

FACILITATING ACHIEVEMENTS IN BASIC SCIENCE EDUCATION USING COMPUTER ASSISTED INSTRUCTION IN FEDERAL CAPITAL TERRITORY, ABUJA, NIGERIA

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Abstract

The study examined the effect of Facilitating Achievements in Basic Science Education using Computer Assisted Instruction in Federal Capital Territory, Abuja, Nigeria. Two research questions and three hypotheses formulated guided the study. The population of the study was all public schools in the FCT, Abuja with a target population of 524 Junior Secondary School (JSS 3) Students. A quasi-experimental design was used for the study. Frequency count and percentages were used to analysed the respondents Bio-Data, while mean and standard deviation were used to answer all the two research questions and the three hypotheses were tested using t-test at 0.05% level of significance. Findings from the study among others reveal that there is a significant difference in the post-test achievement scores of students taught Basic Science Education using computer assisted instruction when compared with those taught using conventional strategy; there was a significant difference in the both achievement and attitude of male and female students taught Basic Science Education using computer assisted instruction. The study concluded that students achieved higher in basic science education when taught with computer assisted instruction strategy than when taught with the conventional strategy. Based on the findings of the study, it was recommended among others that CAI software's such as (Amination, illustrator. Graphics) as well as CAI resources such as well-equipped computer laboratories with power sources be made available in all junior public schools in the FCT, Abuja, for effective Basic Science lesson delivery that will in turn enhanced better and higher students' achievement.

Keywords: Computer Assisted Instruction, Basic Science, Amination, Graphics, Laboratories

Introduction

The principles and concepts generated from basic science are very useful in interpretation of natural phenomena in sciences. Achieving the objectives of basic science depends a lot on the mode of teaching strategies adopted by teachers and assessment by both teachers and examination bodies (Takema, 2017). Takema observed that the mode of assessment directly influences teachers' teaching strategies, students' learning styles and attitudes towards practical activities.

The evolving needs of modern workplaces in our industries and the ever - growing non-formal sector which is currently being driven by innovations in science and technology require the acquisition of appropriate scientific and technological skills (Egbujuo, 2012). Science and technology have been identified as a veritable tool for economic emancipation and national transformation. Science educators, as well as researchers, have considerable advanced knowledge on best practices in science teaching and learning. The result is that a lot of information has been generated from which the practitioners of science education can draw inferences in order to make science teaching and learning more effective, meaningful and functional (Egbujuo, 2012).

The focus of basic science instructions is to guide students to an understanding of basic science concepts and to have the ability to apply this knowledge to daily endeavors (Takema, 2018). The introduction of computer assisted instruction is a means of teaching strategy which serve as a

paradigm shift in content standards and pedagogical skills to meet the challenges of local needs and global competitiveness (Takema, 2015). Students' achievement in science solely depends on the mode of teachers' instruction delivery.

Ogunyemi, Ndunna, Ebhohimen and Igbokwe (2018) reported that students are to be made able to acquire scientific knowledge by thinking, analyzing and interpreting observed facts. A new strategy that could trigger the thinking, analyzing and inferring in the students' mind is needed which could be done by using computer assisted instruction strategy. Takema (2015) was of the opinion that computer instruction strategy in science is an intellectually stimulating and a scientifically authentic way which emphasis is given to the ways of acquiring knowledge rather than to the content. This is a shift from the traditional strategy. The author opined that the CAI strategy of teaching science is meant to foster inquiry and manipulative skills in students and discourage rote learning. This strategy embraces other strategies of science teaching and is mainly activity based, superior to those in which students are not actively involved in the learning process (Takema, 2017).

Computer assisted instruction is the use of computer to provide instructional content to learners. There are various programmes designed on CAI that are meant for students' ability levels and others limit advancement until skill mastery is achieved (Adodo & Gbore, 2012). Omajuwa (2011) reveals that there are about 15 science process skills recommended for science curricula, still yet about 70% of the students still experience difficulties in acquiring them. More also, Ajaja (2010) asserted that there are various factors that influence the acquisition of cognitive skills such as science instruction delivery strategy. The teacher plays an important role in learning, including the acquisition of science computer skills. Takema (2017) asserts that, although schools make little difference, that is only approximately 10% in students' achievement, the most important factor affecting students' learning is the teacher. Takema & Famade (2021) identified three main aspects of teacher's role which include; setting up the learning environment; organizing classroom activities; and interacting with students. Among these aspects, the most important aspect is teachers' interaction with students during their teaching.

Students' high achievement in any subject is dependent on some factors such as ways/strategy employed by the teacher in content delivery of such subject, students being motivated by teachers to have interest in the subject taught to them, attitudes of students towards the subject, etc.

Reports of Taber (2010) and Haung (2010) indicate that these research efforts have proposed various strategies and recommendations for improving the quality of science teaching and learning in the classroom. Despite these suggestions for improvement, the effectiveness of science teaching and learning has continued to generate some doubts in the minds of many, considering students negative attitude and poor achievement in the sciences in both internal and external examinations (Achimugu, 2016).

McClelland (1998) proposed that an individual's specific needs are acquired over time and shaped by one's life experience. McClelland explains that people with high achievement motivation tend to be interested in the motivators (the jobs itself). This author explained that man has a strong achievement motive inherent in him. These include the desire to achieve, to produce and to develop skills. McClelland further stressed that whether we are striving for success in work situations, or in personal and social relationships, it is noticeable that some people succeed more than others. The actual

content and the types of competencies sought for within basic science subject contribute to students' perceptions of basic science as well as in achievement.

What makes science learning truly meaningful and achievable is when students consciously and explicitly link new knowledge to relevant concepts already possessed (Afolakemi & Adebisi 2013). Afolakemi & Adebisi were of the view that motivation is a thread in life. In situations where teachers are not motivated to put in their best while teaching may result to poor comprehension of the subject by students and then this may lead to poor achievement on the side of the learner. In the teaching situation, you let your students know you value them by really listening to their feelings, attitudes and intentions towards the subject you as a teacher teaches.

Motivation is another factor that influences the acquisition of science skills which basic science is the foundation of science subjects at the basic education level, therefore students at this level of education need to be motivated (encouraged) in order to have positive attitude towards basic science subject and in turn achieved high (Takema, 2015). The researcher further stated that high achievement of students in basic science is not depended on gender but the zee and proper teaching/learning strategy employed by teachers of various subjects. Takema (2020) was of the opinion that males and females are in fact quite similar on most, though not all, psychological variables. Takema was of the view that the gender similarities stand in stark contrast to the differences model, which holds that men and women, girls and boys, are vastly different psychologically. The gender similarities could be that males and females are alike on most but not all psychological variables. These differences in performance can be attributed, to gender stereotyping which encourages male and female students to show interest in subjects relevant and related to the roles expected of them in the society.

Students' readiness is perceived as learner's developmental level of cognitive functioning. It is the cognitive maturity that is assumed to determine the extent to which learners are capable under consideration in teaching students. Famade (2012) reveals that motivation to learn is an important factor controlling the success of learning and teachers face problems when their students do not all have the motivation to seek to understand due to their negative attitude towards the subject. However, the difficulty of a topic, as perceived by students, will be a major factor in their ability and willingness to learn it.

Achor (2003) revealed that science process skills can be developed by engaging learners in authentic learning activities. These are activities that should provide learners with design investigations for solving these problems. This requires teachers to adopt inquiry-based strategies to science teaching and learning. Therefore, Achor (2003) asserts that science teachers should have the necessary knowledge and skills for planning and executing learning experiences that will expose learners to inquiry experience, thereby allowing them to apply both cognitive and manipulative processes in solving scientific problems; but the problem of inadequate laboratories had made this approach a nightmare.

In Ghana, James & Seidu (2015) worked on promoting teaching and learning in Ghanaian basic schools through ICT which they investigate the extent to which school administration, and teaching and learning are promoted through the use of ICT in Ghanaian basic schools. The findings show that there are relatively low computers at primary schools, 69% of female teachers and 50% of male teachers use ICT tools to teach. The researchers were of the view that the ability of teachers to use

computer to teach and research is weak due to lack of access to internet, electricity/power problem, inadequate number of computers and technical know-how.

Another study done by Ishaya (2014) on Assessment of the Implementation of Integrated Science Curriculum in Junior Secondary Schools in Kaduna State opined that the implementation of the objectives of Integrated Science curriculum has significant impact on teaching and learning in junior secondary schools. In addition, methods and techniques that aid learning in Integrated Science have tremendous effect on teaching and learning of students in junior secondary schools. Furthermore, teachers' qualification and expertise in the use of computer assisted instruction determines the level of students' achievement of integrated science curriculum mastery. The researcher revealed that the inability of teachers of integrated science to effectively utilized the computer for effective teaching and learning in the delivery of integrated science has tremendous effect on the learners' achievement.

The poor achievement of students in basic science has been a major source of concern to all educational stake holders. Some researchers have reported on the factors which tend to affect students' achievement in basic science and have suggested ways in which this poor achievement could be curbed. Among identified factors are: methods of teaching, inadequate instructional facilities, lack of qualified teachers and students' attitude towards basic science. Phobia by students in the subject in general may be as a result of lack of positive attitude to the subject

Some researchers have carried out researches on the use of computer assisted strategy to complement the conventional teaching strategies and have suggested ways which could curb students' high achievement in science subjects both at basic and senior secondary education, in other areas of study, but not in basic science at the junior secondary education level of the FCT Abuja, therefore, there is need to investigate the effect of computer assisted instruction as a tool toward effective basic science lesson delivery and students' achievement in the Federal Capital Territory, Abuja, Nigeria.

The general achievement of students at credit level in Basic School Certificate Examination (BSCE) from the federal capital territory has not been encouraging as indicated in the table below.

Table 1.1: Performance in the Basic Science May/June Basic School Certificate Examination (BSCE) between 2018 to 2022

<i>Year</i>	<i>Total Number of Entry</i>	<i>% pass at credit level (A1 to C6)</i>
2018	875,253	60.25
2019	886,348	64.48
2020	967,428	50.68
2021	986,745	48.42
2022	998,678	56.68

Source: Planning Research and Statistics, Education Resource Center, FCT-Abuja 2022

Table 1.1 shows that for the past five years, the average pass at credit level (A1 – C6) in basic science is 56.1%. Evidently, the performance of the students has not shown any significant improvement except in 2019 when the percentage significantly rose 64.48% and after which there was a decline. Many factors could contribute to this anomaly. Some of the factors may include methods of teaching, inadequate instructional facilities, lack of qualified teachers in the subject area of study, and lack of students' positive attitude towards basic science, lack of well-equipped computer laboratories, power supply etc.

Statement of the Problem

Basic science teaching as a subject at basic education level is most priority in the Nigeria education sector. To meet the standard of education in Nigeria, basic science is one of the major subjects to be offered at the basic education level so as to meet the global competitiveness in the science sector. Students' achievement in basic science is worrisome in the FCT Abuja public schools based on the report from the Basic Education Examination Board. Students' achievement in this subject is at a low level of performance compare to other subjects offered at the basic education level. This low students' achievement in basic science could be as a result of some factors which could hinder students' high achievement in basic science, which may include, lack of qualified teachers with the knowledge of computer instructional strategies, students' low attitude to basic science as a subject, lack of teaching resources like infrastructure, well equipped computer laboratories, power supply etc. The utilization of computer instructional graphics, animations, design applications in basic science lesson delivery is not given much emphasis in the basic secondary schools in the FCT Abuja, especially, regarding the effective application in the basic science 3 which involves the use of computer in the ICT teaching. From the researcher's observation in FCT Abuja basic secondary education schools, students are unable to carry out simple operations on a computer such as using the computer to perform simple graphic illustrations of CorelDraw, painting, application of colors, creating email address, downloading useful and educational images to illustrate basic science-oriented concepts, as well as send and receive messages using a computer system.

Most of the students who knows how to use a computer system tend to play more of games and watch video, and this caught up the attention of the researcher to find out why students at the basic education level in the Federal Capital Territory Abuja, of the 21st century who are to be effectively equipped with computer skills and the technical know-how on the importance of computer as a tool for innovative teaching and learning are not properly guided on the use of computer for education purposes. Hence, this study investigates the effect of computer assisted instruction on basic science lesson delivery and students' achievement in the Federal Capital Territory, Abuja, Nigeria.

Purpose of the study

The main purpose of this study is to determine students' achievements in basic science using computer assisted instruction in Federal Capital Territory, Abuja, Nigeria.

Research Questions

The following research questions were answered in this study

- i. What is the effect of utilization of computer assisted instruction strategy on the basic science students' achievement in the FCT, Abuja Junior secondary schools?
- ii. What is the effect of computer assisted instruction strategy on male and female basic science students' achievement and attitude in the FCT, Abuja Junior secondary schools?

Research Hypotheses

To guide the study, the following research hypotheses formulated were tested at the 0.05 level of significance ($P < 0.05$)

H₀₁: There is no significance difference in the mean achievement of basic science students taught using computer assisted instruction strategy and those taught with the conventional strategy in the FCT, Abuja Junior secondary schools.

Ho₂: There is no significance difference in the mean achievement of basic science male and female students taught using computer assisted instruction strategy in the FCT, Abuja Junior secondary schools.

Ho₃: There is no significance difference in the mean attitude of basic science male and female students taught using computer assisted instruction strategy in the FCT, Abuja Junior secondary schools.

Method

The study used a Quasi-experimental design. The target population of the study comprised all junior secondary school (JSS III) students in the four Council areas from the FCT- Abuja namely: Abaji, 5; Gwagwalada, 8; Kuje, 7 and Kwali, 5. Twenty-five (25) public junior secondary schools were sampled to form the study sample size. Four (4) intact classes from four council area of FCT were used for the study. A stratified random sampling technique was used to select one hundred and thirty-one (131) JSS III students from each of sampled schools which consisted of 524 students who were the respondents. The selection of the schools was done purposefully, because of the homogeneous peculiarities of those schools, since they use the same curriculum, available facilities and teachers of basic science of those schools. Basic Science Achievement Test (BSAT) and the Basic Scienced Attitudinal Questionnaire (BSAQ) research instruments developed by the researcher were used to collect data for this study. The instrument test comprises of two sections.

Section A seeks for personal information on the school and respondent (bio data), while section B consisted of 4 practical items of basic science questions on the selected graphics design of color combination (painting), application of colors, creating email address, downloading useful and educational images to illustrate basic science-oriented concepts, as well as send and receive messages using a computer system, while the BSAQ consisted of 20 item questionnaire, students were expected to choose two out of the four questions and answer, while students were expected to answer all the BSAQ 20 item questionnaire which was intended to measure students' achievements to test their knowledge of basics science under ICT skills and their attitudes towards basic science, these were extracted from BESEC/ Junior School NECO past questions. Both BSAT and BSAQ were subjected to both content and face validity by three experts in science education and two in test and measurement of the Nigerian Educational Research and Development Council (NERDC), Abuja. The instruments were also given to four basic science teachers who have taught basic science for more than five years from junior secondary schools within the study area which were not part of the selected schools for the study, for their valid contributions to the instruments. The experts rated the relevance of each item as an indicator of the construct, pointed out those aspects of the construct that was not covered adequately and also rated the clarity and conciseness of each item.

The basic science teachers in all the sampled schools served as research assistance in administering both BSAT and BSAQ instruments to the selected students. The BSAT and BSAQ were administered to 23 students from government day secondary school Gwagwalada which forms part of the population in the study area but not one of the sampled schools for the main study in order to ascertain the reliability of the instruments by means of pilot study. The instruments were collected on the same day, marked and scored using means and percentages. The level of difficulty of a computer assisted instruction skill was determined by the value of means as follows: means percentages less than 50% ($< 50\%$) as Simple, and means percentages equal to or above 50% ($\geq 50\%$)

as Difficult. The influence of the independent variables, student-related (gender and students' achievement and attitude) and school related (Computer Assisted Instruction lesson delivery) on students' basic science computer assisted instruction skills, was analyzed using t-test statistics. The data obtained was analyzed using Pearson Product Moment Correlation Coefficient (PPMCC). A correlation coefficient of 0.94 was obtained while the adapted attitudinal scale shows a reliability index value of 0.74, which was considered adequate for this study.

A pre-test and post-test treatment were the procedure used for data collection for the main study. Pre-test was the first treatment giving to both control group and experimental group. The two groups were subjected to BSAT as pre-test. A sequential lesson plan was developed by the researcher which was used by the basic science teachers from the selected schools, who served as research assistance for basic science delivery instruction to students of the selected schools for the study. The teaching for the two groups lasted for six weeks, after which the experimental group was exposed to a computer package called CorelDraw under their teachers' supervision and this was installed on computer systems from those schools, while the control group was exposed to the conventional teaching strategy using the same content used for the experimental group by the researcher with the assistance of the research assistance of those selected schools.

A post-test of BSAT was administered to both groups after a period of two weeks. The experimental group was subjected to using a computer system that was installed with CorelDraw to take their test, while the control group were tested using paper, pencil, color, rulers, drawing books.

The results from the two groups were collected and analyzed. Frequencies and percentages were used to analyzed the biodata of the respondents, while the descriptive statistics of mean and standard was used to answer the research questions. Hypothesis 1 was tested using inferential statistics of independent t-test, while sampled t-test was used to test hypothesis 2 and 3 at 0.05 level of significance.

Results

H₀₁: There is no significance difference in the mean achievement of basic science students taught using computer assisted instruction strategy and those taught with the conventional strategy in the FCT, Abuja Junior Secondary Schools.

Table 1: Independent t-test Showing Differences in Mean Post-test Scores of Experimental and Control Groups

Groups	N	Mean	Std. Deviation	<i>t-test for Equality of Means</i>		
				<i>t</i>	<i>df</i>	<i>Sig. (2-tailed)</i>
Experimental	3 45	34.68	4.121	5.286	523	.000
Control	179	33.95	8.467			

$p < 0.05$

Table 1 shows that $p = .000 < \alpha = .05$ at $t\text{-cal} = 5.286$ and $df = 523$. The null hypothesis (H_{01}) is rejected, hence, there is a significance difference between experimental and control group of basic science students taught using computer assisted instruction strategy. Thus, null hypothesis one is rejected. This implies that the experimental group that was subjected to the use of Computer Assisted Instruction Strategy during lesson delivery performed significantly better in favor the experimental students ($\bar{x} = 34.68$).

H₀₂: There is no significance difference in the mean achievement of basic science male and female students taught using computer assisted instruction strategy in the FCT, Abuja Junior secondary schools.

Table 2: Results of Independent Sample t-test of Mean Achievement Scores of Basic Science Male and Female Students Taught using Computer Assisted Instruction Strategy.

Gender	N	Mean	Std. Deviation	<i>t-test for Equality of Means</i>		
				<i>t</i>	<i>df</i>	<i>Sig. (2-tailed)</i>
Male	373	36.79	6.155	5.425	523	.000
Female	151	33.19	8.435			

p < 0.05

Table 2 shows that $p = .000 < \alpha = .05$ at $t_{cal} = 5.425$ and $df = 523$. The null hypothesis (H_{02}) is rejected, hence, there is a significance difference in the mean achievement scores of male basic science students from the female basic science students from in favor of male students ($x = 36.79$).

H₀₃: There is no significance difference in the mean attitude scores of basic science male and female students taught using computer assisted instruction strategy in the FCT, Abuja Junior secondary schools.

Table 3: Results of Independent Sample t-test of Mean Attitude Scores of Basic Science Male and Female Students Taught using Computer Assisted Instruction Strategy.

Gender	N	Mean	Std. Deviation	<i>t-test for Equality of Means</i>		
				<i>t</i>	<i>df</i>	<i>Sig. (2-tailed)</i>
Male	373	23.23	5.653	-3.825	523	.000
Female	151	25.37	6.192			

p < 0.05

Table 3 shows that $p = .000 < \alpha = .05$ at $t_{cal} = -3.825$ and $df = 523$. The null hypothesis (H_{03}) is rejected, hence, there is a significance difference in the mean attitude scores of scores of male basic science students from the female basic science students from in favor of female students ($x = 25.37$).

Discussion of Findings

It is found from table 1 showed that the t-cal value was more than the t-crit value at; 0.05 level of significance. The result indicates that there is a significant difference in the mean achievement scores between experimental and control group of basic science students taught using computer assisted instruction strategy. The findings of this study are in line with that of Ogunyemi, Ndunna, Ebhohimen and Igbokwe (2018) who were of the view that students are to be made able to acquire scientific knowledge by thinking, analyzing and interpreting observed facts. A new strategy that could trigger the thinking, analyzing and inferring in the students' mind is needed which could be done by using computer assisted instruction strategy. The result is also in agreement with that of Takema (2015) who submits that computer instruction strategy in science is an intellectually stimulating and a scientifically authentic way which emphasis is given to the ways of acquiring knowledge rather than to the content. This is a shift from the traditional strategy. The author opined that the CAI strategy of teaching science is meant to foster inquiry and manipulative skills in students and discourage rote learning.

It is also found that there is a significant difference in the mean achievement scores of male and female basic science students taught using computer assisted instruction strategy. The findings of this study agree with that of Takema (2020) who opines that male and female are alike on most but not all psychological variables. These differences in performance can be attributed, to gender stereotyping which encourages male and female students to show interest in subjects relevant and related to the roles expected of them in the society. Also, it is also found that there is a significant difference in the mean attitude scores of male and female basic science students taught using computer assisted instruction strategy. The finding is in agreement with that of Takema (2015) who reveals that students' positive attitude towards basic science subject and high achievement is not depended on gender but the zee and proper teaching/learning strategy employed by teachers of various subjects. Students' readiness is perceived as learner's developmental level of cognitive functioning. It is the cognitive maturity that is assumed to determine the extent to which learners are capable under consideration in teaching students.

The low achievement of basic science students in the end of year 3 basic education examination in the FCT-Abuja which serve as a yard stick for their promotion and placement into the senior secondary education level 1 (SSE 1) could be as a result of students having negative attitude towards the subject and may be associated with basic secondary schools not having well equipped computer laboratories, lack of qualified teachers with computer skills thereby leading to low acquisition of basic science knowledge in the aspect of ICT skills, which has resulted to students' low acquisition of computer skills which has become more evident in the low achievement of students in the subject in their placement examinations into the senior secondary education level. The inability of students to carry out these activities properly results in low scores in the test of practical knowledge. It is hoped that the adoption of the findings of this study in the classroom situation and the awareness of the computer assisted instruction strategy skills in basic science lesson delivery could bring about the much-desired improvement in students' achievement in basic science subject under the ICT topic at the basic education level.

Conclusion

Computer Assisted Instruction strategy is very fundamental to basic science lesson delivery and identifying some of the student and school variables would help greatly to remedy the serious educational gap in bringing the computer skills into the classroom for students' acquisition. Considering the results from the findings of this study that gender, does not influence student' acquisition of basic science under the ICT topic but; students' attitude, properly equipped computer laboratory, and qualified basic science teachers with adequate computer skills for effective basic science lesson delivery have great influence on students' basic science and computer skills acquisition.

Recommendations

Based on the above findings, it is recommended that:

- i. Public junior secondary school's computer laboratories should be properly equipped and expanded by the educational stake holders to accommodate and enable teachers to adopt strategies that will lead students to have the appropriate skills.
- ii. There should be training of physics teachers on acquisition of computer assisted instruction skills so that they could include and imbibe on student-activity centered strategy which promote active learning in basic science and ICT.

- iii. Computer Assisted Instruction software's such as (Amination, illustrator. Graphics) as well as CAI resources such as well-equipped computer laboratories with power sources be made available in all junior public schools in the FCT, Abuja, for effective Basic Science lesson delivery that will in turn enhanced better and higher students' achievement.

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