EFFECTS OF COMPUTER ASSISTED INSTRUCTION ON JUNIOR SECONDARY SCHOOL STUDENTS' ACHIEVEMENT IN BASIC SCIENCE

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Abstract: This study explored the effects of computer assisted instruction as a teaching strategy on junior secondary school students' achievement in Basic Science. Quasi-experimental design was used for the study. Two co-educational schools were drawn for the study through simple random sampling technique. One school was assigned to the treatment group while the other was assigned to the control group through a simple toss of the coin. Basic Science Achievement Test (BSAT) with a reliability score of 0.75 was the instruments used to collect data. Three research questions and three null hypotheses guided the study. The data for the research questions were answered using mean and standard deviation, while the hypotheses were tested using the analysis of Covariance (ANCOVA) at an alpha level of 0.05. The findings of the study revealed that computer assisted instruction as a method of teaching enhanced higher students' achievement in Basic Science than the conventional method. Based on the findings the researchers made some recommendations.

Keywords: Computer Assisted Instruction, Basic Science, Quasi-Experiment, Achievement.

Introduction

The dawn of the 21st century is characterized by digital revolution witnessed in the speed and ease of information transmission, cheaper and better ways of global communication as well as innovative and enhanced means of teaching and learning in the various institutions of learning. These great advancements in technology are the 'brain-child' of the greatest invention in the history of science and technology – the computer.

Computer use in schools has become widespread from primary education through the university level and even in some preschool programs. (Encyclopedia Britannica, 2015)

Oka (2014) posits that information and communication technologies enable man to timely and efficiently increase his speed of operation, interact in flexible ways, utilize his potentials to become innovative and creative. This flexible way of interaction and abilities to become creative and innovative can also be successfully integrated into the educational venture

for effective teaching and learning of sciences. In Alumode (2002), Fafunwa (1964), sees education as the aggregate of all the processes by which a child or young adult develops the abilities, attitudes and other forms of behavior which are of positive value to the society in which he lives. He advised that when evaluating any educational system, one must determine the extent to which it is meeting the needs of a particular society at any given time hence, its effectiveness to the society.

The Encyclopedia Britannica (2014) posits that the use of computers in educational instruction provides one-to-one interaction with a student, as well as an instantaneous response to the answers elicited, and allows students to proceed at their own pace. Computers are particularly useful in subjects that require drill and constant practice. A computer program can be used diagnostically, and, once a student's problem has been identified, it can then focus on the problem area.

Igwe (2003) observed that science cannot be practiced without equipping both the teacher and the students with the adequate knowledge on the resource materials to be used. Computers provide this service to both the teacher and the students in a more fascinating and comprehensive manner.

Computer Assisted Instruction (CAI) is a diverse and rapidly expanding spectrum of computer technologies that assist the teaching and learning process. Examples of CAI applications include guided drill and practice exercises, computer visualization of complex objects, and computer-facilitated communication between students and teachers.

According to Microsoft Encarta (2009) the number of computers in American schools has risen from one for every 125 students in 1981 to one for every nine students in 1996. While the United States leads the world in the number of computers per school student, Western European and Japanese schools are also highly computerized.

The trend is the same in developed nations. There is continual integration of computer in the teaching and learning process bringing about high level of achievement of students academically. Nigeria, as a developing nation must queue into the computer-based method of teaching in her education to be among the League of Nations that are scientifically and technologically stable.

Computer Assisted Instruction (CAI) according to WikiEducator (2008) refers to the use of the computer as a tool to facilitate and improve instruction. It went further to show that there are many terminologies of Computer Assisted Instruction such as; Computer Aided Instruction (CAI), Computer Assisted Learning (CAL), Computer Based Education (CBE), Computer Based Instruction (CBI), Computer Enriched Instruction (CEI), Computer Managed Instruction (CMI) among others.

CAI is a program of instructional material presented by means of a computer or computer systems. Nwafor (2015) states that computer Assisted Instruction (CAI) enables a lesson to be delivered through computer without constant teacher instruction. However, she states that “to make the learning interesting and worthwhile, the computer assisted instruction must be carefully planned. CAI programs use tutorials, drill and practice, simulation, and problem solving approaches to present topics, and they test the student's understanding as Abonyi(2005) posits that there is no activity in the teaching-learning setting that takes place more frequently than measuring and evaluating the learners. Igwe (2003) opines that education has been improved tremendously through the process of Computer Assisted Instruction (CAI). To argue against this statement is to argue against the great developmental strides that man has achieved ever since the invention of computer.

Basic science formally known as Integrated Science is a subject taught at both public and private schools at Junior Secondary School level Nwafor (2012). It is an introduction to the study of the sciences in the Senior Secondary Schools. Basic Science is the study of elementary

biology, anatomy, earth/solar system, ecology, genetics, and physics as a single science subject in the junior secondary school (Answers.com). It offers the basic training in scientific skills required for human survival, sustainable development and societal transformation. Basic Science studies involve bringing together traditionally separate subjects so that students grasp a more authentic understanding.

According to the Science Teachers Association of Nigeria (1970) Nigeria Integrated Science, the objective of Integrated Science(Basic Science) should enable students to be able to:

- Observe carefully and thoroughly
- Report completely and accurately
- Organize information acquired
- Generalize on the basis of acquired information
- Predict as a result of the generalization
- Design experiments (including controls, where necessary to check the prediction).
- Use models to explain phenomena, where appropriate and
- Continue the process of inquiry when new data do not conform to predictions.

To achieve these objectives, it is suggested that the teaching and learning of Basic Science should involve the use of innovative methods in teaching; methods like discovery, problem-solving, field trip and laboratory method among others.

These suggested methods of teaching have been utilized for many years now. However, Nwafor, (2008) stated that results from previous researchers showed that the teaching and learning of Basic Science in Nigeria in general and Ebonyi State in particular have not been encouraging. However, present day statistics on the students' performance tend to show that the teaching and learning of Basic Science as a subject at the Junior Secondary School is still

inadequate. For example, Table 1.1 shows the performance of students in Abakaliki, Ebonyi State in 2009 and 2010.

Table 1.1: Results of Basic Science, 2009 and 2010 in Abakaliki, Ebonyi State

YEAR	DISTINCTION	CREDIT	PASS	FAILED	TOTAL
2009	81	501	1,071	69	1,722
2010	50	553	1,059	82	1,744

Source: Nwafor (2012) *Comparative Study of Students Academic Performance in Junior Secondary School Certificate Basic Science in Public and Private Secondary Schools in Ebonyi State, Nigeria.*

Table 2.2 below also shows the performance of students in Basic Science in Ebonyi State from 2011 to 2013.

Table 2.2: Results of Basic Science, 2011 - 2013 in Ebonyi State

YEAR	DISTINCTION	CREDIT	PASS	FAILED	ABSENT	TOTAL
2011	1470	11136	14418	448	250	27,722
2012	1744	10823	19165	270	116	32,118
2013	1486	8520	18902	450	260	29,618

Source: Ministry of Education, Abakaliki, Ebonyi North Zonal Office, 2015.

It can be deduced from the above information that the performance of the students in Basic Science in Ebonyi State in particular is not encouraging. This status may be attributed to lack of trained teachers, lack of proper teaching materials, absence of conducive teaching and learning environment, inadequate evaluation or probably, the approach/teaching methods used and learning of the subject. The researchers therefore sought to find out the effect Computer Assisted Instruction (CAI), as an innovative method of teaching, will have on the achievement of students in Basic Science in Junior Secondary Schools in Abakaliki, Ebonyi State.

Objectives of the Study

The main purpose of this study is to determine the effect of computer assisted instruction on Junior Secondary schoolstudents' achievements in Basic Science. Specifically, the study explored:

1. The effect of computer assisted instruction on students' achievement in Basic Science.
2. The effect of computer assisted instruction on achievement of male and female students' in basic science.
3. The interaction effect of method and gender on students' achievement in Basic Science.

Scope of the Study

The study was restricted to the effect of computer assisted instruction on Junior Secondary school II (JSS II) students'achievement in Basic Science. The Basic Science lessonstaught during the 8 weeks of the experiment were drawn from the themes: *You and Environment and You and Energy*, as contained in the current syllabus from the national curricular as approved by the NationalCouncil on Education (2007). The sub-topics include: Pollution, Earth Science and Simple Machines.

Research Questions

The following research questions guided the study:

1. What is the effect of computer assisted instruction on the mean achievement scores of students in Basic Science?
2. What is the effect of computer assisted instruction on the mean achievement scores of male and femalestudents' in Basic Science?
3. What is the interaction effect of gender and method on students' mean achievement scores in Basic Science?

Hypotheses

The following null hypotheses were tested at an alpha level of 0.05

$H0_1$: There is no significant difference in the mean achievement scores of students taught Basic Science using computer assisted instruction and those taught using conventional methods.

$H0_2$: There is no significant difference in the mean achievement scores of male and female students' taughtBasic Science using computer assisted instruction method.

$H0_3$: There is no significant interaction between gender and method on students' achievement in Basic Science.

Research Design

The study employed a quasi-experimental research design. Intact classes were used hence no random assignment of subjects. The specific design used isa pretest posttest non-equivalent control group design. There was treatment group (where students were taught using computer assisted instruction) and control group (where students were taught using conventional lecture method). Thedesign is represented thus:

$$\frac{Y^b \; X \; Y^a}{Y^b \; \sim X \; Y^a}$$

Where: Yb = Measurement taken before treatment (Pre-test)

Ya = Measurement taken after treatment (Post-test)

X = Treatment

~X = Conventional Method

The study was conducted in Abakaliki Education Zone. Ebonyi State is divided into three Education Zones: Abakaliki, Onueke and Afikpo. Abakaliki Education Zone was chosen the enable the researchers thoroughly supervise the study properly. Abakaliki Education is

accessible throughout the year. Most schools in the zone are coeducational hence the researchers used only coeducational schools.

Two secondaryschools were drawn from the one hundred forty-two coeducational secondary schools in the zone through simple randomsampling. Out of the two junior secondary schools that were used for the study, one was assigned to the treatmentgroup while the other was assigned to the control group through a simple toss of coin. Due to the largepopulation at the junior secondary level data for the study were collected from only four intact classes in JSS IIfrom each of the two coeducational schools that were used for the study. In all therefore a total of four intact JSS II classes were used for this study (2 intactclasses for treatment group and 2 intact classes for the control group).

The instrument that was used for data collection is Basic Science Achievement Test (BSAT). TheBSAT is a 20-item multiple-choice test. The items were drawn from the themes: *You and Environment and You and Energy*. The three units considered (Pollution, Earth Science and Simple Machines) were taken into consideration in item generation. The distribution of the items acrossthe contents was guided by a test blueprint.The BSAT was subjected to both face and content validation. The Basic Science Achievement Test wasface validated by specialists in Science Education and Measurement and Evaluation. During the face validationthe test was scrutinized in terms of relevance, general test format, suitability and clarity. In addition, the researcherssubjected the BSAT to item analysis to verify the difficulty and discrimination indices of the items.

The reliability of the Basic Science Achievement Test (BSAT) was obtained using Kuder-Richardson's formula (KR-20). The Kuder-Richardson formula 20 test checks the internal consistency of measurements with dichotomous choice. It is applicable when each question is either right or wrong. A correct question scores 1 and an incorrect question scores 0 (Zaiontz, 2015). A reliability coefficient of 0.75 was obtained.

Experimental Procedure

The researchers developed two instructional packages for this study. The first instructional package is based onthe Computer Assisted Instruction Approach while the second package is based on the conventional method. The twopackages were drawn from the same curriculum content. The Computer Assisted Instruction Approach was used fortreatment group while the conventional package was used for the control group. At the onset of the experiment,the subjects in both the treatment and control groups were given the pre-test. After the pre-test the regular BasicScience teachers began the experiment in their respective schools adhering strictly to the lesson procedure that was developed from the instructional package during the pre-experimental training. The experiment wasconducted during the normal school periods in accordance with the school timetable. At the end of theexperiment that lasted eight weeks the posttest was administered to the subjects in the two groups. Data werecollected during the pre and posttest for the two groups on achievement in Basic Science. Research questionswere answered descriptively using mean and standard deviation, while the hypotheses were tested using theAnalysis of Co-variance (ANCOVA) at an alpha level of 0.05.

Control of Extraneous Variable

The following procedures were adopted by the researchers to ensure that extraneous variables, which mayinfluence the internal validity of the findings, are controlled:

(i) Teacher variable

To control the errors which may arise as a result of teacher difference, the researchers organized a pretreatment conference for the teachers that were used for the study. Separate conferences were conducted for teachers in the two groups (treatment and control). The conference helped to establish a common instructional standard among the instructors. The

researchers will monitor the teachers to ensure that they adhere strictly to the specifications of the manuals. The regular Basic Science teachers of the schools (treatment and control) groups were used

(ii) Instructional situation variable

To ensure that Instructional situation is the same for all the schools the researchers issued instructional guides to the teachers in each group. The teaching was conducted in all classes of JSS II in the various schools that were used for the study. All the intact JSS II classes of the selected schools were involved in the study. This is to avoid Hawthorne effect (a laisser-faire attitude that arises when students realize they are being used for experiment). However, pre-test was also administered to all the classes but the post-test was restricted to the intact classes chosen for the study.

(iii) Inter-group Variables

Intact classes were used for this study. This implied that initial equivalence cannot be achieved for the researchsubjects in the two groups and even within a group. In order to control the errors that may arise as a result of thenon-equivalence, the researchers employed Analysis of Co-variance for data analysis.

(iv) Subject Interaction

The researchers did not select treatment and control groups from the same school to ensure that the students in thetreatment and control groups do not exchange ideas and information. This is to reduce errors arising frominteraction among the research subjects in the two groups which may lead to John Henryeffect (the spirit of competition triggered in students on realizing that they are being used for experiment that requires comparison at the end).

(v). ***Testing effect***

The same test was used for pretest and posttest. In order to reduce errors of memorization of previous test itemsthe researchers reshuffled the items of the posttest.

Results

Research Questions

Research Question 1

What is the effect of computer assisted instruction on the mean achievement scores of students in Basic Science?

For this research question data obtained with the Basic Science Achievement Test for the treatment and controlgroups were used to answer the research question. Mean for pretest and posttest were adjusted statistical in theanalysis to take care of the initial equivalence of the research subjects. Summary of result of data analysis ispresented in table1.

Table 1: *Mean Basic Science achievement scores of students taught Basic Science using the computer assisted instruction and those taught with the conventional method.*

Group	Adjusted Mean	StD
Treatment Group (Group Taught with Computer Assisted Instruction)	55.35	6.57
Control Group (Group Taught with conventional method)	41.75	8.15

Summary of result in Table 1 shows that computer assisted instruction method is superior to the conventional lecture method in facilitating junior secondary school students' achievement in Basic Science. While the computer assisted instruction method yielded a mean achievement score of 55.35 the conventional method yielded a mean score of 41.75

Research Question 2

What is the effect of computer assisted instruction on the mean achievement scores of male and female students' in Basic Science?

In answering this research question the researchers used the subjects from the treatment group only. The pretest and posttest scores of males and females who were taught Basic Science using the computer assisted instruction approachwere adjusted in the analysis. The summary of result is shown in table 2.

Table 2: *Mean Basic Science scores of males and females taught Basic Science using computer assisted instruction*

Gender Group	N	Adjusted Mean	StD
Male Students	25	57.30	4.67
Female Students	25	53.40	7.63

Result on table 2 above show a mean achievement score of 57.30 for themales and mean achievement score of 53.40 for the females.The results for male and female groups of students had marginal effect in achievement score in basic sciences.The male performed better than the female.

Research Question 3

What is the interaction effect of gender and method on students' mean achievement scores in Basic Science?

The adjusted mean for the two levels of gender that were subjected to the computer assisted instruction approach andthose subjected to the Conventional approach were used to assess the interaction. Summary of result ispresented in table 3.

Table 3: *Summary of interaction of gender and teaching method on students' mean achievement scores inBasic Science*

Group	**Adjusted Mean for Treatment Group**	**Adjusted Mean for Control Group**
Males	57.30	40.80
Females	53.40	42.70

The result in table 3 shows that the treatment group (group taught with computer assisted instruction approach) is superior to the control group (group taught with conventional lecture approach) at the two levels of gender implying a situation of no interaction.

Hypotheses

$H0_1$: *There is no significant difference in the mean achievement scores of students taught Basic Science using computer assisted instruction and those taught using conventional methods.*

$H0_3$: *There is no significant interaction between gender and method on students' achievement in Basic Science.*

These two hypotheses were tested using Analysis of Co-Variance. Summary of the analysis for these two nullhypotheses is shown in table 4.

Table 4**: *Analysis of Co Variance for Students Overall Basic Science Achievement scores by teaching methodsand by gender with interaction effect***

Source of Variation	**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig. F**	**Decision**

Corrected Model	15803.065	4	3950.766	28.572	.000	
Intercept	23637.147	1	23637.147	170.945	.000	
Covariates	98.065	1	98.065	.709	.402	
Teaching Methods	**14955.932**	**1**	**14955.932**	**108.162**	**.000**	Reject HO_1
Gender	59.859	1	59.859	.433	.512	
2-Way Interaction Teaching Methods and Gender	**57.939**	**1**	**57.939**	**.419**	**.519**	Reject HO_3
Error	13135.935	95	138.273			
Total	476500.000	100				
Corrected Total	28939.000	99				

For Hypothesis 1, summary of results in Table 4 above shows that for the comparison of teaching methods the F-ratio is 108.162 while the F. significance value at 0.05 probability is 0.000. Since the alpha level (0.05) is greater than the significance of F. value (0.000) the researchers rejects the null hypothesis and concludes that there is significant difference in the mean achievement scores of the students taught Basic Science using Computer Assisted Instruction and those taught with the conventional approach.

For hypothesis 3, the same ANCOVA table reveals that for the two-way interaction, the F-ratio is0.419while the F. significance value at 0.05 probability level is 0.519. Since the alpha level (0.05) is less than the F. significance (0.519) the researchersupholds the null hypothesis and concludes that there is no significant interaction between gender and method onstudents' mean achievement in Basic Science.

$H0_2$: *There is no significant difference in the mean achievement scores of male and female students' taught Basic Science using computer assisted instruction method.*

This hypothesis was also tested using the Analysis of Co-variance. Summary of result is shown in Table 5

Table 5: ***Analysis of Co Variance for Students Overall Basic Science Achievement scores for treatment grouponly by gender***

Source of Variation	Sum of Squares	df	Mean Square	F	Sig. F	Decision
Corrected Model	86.116	2	43.058	.332	.719	
Intercept	16754.011	1	16754.011	129.175	.000	
Covariates	78.116	1	78.116	.602	.442	
Gender	**42.538**	**1**	**42.538**	**.328**	**.570**	
Error	6095.884	47	129.700			
Total	321400.000	50				
Corrected Total	6182.000	49				

For Hypothesis 2, summary of results in Table 5 above shows that the F-ratio is .328 while the F. significance value at 0.05 probability is .570 Since the alpha level (0.05) is less than the significance of F. value (0.570) the researchers upholds the null hypothesis and concludes that there is no significant difference in the mean achievement scores of male and female students taught Basic Science using Computer Assisted Instruction method.

Summary of Result

Results presented in this chapter reveal that:

a) Computer Assisted Instructionis superior to the conventional lecture method by highly enhancing students' achievement in Basic Science.
b) There is no significant difference in the mean achievement of male and female students taught using computer assisted instruction method.
c) There is no significant interaction between gender and teaching methods on students' mean achievement scoresin Basic Science

Discussion, Conclusion and Recommendations

From the results obtained, the study reveals that computer assisted instruction method of teaching is superior to the conventional talk and chalk (lecture) method in facilitating junior secondary school students' achievement in Basic Science. When students are exposed to learning through exploration, asking question,answering questions using the computer assisted instructions and writing down questions and answers on what they have explored, concepts are moreappropriately internalized with the learner taking responsibility of their own learning. This study agrees with Schacter (1999) who opines that Dale Mann's study of the state of West Virginia's Basic Skills/Computer Education has already found that consistent student access to the technology, positive attitudes towards the technology (by both teachers and students), and teacher training in the technology led to the greatest student achievement gains. They added that"all students' test scores rose on the Stanford 9 because of BS/CE with lower achieving student scores rising the most". This also agrees with Encyclopedia Britannica (2014) that computer assisted instructions are best used for subjects that require drill and constant practice – like Basic Science. This is because through computer assisted instruction, real life situations can be brought into the classroom just by the use of a computer. Models, concepts etc., which may be considered hazardous or big can be brought to all the students in the classroom.

Based on the findings ofthis study, the researchers recommend that computer assisted instruction should be included in thecurriculum of pre-service teachers. In addition, conferences, seminars and workshops should be organizedregularly by government and relevant professional bodies to educate basic science teachers on the use of computer assisted instruction instructional strategies. Government agencies and professional associations, whoseresponsibilities it is to design and revise the curriculum for secondary schools, should incorporate and emphasizethe use of computer assisted instruction strategies in basic science curriculum.

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