

EFFECT OF TWO MODES OF COMPUTER AIDED INSTRUCTION ON STUDENTS' ACHIEVEMENT AND INTEREST IN STATISTICS AND PROBABILITY

BY

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Abstract

The study investigated the effects of two modes of Computer Aided Instruction in Mathematics (CAIM) on students' achievement and interest in Mathematics. A non-equivalent quasi-experimental research design was adopted in the study. Specifically, the study adopted pre-test post-test control group design. The study was carried out in Enugu Education zone using a random sample of 250 senior secondary school two (SSS2) students. Two groups were taught using Computer Aided Instruction in Mathematics; the treatment group was taught using drill and practice method and the control group were taught using tutorial method. The study was guided by four research questions and four null hypotheses tested at 0.05 level of significance. Data for the achievement in mathematics were collected using Statistics and Probability Achievement Test (SPAT) while data on interest were collected using Statistics and Probability Interest Inventory (SPII). Research questions were answered using mean and standard deviation while hypotheses were tested using analysis of co-variance (ANCOVA). The findings reviewed that students performed better as well as show more interest in solving mathematics problems when the drill and practice method of Computer Aided Instruction in Mathematics (CAIM) was used then when the tutorial approach was used. Again, the finding revealed that practicing at the computer terminals stimulate students more and helps them retain what they learnt longer, among other issues. It was recommended that government should organize mass computer literacy programme for secondary school mathematics teachers as well as providing adequate number of computers to schools for effective mathematics instruction with computers.

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Introduction

The success of any nation such as Nigeria in the new-millennium goal on science and technology demands that her citizens in formal schools should be competent in manipulating mathematics. Mathematics is viewed as tool for achieving success in scientific and technological development of any nation. Umoingang (1997) viewed mathematics as the springboard for technological and overall national development. Really, without mathematics there is no science there is no technology and without technology there will not be all the factors of modern society (Ukeje, 1997). Probably because of this consideration of the vital contribution of mathematics to the national development the Federal government of Nigeria made the study of mathematics compulsory at all levels of 6-3-3 system of education in Nigeria as indicated in the National Policy on Education (2004) provision.

Despite the importance of mathematics in science and technological advancement of the Nigeria nation, its study in Nigeria secondary school level is bedeviled by incessant poor performance among the students. Really, the problems associated with the teaching and learning mathematics in Nigerian secondary schools have continued to be topical and attract the attention of researchers and mathematics educators. The incessant low achievement in mathematics among Nigerian secondary school students is a clear manifestation of this problem. (West African Examination Council (WASC) Chief Examiners' reports (2005-2006), Bot, 2011; Imoke and Anyagh, 2012, and Unodiaku, 2012).

Harbor-Peters (1992) and Ozofor (2001) reported that poor students performance in mathematics has been more prominent in some aspects of mathematics curriculum content than in others. Such content areas have also been shown to be very difficult to tackle by students. Some topics Harbor-Peters(1988) identified in the senior secondary school mathematics and further mathematics to be difficult to comprehend to students include geometry, number and numeration, algebraic processes, statistics and probability; and calculus. Moreso, Anioke and Ezike (1989) and Obioma (1991) reported that statistics and probability are difficult topics in school mathematics, to students and their teachers alike. Yet more, WAEC Chief Examiner (2006) reported that at the school certificate level students exhibit negative attitude towards probability.

From the experience of the researcher, students still find mathematics difficult especially statistics and probability aspects. Some mathematics educators (Nwosu, 1989; Adichie, 1990; Onubuogu, 1990, and Ezeilo, 1991) reported that poor performance of students in probability may be attributed to poor methods of presenting the concepts. A method such as the Computer Aided Instruction in Mathematics (CAIM) has been considered to be efficient in teaching specific identified topics in mathematics (Emerson and Forbes, 1991; and Ozofor, 2001), especially statistics and probability. The reason for the choice of this alternative method is that the research on tutorial (TR) and Drill-Practice method of Computer Aided Instruction in Mathematics (CAIM) invoked, and with many states in Nigeria, using computers to teach school mathematics can then be initiated in all schools.

Moreso, with some states government such as Enugu, Imo, Anambra, Abia, Lagos, Oyo and Adamawa state pressing on their teachers of science and mathematics to become computer literate (at least at computer appreciation level), one would see the probability of utilizing computer in teaching and learning mathematics.

The tutorial package demands self contained and guided instructional program. The program requires little or no assistance from the teacher(s) of mathematics (Mathematics Teacher, 1972). The computer monitor or screen has to be operationally in order to enable a proper display of the concepts to be learnt. The students should be properly taught on the use of the major function keys of the computer keyboard. The tutorial method is a type of programmed learning, using Stimulus-Response theory of learning. On the other hand, the Drill-Practice Approach demands the teacher's expertise in introducing and developing the concepts to be taught in a one-third lesson time. After the introduction, the students would begin to practice using the instructional terminals (keyboard). The Drill-Practice method is developed following the Gestalt theory of learning. The Drill-Practice method involved four levels of control: content selection, Display selection, conscious cognition and meta cognition.

Statistics and probability are aspects of mathematics that teachers are finding difficult to teach. Therefore, the use of Computer Aided Instruction in Mathematics (CAIM) may serve as a great relieve to secondary school teachers in search of instructional method for teaching the topics. Hence this study was designed to investigate the effect of two modes of computer Aided Instruction on students' achievement and interest in statistics and probability.

Statement of the Problem

Mathematics is the springboard for technological and scientific development of all nations. But the incessant poor performance of students in both internal and external examinations vindicates that students find mathematics difficult especially difficult topics in school mathematics such as statistics and probability. Difficult in learning statistics and probability has been associated with poor teaching methods teachers use in teaching the topics which failed to arouse the interests of the students in learning the subject. To what extent would the use of Drill-Practice or Tutorial approaches in Computer Aided Instruction be effective in improving students' achievement in statistics and probability? Moreso, how would male and female students perform when exposed to the drill-practice or tutorial approaches in computer aided instruction? And more crucially, would their use elicit and sustain higher interest in learning the concepts of statistics and probability?

Purpose of the Study

This study sought to investigate the effect of two modes of computer aided instruction on students' achievement and interest in statistics and probability. The objectives of this study are to find out:

- i. The effect of Drill/practice (DP) and Tutorial methods on students achievement in statistics and probability.
- ii. The effect of Drill/practice (DP) and Tutorial methods on students interest in statistics and probability.
- iii. The impact of Drill/Practice method on the mean interest score of male and female students in statistics and probability.
- iv. The impact of Drill/Practice on the mean interest score of male and female students in statistics and probability.

Scope of the Study

The study is limited to two modes of Computer Aided Instruction in Mathematics (CAIM) on students' performance in statistics and probability. Moreso, it is limited to senior secondary school two (SS2) students. The statistics and probability covered four content areas viz: measures of central tendency, measures of variability, set theories and case of simple events, and problems on probability.

Research Questions

The following research questions were posed to guide the study.

1. What is the effect of Drill/Practice method on the mean achievement of male and female students in statistics and probability?
2. What is the effect of Drill/Practice and the Tutorial method on students' interest in statistics and probability?
3. What is the impact of the Drill/Practice method on the mean achievement of male and female students in statistics and probability?
4. What is the impact of Drill/Practice on the mean interest score of male and female students in statistics and probability?

Research Hypotheses

The study was guided by the following formulated null hypothese. The hypotheses were tested at 0.05 significant level.

Ho₁: There is no significant difference in the mean achievement scores of students taught statistics and probability using the Drill/Practice and the Tutorial method.

Ho₂: There is no significant difference in the mean interest scores of students taught statistics and probability in the Drill/Practice and the Tutorial method.

Ho₃: There is no significant difference in the mean achievement scores of male and female students taught statistics and probability using the Drill/Practice method.

Ho₄: There is no significant difference in the mean interest scores of male and female students taught statistics and probability using the Drill/Practice method.

Methodology**Research Design**

The design of the study a non-equivalent quasi-experimental design. Specifically, the design is pretest-posttest control group design. The study was carried out in the old Enugu Education zone of Enugu State. The population of the study consisted of 7,048 senior secondary two (SS2) students in the 102 secondary schools in Enugu Education zone of Enugu State.

The sample for the study was obtained through simple random sampling technique. Based on this technique, 5 schools were selected out of the 102 schools. This was followed by randomly selecting a total of 10 intact classes from the 5 schools. This brought the total number of samples

subjects to 250 students used for the study. In each of the five schools, 2 intact classes were randomly drawn from SS 2 classes. Out of the two classes, one class was assigned to be experimental group while the other was assigned to be control group through a simple balloting technique. The experimental group was composed of _____ students while the control group consisted of _____ students. Both groups was composed of 110 males and 140 females used for the study.

The instrument used for data collection was called Statistic and Probability Achievement Test (SPAT). The instrument was subjected to face and content validation processes. The content validation of the Statistic and Probability Achievement Test (SPAT) was ensured through the use of test blue print. The test was vetted by these experts. The instrument was composed by twenty-five objective items selected from the content which includes, the measures of central tendency, measures of variability, permutations and combinations, and application on probability. Interest inventory consisted of ten structured response items. The instrument was field-tried in two secondary schools in Enugu Education of Enugu State using SS2 students. These two schools were not used in the main study.

For the purpose of data collection, the researcher administered the Statistic and Probability Achievement Test (SPAT) instrument to the two secondary schools students (SS2) in Enugu State during trial-testing and data obtained was analyzed using computer software (SPSS, Version 8.0) by applying the Croubach's alpha reliability procedure in calculating the internal consistency reliability coefficient of the Statistic and Probability Achievement Test (SPAT) which yielded 0.9824. Based on the calculated reliability index which was high, the Statistic and Probability Achievement Test (SPAT) was considered a highly reliable instrument for data collection.

In conducting the study, classes in each samples school, were randomly assigned to treatment and control groups. The Computer Aided Instruction in Mathematics (CAIM) and the control group were taught using the tutorial method (TR) in the Computer Aided Instruction in Mathematics (CAIM). The basic resource materials used by the teachers of both experimental and control groups for teaching the lessons are computer machines. At the end of the lesson, achievement test known as the Statistics and Probability Achievement Test (SPAT) was administered to the two groups. The answered samples of the treatment and the control groups were properly evaluated and the scores were distributed according to the groups. In other to ensure valency of the scores, the students' scores of both experimental and control groups were

transformed into standard scores before analyzing the scores. The data generated with the instrument was analyzed using descriptive statistics and ANCOVA technique.

Results

Research questions one and two were answered using Table 1 below.

Table 1: Mean and Standard Deviation of Achievement and Interest of Students in Statistics and Probability.

		Control	Treatment or Experiment
Achievement			
Pretest (SPAT)	\bar{x}	34.928	40.04
	S.D	8.846	5.979
Posttest (Post-SPAT)	\bar{x}	45.688	58.528
	S.D	9.543	7.394
Interest			
PretSPII	\bar{x}	4.155	41.044
	S.D	9.071	8.085
PostSPII	\bar{x}	51.616	61.544
	S.D	12.901	10.085

Table 1 revealed that for the pretest (SPAT), the experimental group taught using Drill-practice, has a mean (\bar{x}) of 40.04 with S.D. of 5.979, and for the control group taught using tutorial (TR) had mean score of 34.928 with S.D. of 8.846.

The Posttest of the experimental group has a mean (\bar{x}) score of 58.28 with S.D. of 7.394, and the control group has a mean (\bar{x}) score of 45.688 with S.D. of 9.543.

The same table 1 revealed that experimental groups taught using Drill/Practice has mean (\bar{x}) interest score of 41.044 with S.D. of 8.088 from the Pre-SPII, while the control group taught using tutorial approach has a mean (\bar{x}) interest score of 42.155 with S.D. of 9.071 from the SPII. From the Posttest scores (SOII), the experimental group scored a mean (\bar{x}) interest of 61.544 with S.D. of 10.085 while the control group scored a mean (\bar{x}) interest of 51.616 with S.D. of 12.901. The table further revealed that the experimental group taught with Drill/Practice had a high mean (\bar{x}) interest score and a smaller S.D. of the interest scores than the control group taught using tutorial method.

This indicates that the students developed greater interest using Drill/Practice as a method of Computer Aided Instruction in Mathematics (CAIM).

Research Questions three and four were answered using tables 2 and 3 respectively.

Table 2: Interaction effect of gender and method on students achievement in statistic and probability.

Gender	Method 1 (T-R)			Method 2 (D-R)		
	\bar{x}	SD	n	(\bar{x}	SD	n
Male	47.42	9.96	55	58.18	8.22	55
Female	44.43	9.04	70	59.03	6.73	70

Table 2 revealed that in tutorial approach male students achieved high mean score compared with their female counterpart but with Drill/Practice, the females achieved high mean score than their counterpart male students.

Table 3: Interaction effect of gender and method on students interest in statistics and probability.

Gender	Method 1 (T-R)			Method 2 (D-R)		
	\bar{x}	SD	n	(\bar{x}	SD	n
Male	54	12.85	55	62.2	13.30	55
Female	49.86	12.45	70	63.8	9.09	70

From table 3 above, it is observed that the female students showed a greater interest in the experimental group with a mean interest score of 63.80 and S.D of 9.09 as against the male students mean interest score of 62.20 and S.D of 13.30.

Hypotheses one to four were answered using tables 4 and 5 below.

Table 4: ANCOVA for students' overall achievement by instructional approach and by gender.

Source of variation	Sum of squares	Degree of freedom	Mean square	Fcal value	Fcrit value
Covariates	5339.637	1	5339.637	81.893	0.000
Main effects	6856.983	2	3428.491	52.528	0.000
Gender	71.462	1	71.462	1.096	0.296
Method	6773.814	1	12401.521	103.889	0.000

2-way Interaction Gender/method	204.901	1	15974.563	3.143	0.078
Explained	12401.521	4	3100.380	47.550	0.000
Residual	15974.563	245	65.202		
Total	28376.084	249	113.960		

From table 4, Fcal. Value = 103.889 is greater than Fcrit value = 0.000 from the F table of 0.5 level of significant. The null hypothesis 1 is therefore rejected. This shows that there is a significant difference between the mean achievement in the performance of students taught with D-P and T-R approached of Computer Aided Instruction in Mathematics.

Table 5: ANCOVA for students' overall interest by instructional approach and by gender.

Source of variation	Sum of squares	Degree of freedom	Mean square	Fcal value	Fcrit value
Covariates	438.928	1	438.928	3.322	0.070
Main effects	6391.296	2	6391.296	24.186	0.000
Gender	649.181	1	649.181	4.913	0.028
Method	5710.543	1	5710.543	43.220	0.000
2-way Interaction Gender/method					
Explained	7037.626	4	1759.407	13.316	0.000
Residual	32371.274	245	132.128		
Total	39409.900	249	158.269		

From table 5, Fcal of 4.913 is greater than Fcritical value of 0.028 from the F-table at 0.05 significant level. The null hypothesis 2 is therefore rejected. This shows that there is a significant difference between the mean interest scores of students taught statistics and probability using Drill/Practice and Tutorial method.

From table 4, Fcal value = 1.096 and is greater than the Fcritical value = 0.296 from the F table at 0.05 level of significant. The null hypothesis 3 is therefore rejected. This implies that the female students significantly performed better than their male counterpart students.

From table 5, $F_{cal} = 43.220$ and is greater than F_{crit} . Value = 0.000 from the F table at 0.05 significant level. Therefore the null hypothesis 4 is rejected. We conclude that there is significant difference in the mean interest scores of males and female students.

Discussion of Results

Based on the findings of the study, it is obvious that the experimental group taught with Drill-practice performed better than their counterparts in control group taught with tutorial method. It was also observed that students from the experimental group understand questions faster, responds sharper and retain their learnt concepts longer. But in the control group where the computer machine served as a tutorial aid many of the students were reduced to simple observers of the computer mystery.

Underwood and Underwood (1999) reported that the more children (students) interact with the computer, the more they think faster, answer questions more logical and retain the contents learnt longer. However, Sinclair (1990) remarked that all the approaches of the computer aided instruction do not yield the same result when they are used in teaching mathematics. In agreement with the findings Forbes (1992) observed that “gifted children” and professional enjoy problem-solving and tutorial approaches than any other computer aided instruction (CAI) modes known. The issue of effect of different modes of computer aided instruction on students’ achievement in mathematics (statistics and probability) appears to be inconclusive and need further enquiring to clarify the notion.

Furthermore, this study revealed that experimental group taught using Drill-practice approach showed more interest in the use of the computer in learning statistics and probability. Moreso, some of the students in control group taught with tutorial approach were stimulated by the way the machine was teaching. This two is consistent with earlier postulate of Akudolu (1996) who reported that students of languages in universities found Computer Assisted Language Learning very interesting and stimulating.

Similarly, O’Shea and Self (1998) found that students of mathematics and language found it easy to use, enjoyed its use and very many of them continued to use it outside the classroom period. Yet more Underwood (1990) reported that teachers use of computers motivated students to learn. Contradicting these reports, Schostak (1988) in his study observed that teachers and students attitude towards computers in education believed that computers in schools does not encourage creativity, invention and discovery. In support of Schostak (1988), Ozofofor (2001) reported that the

ignorance of the teachers in the computer modes got many of the students more confused learning statistics and probability especially those in the control group.

In the study it was observed that while boys performed better in the control where tutorial was used, girls performed better in the treatment group where drill-practice was used. This indicates that the benefit a gender type makes depends on the computer method adopted by the mathematics teacher. The study further revealed that girls performed better and showed more interest in the experimental group where drill-practice approach was used, while boys showed more interest in tutorial approach. The issue of sex differences in mathematics performance appears to be inconclusive. There is need for further enquiry to clarify the notion. This result suggests the establishment of differential norms for both male and female students across the two modes of computer aided instruction on mathematics especially on the aspect of statistics and probability.

Conclusions

The conclusions of this study are made based on the investigated problems. The results of data analysis clearly indicated that students in experimental group achieved higher result in the mathematics interest inventory than students in the control group. Again, experimental group taught with Drill-practice achieved a higher mean score in the SPAT compared with those in the control group taught with tutorial.

Moreso, significant difference was found to exist between the mean achievement in the performance of the subjects taught using Drill-practice and those taught using tutorial approach of CAIM. Girls were found to have performed better than boys in the experimental group taught with Drill-practice. Significant difference was also found between the mean achievement scores of males and females as measured by SPAT ($P < 0.05$) using ANCOVA. Therefore the computer aided instruction is effective in teaching and learning mathematics, particularly statistics and probability aspects.

Recommendations

Based on the findings of the study, the following recommendations were made:

1. Government and educational agencies curriculum designs should make programming languages especially Basic (Q-Basic, Quick Basic0, FORTRAN and COBOL part of the school curriculum in studying English Language and Mathematics.

2. In so far the two modes of computer aided instruction in mathematics have effect on students achievement and interest in mathematics, governments (local, state and federal) should organize mass computer literacy programme for secondary school mathematics teachers as well as supplying enough computers to schools free of charge.

REFERENCES

- Adichie, R. (1990) *Introduction to College Statistics*. Ibadan; Oxford University Press.
- Akudolu, L.R. (1995) *effect of Call in Students Achievement and Interest in French*. Unpublished Ph.D Thesis, University of Nigeria, Nsukka.
- Amoke, A.O. and Ezike, R.O. (1989) *Teaching Senior Secondary School Mathematics Creativity*. In Ohuche and Ali (ed) 91989). Onitsha Summer Educational Publisher Ltd.
- BOT, T.D. (2011) *Students' Attitude towards Problem-solving and Achievement in Mathematics: A Study of some Selected Senior Secondary Schools in Jos, Plateau State in African Journal of Science, Technology and Mathematics Education (AJSTME)*, 1(1), TIMEX Enugu.
- Emerson, A. and Forbes, R. (1991) *Invading the Computer Culture*. Illinois: University Press.
- Ezeilo, (1991) *Understanding Probability*. Ibadan: Y-Books.
- Federal Republic of Nigeria (2004) *National Policy on Education (4th ed.)* Lagos: NERDC Press.
- Harbor-Peters, V.F. (1992) "Identification of Difficult Topics" *Abacus – The Journal of the Mathematical Association of Nigeria* 21(1).
- Imoke, B.I. and Anyagh, I.P. (2012) *Effect of Bilingual Medium of Instruction on students Achievement in Mathematics*. *African Journal of Science, Technology and Mathematics Education (AJSTME)*, University of Nigeria, Nsukka, 2(1), 83-90
- Nwosu, P. (1989) *Intermediate Mathematics for Schools and Colleges*. Enugu Fourth Dimension Publication.
- O'Shea, Tim and Self, J. (1988) *Learning and Teaching with Computers: Artificial intelligence in Education*. Great Britain: The Harvester Press.
- Onubuogu, C. (1990) *Probability Concepts for College Students*. Ibadan: University Press Ltd.
- Ozofor, N.M. (2001) *Effect of Two Modes of Computer Aided Instruction on Students Achievement and Interest in Statistics and Probability* Unpublished Ph.D. Thesis, University of Nigeria, Nsukka.
- Sinclair, L.R. (1990) *Computer Science: A Concise Introduction*. Oxford: Heinemann Newness.
- Ukeje, B.O. (1997) *The challenges of Mathematics in Nigeria's Economic Goals of Vision 2001: Implications for Secondary school Mathematics*. A Paper presented at the 34th Annual National Conference at the Mathematical; Association of Nigeria (MAN), Abuja.

- UmOinyana, E.I. (1997) Maximizing Students Achievement in Mathematics through Multigame Classroom Approach, Proceedings of the 4th Annual Conference of Science Teachers Association of Nigeria (STAN), 226 – 229.
- Underwood, J.D.M and Underwood, G. (1999) Computers and Learning: Helping Children Acquire Thinking skill. Oxford, Basil Blackwell.
- Unodiaku, S.S. (2012) Development and Validation of Mathematics Readiness Test for Senior Secondary School Students. African Journal of Science, Technology and Mathematics Education (AJSTME), 2 (1), 57-69.
- WAEC (2005-6) Chief Examiners' Reports. Yaba: Lagos.