EFFECTS OF COMPUTER- BASED INSTRUCTION ON STUDENTS' PERFORMANCE AND RETENTION ON TRIGONOMETRY AMONG SENIONR SECONDARY SCHOOLS IN SOKOTO STATE, NIGERIA

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Abstract

This study examined the effects of Computer-Based Instruction (CBI) on students' performance and retention on Trigonometry among Senior Secondary School Students in Sokoto state, Nigeria. The study was guided by two research questions and two null hypotheses. Quasi experimental research design involving two groups (experimental and control) was used. The population of the study was twenty seven thousand eight hundred and seventy six (27,876) comprised of Senior Secondary School Two (SS 2) students of the public senior secondary schools in Sokoto Metropolis in Sokoto state. Two (2) coeducational schools were selected using the simple random sampling technique for the study. Two intact classes of SS 2 students were used for the study which involves (52 males and 50 females) respectively. The instrument used for data collection was Trigonometry Performance Test (TPT). The hypotheses were analyzed using the t-test at P ≤ 0.05 level of significance using Statistical Packages for Social Sciences (SPSS). The results showed a significant difference in performance in favour of the CBI group. Also, the CBI group was observed to have better retention ability compared with their counterpart in the control group. Based on the finding's it was recommended that teachers should employ CBI in the teaching of Trigonometry at the SS level to enhance students' performance and retention. Finally, workshops and seminars for mathematics teachers should be organized by the Ministry of Basic and Secondary Education for each educational zone in Sokoto State on the use of CBI.

Keywords: Computer-Based Instruction (CBI), Performance, Retention and Trigonometry

Introduction

Education is considered to be the most powerful tool for all-round development of the human beings. As such, the enlightened nations have to assign priority to education system. The utility of Mathematics made it an inevitable course of school life all over the world. But what a great misfortune with such a significant subject that the majority of school going population is afraid of it (Susan, 2006). This dread of Mathematics is due to callous and weak approach of teaching mathematics. Students who are bright and shining in almost all other subjects of their study should not be blame for this discrepancy. Mathematics taught at secondary level is not compatible with the needs of students and in line with the prevailing boom of technology in Nigeria (Sulman, 2006).

Development of any society comes from educational development in which frequent changes have been made in the pattern of education from time to time to meet the needs of society. The remarkable progress of science and technology and the economy have not been only causing great changes in every aspect of society but also bringing crucial changes in education (Anderson, 2007). Although the textbooks elaborate the concepts logically, comprised of numbers of solved examples, illustrations and exercises, the situation of teaching of mathematics in typical schools of Nigeria is that there is no room for participation, intellectual development, expositions of incorporating derivation, and

theorem-proving exercises in which students verify mathematical facts in a symbolic computation environment. Learning mathematics include solving various types of problems, from those which require performing arithmetical operations to those which require problem solving skills. Students are faced with mathematical trigonometrical problems consisting of both word and numbers as early as the pre-school age and also later in school age. Effective performance and retention of trigonometrical problems requires affective approach (Anderson, 2007).

Mathematics which has been aptly described by many individuals as the queen and servant of all subjects has been of great importance to mankind very many years ago. In contrast to other disciplines, the knowledge of mathematics has a boundless limit in terms of application and usage. In fact, one would regard mathematics as a basic tool in realizing global aspiration in the areas of science and technology. Azuka, and Harbour, (2000) all stressed the importance of Mathematics. They maintained that Mathematics is the foundation of science, and science as the bedrock of modern development is the foundation of technology. Hence for any nation to achieve meaningful technological development there must be effective teaching and learning of Mathematics in the school system.

Neuman (2008) described Mathematics as the language of nature which can satisfy a wide range of interests and abilities. It develops the imagination, and trains individual in a clear and logical thought. It is a challenge with a variety of difficult ideas and unsolved problems, because it deals with questions arising from complicated structures. Today more than ever before, all fields of knowledge are depending on mathematics for solving problems, stating theories and predicting outcomes. It is an indispensable tool in creating new knowledge. Nigeria like any other developing nation is making a swift move towards technological development. However, any loud able achievement in technological development will be hampered if the potential Scientists, engineers and technologists are not fully equipped with sound knowledge of mathematics. Daves (2006) was of the view that new technologies have the potential to support education across the curriculum and provide opportunities for effective communication between teachers and students in ways that have not been possible before. Several studies such as Hussain & Safdar (2008), Groff (2013) and Scott (2015) argued that the use of new technologies in the classroom is essential for providing opportunities for students to learn and operate in an information age.

It is evident, as Daves (2006) argued that traditional educational environments do not seem to be suitable for preparing learners to function or be productive in the workplaces of today's society. She claims that organizations that do not incorporate the use of new technologies in schools cannot be seriously claimed to prepare their students for life in twenty-first century. Due to the importance of computer in our classrooms and the entire school system, the possible obstacle to the integration of these technologies in schools would be an important step in improving the quality of teaching and learning. However, current research would suggest that the use of computer will necessarily transform science education. The improvements in the capabilities of computers and advances in telecommunication technology tools have important implications for education in mathematics and technology. The ever-increasing sophistication in computing and telecommunications technologist has led to questions that challenge the spatial and temporal boundaries (Jonassen, 2005).

Information and communication technology (ICT) now offers the possibility for learning and teaching to take place in new settings and to inspire and facilitate lifelong education. The Information and Communication Technology (ICT) has become the basis of any other technology, mode of delivery communication and interaction. According to UNESCO (2002), Information and Communication Technology is defined as the combination of informatics technology (technological applications of informatics in society) with other related technologies, specifically communication technology. Therefore, making use of computer, internet, websites, e-mails chatting, online programs and educational software comes under Information and Communication Technology (ICT). Information and Communication Technology (ICT) enables students to work at their own pace with continuous assessment, in contrast to the traditional teaching methods which can be described as batch-processing with episode assessment. Continuous assessment allows teachers to pinpoint the areas where students falter- and incase of some multi-media programs, those areas trigger further practice automatically so that students receive more instructions "just in time" when they need it most (Susan, 2006).

Studies of the scholars such as Akcay and Unal (2009) and Wekesa (2017) reported that CBI improves students' learning outcomes especially in science- based subjects like mathematics. Also Olga, (2008) and Gambari, Falode & Adegbenro (2014) asserted that innovative methods involving CBI enhances students' retention of trigonometry concepts of senior secondary school students. It will be quite imperative to look for a computer related teaching approach which could make the teaching of mathematics more useful, interesting and meaningful. Hence Trigonometry should be taught with a computer related teaching approach.

The persistent poor performance of senior secondary school students in terminal and Senior Secondary School Certificate Examination (SSCE) in mathematics and trigonometry in Sokoto state, Nigeria has been a major concern for parents, Science educators and Government who spent a lot of money in funding education but to no avail. Also, other problems comprise blaming the curriculum, mathematics teachers and methods of teaching rather than student's lack of capacity to learn. The selection of teaching technique is not an easy task this is because there is no single method that seems to work well for everyone and all situations. In addition, every mathematics teacher should identify appropriate methodology based on the nature of the subject matter and instruction to be given. Most Mathematics teachers use irrelevant and ineffective methods of teaching which are among other factors contributed to students' poor performance in trigonometry which may lead to not having good results to mathematics in general.

The need to find reliable ways of improving students' performance and retention in trigonometry and mathematics is becoming an international issue, this is because the conventional lecture method of teaching mathematics is no longer effective (Bolaji, Kajuru & Timayi, 2015). Consequently, the study explored Computer-Based Instruction (CBI) on student's retention and performance in algebraic word problem an area of mathematics students' have shown lack of understanding.

Objectives of the Study

The following objectives were to determine the:

i.   effects of Computer-Based Instruction on the Performance Senior Secondary School Students taught trigonometry and those taught using lecture method in Sokoto Metropolis in Sokoto State, Nigeria.
ii.   retention ability of Senior Secondary Schools Students taught trigonometry using Computer-Based Instruction and those taught using lecture method in Sokoto Metropolis in Sokoto State, Nigeria.

Research Questions

The following are the research questions:

i.   What is the difference in the Performance of Senior Secondary School Students taught Trigonometry using Computer-Based Instruction and those taught using lecture method in Sokoto Metropolis in Sokoto State, Nigeria?
ii.   What is the difference in the retention ability of Senior Secondary School Students taught Trigonometry using Computer-Based Instruction and those taught using lecture method in Sokoto Metropolis in Sokoto State, Nigeria?

Research Hypotheses

The following null hypotheses were tested at 0.05 alpha level of significance:

H_{01}: There is no significant difference in the Performance of Senior Secondary School Students taught Trigonometry using Computer-Based Instruction and those taught using lecture method in Sokoto Metropolis in Sokoto State, Nigeria.
H_{02}: There is no significant difference in the retention ability of Senior Secondary School Students taught Trigonometry using Computer-Based Instruction and those taught using lecture method in Sokoto Metropolis in Sokoto State, Nigeria.

Methodology

The study utilized the pretest, posttest and post posttest using quasi experimental design involving two groups (experimental and control groups). The population of this study covered all the SS 2 students in Sokoto Metropolis with total of 27,876 students. Two schools were selected using intact classes which comprised of (52 experimental and 50 control) students were used for the study. The selected schools were homogenous with very similar conditions in terms of staffing, provision of equipment, instructional materials and enrolment.

The instrument of Trigonometry Performance Test (TPT) developed by the researchers was validated by experts in mathematics education and was also used for data collection. TPT had a reliability index of 0.789 from the Persons' Product Moment Correlation (PPMC). The treatment period lasted for six (6) weeks after which the post test was administered. The post-posttest was administered two weeks after the posttest. The research questions were answered from the mean and standard deviations scores while the hypotheses were tested using the t-test statistics at $P \leq 0.05$ level of significance by the aid of the computer software Statistical Packages for Social Sciences (SPSS).

Results

The research questions and the corresponding hypotheses were answered and tested using one table. These are presented as follows:

Research Question One

What is the difference in Performance of Senior Secondary School Students taught Trigonometry using Computer-Based Instruction and those taught using lecture method in Sokoto Metropolis in Sokoto State, Nigeria?

Research Question Two

What is the difference in retention ability of Senior Secondary School Students taught Trigonometry using Computer-Based Instruction and those taught using lecture method in Sokoto Metropolis in Sokoto State, Nigeria?

Hypothesis Testing

H_{01}:   There is no significant difference in Performance of Senior Secondary School Students taught Trigonometry using Computer-Based Instruction and those taught using lecture method in Sokoto Metropolis in Sokoto State, Nigeria.

The posttest data generated from TPT were subjected to t-test statistics to test hypothesis one. Summary of the analysis is shown in Table 1.

Table 1:   **Summary of t-test Analysis of Posttest Mean Score of Experimental and Control Groups**

Groups	N	Mean	S.D	df	t-value	P-value	Decision
Experimental	52	58.94	18.78				
				101	4.79	0.001	Reject $H0_1$
Control	50	39.71	20.92				

*Significant at P≤ 0.05

Table1 shows that the experimental group had a mean performance score of 58.94 while the control group scored 39.71. In addition, their respective standard deviation (SD) is 18.78 and 20.92. Clearly, the experimental group outperformed the control group with a mean difference of 19.23. This implies that Computer-Based Instruction as a method of teaching trigonometry in senior secondary schools is more effective compared to the lecture method of teaching trigonometry in senior secondary schools in Sokoto state and Nigeria in general.

The result also revealed that the t-value of 4.79 and P-value of 0.001 were observed at 96 degree of freedom. Since the P-value (0.001) is less than the alpha value of 0.05, it means that there is significant difference between the two groups in terms of their mean performance. Therefore, the null hypothesis one is hereby rejected. It is concluded that the experimental group performed better than the control group in senior secondary schools in Sokoto State, Nigeria.

Research Hypothesis Two

H_{02}: There is no significant difference in retention ability of Senior Secondary School Students taught Trigonometry using Computer-Based Instruction and those taught using lecture method in Sokoto Metropolis in Sokoto State, Nigeria.

The post posttest data generated through TPT administered two weeks after the posttest was subjected to the t-test statistics to determine the retention level of the experimental and control groups. Table 2 presents the summary of the analysis.

Table 2: Summary of t-test Analysis of the Post Posttest Mean Score of the Experimental and Control Groups

Groups	N	Mean	S.D	df	t-value	P-value	Decision
Experimental	52	48.71	18.73				
				101	4.85	0.001	Reject $H0_2$
Control	50	33.69	16.42				

[*]Significant at P≤ 0.05

From the summary of t-test analysis in Table 2, the experimental group had a mean post-posttest score of 48.71 while the control group scored 33.69. In addition, their standard deviation score is 18.73 and 16.42 respectively. This indicates that the students taught using Computer-Based Instruction had better retention ability as compared to those taught by the lecture method of teaching senior secondary school in Sokoto State, Nigeria.

Moreover, the result shows that the P-value of 0.001 is less than the alpha value of 0.05. Consequently, a significance difference exists in the post - posttest mean performance scores in trigonometry between the experimental and control groups in senior secondary schools in Sokoto State. The hypothesis two is hereby rejected.

Discussions

The result of the hypothesis one shows that the students in the experimental group who were taught trigonometry using Computer-Based Instruction performed significantly better and achieved higher scores than their counterparts in the control group also taught trigonometry in senior secondary schools in Sokoto State. This suggests that CBI is more effective in teaching trigonometrical concepts. Therefore, the result of this study has shown that the use of technology in constructivist teaching and learning environment can significantly improve students' academic performance. The findings are in agreement with the findings of Akcay and Unal, (2009) and Wekesa (2017) who found and reported that there was significant difference in the performance of students taught mathematics using CBI. It also tallies with Waxman and Hung (2010) who added that students performed better when exposed to technological based instruction such as the CBI.

The post-posttest score results showed that experimental group taught trigonometry using CBI retained trigonometry concepts better than their counterpart in control group that taught trigonometry using lecture method. This finding is in conformity with that of Olga, (2008) and Gambari, Falode & Adegbenro (2014). This is because understanding and

retention is product of meaningful learning. Hence, when teaching method is effective and meaningful to students, retention is improved upon.

Conclusion

Based on the findings from this study, it was concluded that:

1. Computer-based instruction method is more effective instructional approach in teaching the concept of trigonometry to senior secondary school students Sokoto state.
2. Computer-based instruction improves the performance and retention of students under study in Sokoto state.

Recommendations

Based on the findings, the following recommendations were made:

1. Mathematics teachers should employ the Computer-Based Instruction in the teaching of trigonometry in senior secondary schools in Sokoto state to enhance students' performance and retention ability.
2. Teachers of other science- based subjects such as physics, chemistry and biology should utilize CBI in the teaching primary, secondary and tertiary institutions in Sokoto state.

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