

Effects of Computer Tutor on Students' Achievement and Retention in Basic Science and Technology in Gwagwalada Area Council of the Federal Capital Territory

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Abstract

This study investigated the effect of computer tutor on learners' achievement and retention in Basic Science and Technology (BST). Two research questions and two null hypotheses were formulated to guide the study. The study adopted the quasi-experimental design. The sample for the study was 136 JSII students from four intact classes in Gwagwalada Area Council of the FCT, who served as the subject of the study. The purposive sampling technique was used to select two schools. The instrument used for data collection was Basic Science and Technology Achievement Test (BSTAT). The face and content validation of BSTAT was carried out and content validated. The reliability coefficient of BSTAT was determined using Kuder-Richardson formula 20 (K-R 20), which yielded an internal consistency correlation coefficient of 0.69. Data were collected and analysed with mean, standard deviation and (ANCOVA). Findings revealed that the computer tutor enhanced learners' achievement and retention in BST. Consequently, it was recommended that the computer tutor be used for effective learning and teaching of BST in secondary schools to enhance learners' achievement and learning retention in BST and that computers should be made available in schools by the Government so that every student will have access to computers and make use of them in learning.

Keywords: Computer tutor, achievement, retention, basic science and technology

Introduction

Modern society is characterized by various scientific and technological issues and inventions that play an increasingly a vital function in our daily life. The Revolution of Information and Communication Technology is at the heart of the problems being discussed and regulated in our modern society. The basic understanding of science and technology has therefore become indispensable for citizens' participation and existence in this modern world.

Basic Science and Technology (BST) has all through the years been a vital subject both in the function it plays in our daily activities and in its usage to nation development and technology advancement. The new BST is a product of the reorganising and combination of 4 basic subjects, namely Basic science, Basic Technology, Health and Physical Education and Computer Studies/Information and Communication Technology (ICT). The new BST curriculum according to NERDC (2012) should allow the students to:

- Cultivate positive attitude in science and technology (S & T);
- obtain basic knowledge and skills in S & T;
- use scientific and technological knowledge and skills in meeting contemporary needs of the society;
- take advantage of the various career opportunities made available by S & T;
- prepared for additional studies in S & T;
- stay away from drug abuse and related vices; and
- be security and safety conscious

BST as bases for national advancement can simply be seen as the foundation for man's systematic way of acquiring knowledge and skills in S & T that can be used to understand and explain the natural phenomena such as albinism, rainbow, diffusion, earth rotation, mirage, heat, capillarity, cohesion and adhesion and Newton's laws among others as well as applying the scientific and technological knowledge and skills acquired to meet the contemporary societal needs. BST as a subject was introduced in Nigeria as a result of curriculum reform movement that took place in Nigeria in order to make the teaching and learning of S & T education more useful for national development. (NERDC (2012) stressed that the need for alignment and restructuring of this S & T curricula was as a result of the call for reduction in the number of subjects offered at basic level as recommended by the presidential summit on education. The findings from the curricula implementation in schools indicate that the major causes of curriculum overloading were duplication and repetition of concepts; need to cultivate the use of modern instructional approaches and strategies that encourage creativity and critical thinking in student; need to encourage the view of science and technology at the primary and junior secondary school level in holistic way for better understanding of changes that are taking place in this contemporary world and need to include issues that are emergent such as gender, globalization and entrepreneurial education that are of national and global concern. This need necessitated the development of the new BST curriculum. In order to attain the aim of BST, thematic method to content organization was used by NERDC for

the total presentation of concepts, knowledge and skills in science and technology to students. The topics of the curricula are arranged in sequential and spiral ways, from basics to complex in whole nine years of attending school in order to enhance achievement and retention of learners in technology and science and encourage development of useful learning and skills in learners.

Achievement is the act of showing knowledge achieved or skills developed by learners in a course of study as measured by test scores of students, assigned by instructor or teachers (Ogundokun and Adeyemo, 2010). It is the level of achievement in a specified studying field, for example, in BST (Abakpa, 2011). The researcher argued that performance of students is the act of exhibiting their performance in particular levels of teaching objective outcome of their classroom teaching and experiences. The performance of learners in BST cannot be compromised, because it is vital for the nation economy, labour force production that is literate in science and technology to accomplish the desired changes in nation for sustainability and development (Adejoh, 2008). Atadoga and Lakpini (2013) reported that the repeated poor performance of learners and their negative attitude toward science and technology courses are attributed to their lack of foundation and poor teaching methods used by the science and technology teachers. Adesoji (2008) pointed out that teaching method adopted by science and technology teachers has a vital impact on learners' learning retention and achievement. NECO (2016) also revealed that there is an increase in the percentage of learners who failed BST at junior secondary certificate examination for NECO from 2006 to 2015 in Nigeria. Fakomogbon (2012) stressed that BST students have poor attitude and retention towards the subject. He stressed further that the factors responsible for poor attitude and low retention of learning by students in BST are lack of standard BST laboratory/workshop and poor teaching methods. According to FCT Basic Examination Certificate (JSCE)(2015), many students perform poorly in BST. Adedayo (2001) opined that the problem of learners' failure at basic level of education is usually attributed to teacher's inappropriate use of teaching method, strategies, approaches and techniques, and teachers lack of knowledge of technological innovations in the society. Hence a better teaching of the concept was suggested. The poor performance has also been attributed to poor textbooks, lack of computer technology, lack of knowledge and unavailability of computers (Mansil & Wiln, 1998). They suggested that teachers should be allowed to go more training so as to meet up with the scientific and technological challenges that are taking place in the world and also improve students' achievement in BST.

The attempt to take care of poor performance of learners in BST encouraged some scholars to use computer technology in the classroom to teach and learn science and technology subjects. The computer has the property of being patient and does not care how often the user makes mistakes. According to Odogwu (1999), a student/learner can continue interacting with the computer until a concept is mastered. Ede and Aduwa (2007) noted that the computer can activate the sighting, touching and hearing senses of the learners when using it. This shows that the computer can allow cultivation of individual intellect and creative abilities through higher interaction potential in learners.

The use of computer as an instructional material according to Obodo (2004) adds enrichment, broadens the background of the students and stimulates curiosity in new ideas. The importance of instructional material in teaching is numerous: it helps the teacher to communicate ideas, it provides discovery activities for the student, it adds reality to learning and it makes abstract concepts real. According to Dike (2002), instructional materials are aids which an instructor or a teacher applies in teaching to enable the content of his lesson understandable to the students. The computer being used as instructional material will enhance students' understanding of BST concept; keep students busy and active in the class. It equally stimulates the interest of learners and gives room for effective retention of BST concepts.

Retention is ability to remember what you have being taught or learnt within a specified period of time (Ogbonna, 2007). Retention is an important variable in learning, especially in BST. This is because achievement lasts only when students are able to retain what they have learnt. A student that learns a concept easily and forgets will not perform well in BST. Inability to remember what one has learnt is regarded as a loss of memory. This according to Langer (1997) is failure to remember the past. Many researchers have in the past carried out studies on retention in science and technology subjects (Micheal, 2002; Madu, 2004; Ogbonna, 2007). All viewed retention as important in sustenance of achievement. This is because if a student achieved high in a post-test and when a retention test comes, that student performs poorly, it is an indication that, the student did not register the concept in the long term memory. It is therefore necessary to search for a better strategy that will make students retain what they have learnt in BST.

Huber (2009) argued that human memory is frail and that one major frailty of human memory is that we forget. He suggested that to overcome the frailty of human memory, technology such as computer should be employed to enhance

retention. Since computer technology has been identified as effective in enhancing retention, the researcher deemed it necessary to see the influence of using computer as a tutor on student achievement and learning retention in BST.

Statement of the Research Problem

Poor performance of learners and lack of retention in BST is a known fact and of great concern to educators, researchers, scientist and technologist. Researchers are making great effort to see if the achievement and retention of learners in science and technology can be improved by adopting various approaches of impacting science and technology concepts. Their aim of using various methods is because poor method of teaching science and technology has been identified as the major reason for poor achievement and student inability to retain learning in science and technology. It is in an attempt to remedy the situation that made researchers to suggest the use of methods like inquiry method, expository method, laboratory method and computer in teaching BST and other areas of science and technology. Computer could be used as a tutor when teachers incorporate computer technology into subjects, teachers will then serve as adviser, content expert, and coach. Hence this study investigated the use of computer in enhancing learners' achievement and retention in BST.

Aim and Objectives of the Study

The aim of this study is to ascertain the influence of computer as tutor on students' achievement and retention in BST. Specifically to:

1. Ascertain the effectiveness of using computer and not using computer in learning BST.
2. Ascertain the effectiveness of using computer and not using computer on learners learning retention in BST.

Research Questions

1. What are the mean achievement scores of learners who were taught using computer and those who were taught without computer?
2. What are the mean retention scores of learners who were taught using computer and those who were taught without computer?

Research Hypotheses

H₀₁: There will be no significance difference between the mean achievement scores of learners who were taught with computer and those who were taught without computer.

H0₄: There will be no significance difference between the mean retention scores of learners who were taught with computer and those who were taught without computer.

Research Methods

This study adopted quasi-experimental research design. The design is chosen because it takes care of the threat of internal validity and initial group equivalence and researcher's selection bias, since there was no randomization of the students into groups. In fact classes were used in order not to obstruct the school setting in terms of classroom schedules, and so accommodated the study.

The study was conducted in Gwagwalada Area Council of Federal Capital Territory (FCT), Abuja. Eight Junior Secondary schools (JSS) that have computer facilities and electricity were purposively sampled for the study. The study population is all the JS II students in Gwagwalada Area Council of FCT. According to available records at FCT Education Resource Centre, the total numbers of JSII learners in the nine schools that have computer facilities were 1,109 students. The study sample comprised of 136 JS II students drawn from four schools. The researcher used simple random sampling technique to select one class from each school to make a total of 4 intact classes. Only JS II students were selected. Simple random sampling technique was also used to assign two schools to experimental group and two schools to the control group.

The instrument used for data collection was Basic Science and Technology Achievement Test (BSTAT). Table of specification was followed when developing the instrument. There were 25 multiple choice items and out of the 25 questions, 15 were of higher order while 10 were of lower order. One test was used for pre-test, post-test and retention test. For retention test, adjustment was made in the numbering and the options were equally interchanged. This was to reduce the effect of post-test on the retention test. Test blueprint and test items were subjected to content and face validity. Validators were to look out for the clarity and suitability of test items and restructure or remove any item that was not correctly formulated, ambiguous or double-barrelled statement. The researcher administered the BSTAT to JS II learners in a school in Kuje Area Council of FCT which is outside the Council selected for the study to determine its reliability. The internal consistency was computed using Kuder Richardson formula ($K - R 20$) and recorded a coefficient index of 0.67.

Experimental group were taken to computer room where they were given Intelligent Tutoring Application Software (ITAS) on BST. The software gave tutorial to students like a human tutor. It adopts a “learning-by-doing” approach where the students follow the step-by-step instructions, answer questions and are assessed by the computer. The control group did not use computer. Two graduate teachers of Science and Technology education that are computer literate were used for the study as research assistants. There were two days training for the research assistants where they were taught how to handle the two groups. Two lesson notes were prepared and used for the study by the researcher. The first and second lesson notes were for the experimental group and control group respectively. The lesson note for experimental group tutorial in Intelligent Tutoring application software (ITAS) while the lesson note for control group followed the conventional method. The notes were face and content validated by 2 experts in BST, 2 experts in measurement and evaluation education and 1 expert in Educational Technology. Mean and Standard deviation were used to answer the research questions and ANCOVA was used to test the hypotheses at $P < .05$.

Results

Research Question I

What are the mean achievement scores of students who were taught using computer and those who were taught without using computer?

Table 1: Mean Achievement Scores of Learners who were taught using computer and without computer

Group	N	Pretest	Post-test	Mean gain
Experimental (Computer tutor)	60	8.33	21.35	13.02
Control (Conventional)	76	8.44	14.63	6.19

Table 1 shows the mean achievement score of learners taught using computer as tutor and those who were taught without computer. Learners taught using computer as tutor had a mean of 21.35 and mean gain of 13.02 while students taught without computer had a mean of 14.63 and a mean gain of 6.19. This is an indication that the mean achievement scores of learners taught using computer as tutor is more than the mean achievement score of learners taught without computer. In pre-test, the mean achievement scores of learners taught using computer as tutor and control were 8.33 and 8.44. This indicates that the students were at the same level before the experiment.

Research Question 2

What are the mean retention scores of learners who were taught using computer and those without computer?

Table 2: Mean retention scores of Learners taught using computer and without computer

Group	N	Post-test	Retention	Mean gain
Experimental (Computer tutor)	60	21.35	23.75	2.40
Control (Conventional)	76	14.63	15.24	0.61

Table 2 indicated that the mean retention score of learners taught using computer was 23.75 with a mean gain of 2.40 while learners that were taught without computer had a mean retention score of 15.24 with a mean gain of 0.61. An indication that learners taught using computer retained more learning concepts than those taught without computer.

Research Hypotheses

H0₁: There will be no significance difference between the mean achievement scores of learners who were taught using computer and those who were taught without computer.

Table 3: ANCOVA Table of Students’ scores in Basic Science and Technology Achievement Test (BSTAT)

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Result
Corrected Model	14342.060	4	2775.763	30.314	.000	S
Intercept	19645.113	1	19645.113	293.113	.000	S
Pretest	256.481	1	256.481	2.951	.028	S
Group	19830.030	2	9451.310	99.656	.000	S
Sex	275.413	1	275.413	2.972	.019	S
Group * Sex	69.360	2	45.250	.596	.368	NS
Error	21542.102	129	68.137			
Total	291504.000	136				
Corrected Total	3564.312	135				

S = significant at 0.05 probability level
 NS = Not significant at 0.05 probability level.

Table 3 shows that the adoption of computer in teaching is a significant factor in the mean achievement scores of learners who were taught using computer and

without computer. Because with the 95% confidence interval of difference, the value of F, its degree of freedom and its P-value significant, F value is 30.314, the outcome of the test is significant beyond the .05 level of significant as .000 is less than 0.05. Therefore, the null hypothesis of no significant difference is hereby rejected. This means that there is a significant difference in the mean achievement scores of learners taught using computer and those taught without computer.

Hypothesis 2

H0₂: There is no significant difference between the mean retention scores of learners who were taught using computer and those who were taught without computer.

Table 4: ANCOVA Table of Learners’ Scores on Retention

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Results
Corrected Model	30613.281 ^a	4	4316.440	121.416	.000	S
Intercept	1300.222	1	1300.222	31.032	.000	S
Posttest	11640.151	1	11640.151	286.671	.000	S
Group	531.101	2	271.661	7.314	.000	S
Sex	413.039	1	413.039	12.638	.000	S
Group * Sex	19.715	2	8.326	.289	.512	NS
Error	6215.103	129	25.418			
Total	299610.000	136				
Corrected Total	2916.532	135				

S = significant at 0.05 probability level

NS = Not significant at 0.05 probability level.

Table 4 revealed a significant difference between the mean retention scores of students who were taught using computer and those who were taught without computer. Because with the 95% confidence interval of difference, degree of freedom and the value of p significant, F value is 121.416, and the result of F test is significant beyond .05 level as .000 is less than .05. Hypothesis 4 of no significant difference in the mean retention scores is therefore rejected. Which means that, there is a significant difference in the mean retention scores of learners who were taught using computer and those who were taught without computer? Therefore, learners who were taught using computer retained significantly higher than learners taught without computer.

Discussion of Findings

Results in Table 1 show that learners in experimental group achieved more in BST than learners in control group. This is further confirmed by the result in table 3 which indicated that computer usage is an important factor in the mean achievement scores of learners in BST. It indicates that learners who were taught using computer as a tutor had a higher mean achievement score than those who were taught without computer. This is in agreement with Nwafor & Oka (2016) who carried out a similar study on the effect of computer assisted instruction (CAI) on JSS learners' performance in basic science and the findings of the study revealed that (CAI) as instructional method influenced higher learners' performance in Basic Science than the Traditional method. Thus, this result adopts the computer usage as means for meaningful teaching/learning of BST. This result is also in support of Michael (2002) who indicated that it is good to utilise computer in teaching as it will take care of poor method of teaching and poor textbooks prevalent in schools. Luehrmann (1980) pointed out that computers are either used to tutor learner e.g., tutorial software or to give further practice on particular skills e.g. drill-and-practice software. It can also be observed from table 1 that the mean achievement scores for both the experimental groups and control are generally low. This shows a general poor performance of students in BST which goes to support the FCT Education Resource Centre Report of 2016 and 2017 that students perform poorly in BST and suggested that teachers should intensify effort in bringing out strategies that will improve students' performance for a meaningful teaching and learning of BST.

Results in table 3 showed that learners in experimental group obtained a higher mean retention score compared with learners in control group. This showed that learners that were taught using computers retained more learning than learners that were taught without computer. This result agrees with Micheal (2002) who reported that learners that were taught using computer retained more than learners that were taught using conventional method. The study also concurs with the finding of Suleman, Hussain, Naseer Ud Din and Iqbal (2017) who carried out a study on impact of CAI on Learners' academic achievement in Physics and discovered that (CAI) has a significant positive impact on learners' academic achievement and retention in Physics. More so, Iji (2003), in his own study discovered that learners who utilised Logo and Basic programmes retained more than learners who utilised conventional method. Table 4 indicated that significant difference exist between the mean retention scores of learners that were taught using computer and those that were taught without computer, an indication that CAI has a significant impact on retention of the learners (Cotton, 2001). Research

has also discovered that those learners who use computers possess extensive self-assurance, confidence and are more efficacious and propelled to learn than those learners who are subjected to learn in conventional learning environment (Wishart, 2002). Computers enable learners to focus on the physical meaning of concepts that are abstract, subsequently, to acquire a detail understanding of the theory. (Azar & Şengüleç, 2011; Bayrak, 2008).

Conclusion

The findings of this study provided the empirical evidence that utilizing computer as a tutor enhanced learners' achievement and retention in BST. Thus, the effectiveness of computer in teaching BST also depends on the mode of usage. More so, that the application of computer in learning and teaching BST is better than teaching or learning BST without computer. In general, the use of computer as a tutor has proved to be effective in enhancing the meaningful teaching and learning of BST.

Recommendations

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

1. Pre-service and in-service teacher training programmes must be provided for the development of computer literacy to enable BST teachers use computer in teaching and learning to enhance learners' achievement and retention.
2. Since computer usage as a tutor enhances achievement and retention in BST, the BST teacher should adopt it as one of the strategies to be incorporated in classroom.
3. Government should organize Workshops / Seminars for BST teachers to enable teachers learn how to utilise computer in teaching BST.
4. Computers should be made available in schools, by the Government so that every student will have access to computers and make use of them in learning.
5. Parents and Guardians should equally be encouraged to purchase computers for students' usage at home after normal lessons in schools. This will enable students to engage in further study at home using computer.

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