is capable of creating a more interactive and engaging learning environment for teachers and learners. Also, the study observed that female students' achievement in mathematics as a result of the use of CAI were better than their male counterparts.

Recommendations

It was recommended that curriculum planners and other relevant stakeholders in education such as Nigerian Educational Research and Development Council (NERDC), Mathematics Association of Nigeria (MAN) should consider a review of the curriculum for Mathematics for secondary schools with a view of incorporating the use of CAI method in our public secondary schools. Besides, continuous professional development training should be given to teachers on the use of computerized instructional media so that they can appropriately use modern instructional technology. Adequate effort should be directed to equipping and improving computers and internet facilities and other necessary instructional packages for teaching and learning. Consciously arrange learning, assessment and competitive procedure should be adopted to neutralize the disparity in the achievement of male and female students.

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