



Computer Education Research Journal (CERJ)

Volume 3: Issue No.1 pp 119-126, 2016

EFFECT OF INFORMATION AND COMMUNICATION TECHNOLOGY (ICT) ON GENDER AND ACHIEVEMENT OF STUDENTS IN BASIC SCIENCE AND TECHNOLOGY AT JUNIOR SECONDARY SCHOOL LEVEL

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ABSTRACT

This study investigated the effects of Information and Communication Technology (ICT) on gender and achievement of students in basic science and technology at junior secondary school level. Three research question and three hypotheses were formulated for the study. A quasi-experiments design using the test, post-test control group method was employed for the study. The study involved J.S.S II basic science and technology students using two intact classes in two independent groups. The population is 920 basic science and technology students in the six junior secondary school in Bosso Local Government Area. The sample consists of 90 junior secondary school basic science and technology students in two intact classes drawn from two selected junior secondary schools in Bosso Local Government Area. Random sampling technique was used to select the two schools in the study area. The two schools were randomly assigned to treatment and control schools. Data for the study was collected using the researchers developed instrument called basic science and technology achievement test (BSTAT) and basic science and technology psychomotor achievement test (BSTPAT) mean and standard deviation was used to answer the three research questions while analysis of covariance was used to test the null hypotheses at .05 level of probability. The findings of the study reveal that there is significant difference in the mean score of students when taught basic science and technology using Conventional Teaching Method (CTM), with those taught with Information and Communication Technology (ICT) performing better. It was recommended among others that the study found out, among others, that Information and Communication Technology (ICT) is more effective than Conventional Teaching Method (CTM) in improving students achievement in basic science and technology. There was an effect of gender on students cognitive achievement, however, gender had significant effect on students psychomotor achievement favouring males. The study recommended among others that ICT should be adopted in the teaching/learning of basic science and technology in junior secondary schools.

Keywords: Information and Communication Technology, Gender, Achievement, Basic Science and Technology, Conventional Teaching Method.

INTRODUCTION

The impact of Science and Technology to national development cannot be overemphasized. Science and Technology is a school subject in Nigeria from the elementary level to the university. As a subject at the elementary level, it is taught as an Elementary Science. At the Junior Secondary Schools, it is taught as Basic Science and Technology, and at the university level, it is taught as physical science such as (chemistry, physics), biological science (botany, zoology, microbiology), engineering (electrical, mechanical, civil) etc. The approach of teaching Basic Science and Technology in Junior Secondary Schools in Nigeria over the years had been majorly through the conventional method and in few cases discussion and group methods are rarely used, and all these methods mentioned are majorly teacher-centred rather than being child-centred. These methods had made the teaching of the subject more tedious for the teachers because the methods involve giving of

assignments to students, looking for instructional materials to teach etc and thus become more difficult for the students to learn and grasp the important concepts of the subject. Thus if there could be method(s) that can be used to accompany the other methods to make the learning of BST more interesting at the JSS, then such method(s) need to be investigated (FRN, 2004) and perhaps it could be better when ICT is involved.

Information And Communication Technology (ICT) have become so wide and versatile and also an indispensable part of the contemporary world due to its predominant significance which globally in a number of ways affected the school framework. Educational institutions try to change the pattern of educational program and classroom facilities in order to enhance the teaching and learning process through ICT. The utilization of ICT is a powerful tool for presentation through electronics white board, television, overhead projector, guided web tours where the students

can simultaneously view the resources on visual display unit.

The use of computer has become an indispensable tool for every aspect of human endeavours. In the school system, it has become an important medium in instructional delivery and instructional management. The recognition of the value of computer in the teaching learning process in the contemporary world engendered the introduction of computer education into the Nigerian school curriculum in 1989.

For meaningful teaching of computer education and dissemination of computer knowledge, the UNESCO (2014) is of the opinion that there is the need to produce seasoned professional teachers in computer education in order to accomplish the following objectives: -

- To teach computer studies at the Primary and Secondary school levels
- To program and process given data with maximum speed and accuracy and
- To demonstrate reasonably high level of competence for further studies in computer education and allied disciplines.

With the introduction of computer into the educational system, it has been discovered that teaching could be developed in a more flexible way through Computer - Assisted Instruction (CAI) in order to make it more responsive to student's learning. According to Karohocaa, Duidaa, Yucela, Gulluoglua & Afrifoglua (2010), the most important feature in computerized instruction is that it permits a high degree of individualization. This in effect means that students can proceed at their own pace, following a path through the curriculum as suited to their particular interest and talent.

According, the full potentials of computer in assisting or managing instruction are yet to be exploited in Nigeria. A lot of factors have been identified as hindrances to the use of computer in schools. Among these are cost of purchase, epileptic electricity supply, computer illiterate teachers and gender attitudes.

Studies have shown differences in the attitudes of male and female students to the use of computer in schools. According to the study carried out by Spotts, Bowman & Mertz (date?) in USA on gender and use of instructional technologies males rated their knowledge and experience with some innovative technologies higher than did females. For frequency of use, no significant differences were found with the exception or video, where females indicated slightly more frequent use. Both

rated technologies as important to instruction. The other factors influencing technology use include time to learn a technology increased student learning, ease of use, training and available information in discipline

In view of the foregoing, it is glaring that the traditional technique of instruction cannot withstand modern challenges and particular address the needs of Information and Communication Technology (ICT)

Purpose of the Study

The purpose of the study is to determine the effect of ICT on students academic achievement in basic science and technology. Specifically the study was designed to determine the effect of:

1. ICT and conventional teaching methods on students cognitive achievement in basic science and technology
2. Gender on students cognitive achievement when taught basic science and technology using ICT and CTM
3. ICT and CTM on students psychomotor achievement in basic science and technology

Research Question

1. What is the effect of Information and communication technology (ICT) on students cognitive achievement in basic science and technology?
2. What is the effect of gender on basic science and technology achievement test scores of students when taught using Information and communication technology (ICT) and those taught using the conventional teaching methods?
3. What are the mean psychomotor achievement scores of students taught basic science and technology with the Information and communication technology (ICT) and those taught using the conventional teaching methods?

Hypotheses

The following null hypotheses were tested at .05 level of significance.

Ho₁: There is no significant mean difference between the effect of Information and communication technology (ICT) and conventional teaching methods on student cognitive achievement in basic science and technology

Ho₂: There is no significant mean difference between the effect of gender (male and female)

on students cognitive achievement in basic science and technology

Ho₃: There is no significant interaction effect of treatments given to students taught with Information and communication technology (ICT) and conventional teaching methods and their gender (male and female) with respect to their mean scores in basic science and technology cognitive achievement test.

Methodology

A quasi-experimental design using the pre test, post test control group method was employed for the study. This design was deemed appropriate since the study involved students in junior secondary school two (J.S.S II) using two intact classes in basic science and technology in two independent groups. The population of the study comprised all 920 basic science and technology J.S.S II students in the six junior secondary school in Minna, Niger State. The sample consists of 90 junior secondary school basic science and technology students in two intact classes drawn from two selected junior secondary school in Minna, Niger State. Random sampling technique was used to select the two schools from six junior secondary schools in the study area. The two

schools were randomly assigned to treatment and control schools. The item analysis of the instrument was also conducted to determine how reliable the instrument was the instrument was found to be reliable and the reliability of coefficient value of .089 was obtained for the instrument. Data for the study was collected using the researcher developed instrument called basic science and technology achievement test (BSTAT) and basic science and technology psychomotor achievement test (BSTPAT) mean and standard deviation was used to answer the research questions while analysis of covariance was used to test the null hypothesis as .05 level of probability.

RESULT AND DISCUSSION

Research Question 1

What is the effect of Information and communication technology (ICT) on students cognitive achievement in basic science and technology?

The mean of pre-test scores and post-test scores of the two groups are presented in table 1 below.

Table 1

Mean and Standard Deviation of Pretest and Posttest Scores of Conventional teaching methods Group and Information and Communication Technology (ICT) Group in the Cognitive Achievement Test

Group	N	Pretest scores		Posttest scores		Mean Gain	
		\bar{X}	SD	\bar{X}	SD	\bar{X}	
CTM	58	22.16	6.54	47.63	11.11	25.47	
ICT	60	25.08	6.17	59.67	9.11	34.59	

The data presented in Table 1 shows that Conventional teaching methods group had a Mean score of 22.16 and Standard Deviation of 6.54 in the pre-test and a Mean score of 47.63 and Standard Deviation of 10.11 in the post-test making a pre-test, post-test Mean gain of 25.47. Information and Communication Technology (ICT) had a Mean score of 25.08 and Standard Deviation of 6.17 in the pre-test and a post-test Mean of 59.67 and Standard Deviation of 9.11, with a pre-test, post-test Mean gain of 34.59. With these results, both Information and Communication Technology (ICT) and Conventional teaching methods are effective in improving students' cognitive achievement in basic science and technology, but the effect of

Information and Communication Technology in improving students' cognitive achievement in basic science and technology is higher than the effect of Conventional teaching methods.

Research Question 2

What is the effect of gender on basic science and technology achievement test scores of students when taught using Information and communication technology (ICT) and those taught using the conventional teaching methods?

The mean of pre-test scores and post-test scores of male and female students of the two groups are presented in table 2 below.

Table 2

Mean and Standard Deviation of Pretest and Posttest Gender (male and female) Cognitive Achievement Scores of Students Taught Using Conventional teaching methods (CTM) and Information and Communication Technology (ICT)

Group Gender	N	Pretest scores		Posttest scores		Mean Gain
		X	SD	X	SD	
CTM MALE	42	21.67	5.91	47.25	10.02	25.58
CTM FEMALE	16	22.35	6.85	45.00	10.23	22.65
ICT MALE	43	26.40	6.72	53.30	8.08	26.90
ICT FEMALE	17	24.59	6.01	49.96	9.00	25.37

Table 2 shows that male students taught basic science and technology with Conventional teaching methods had a Mean score of 21.67 and Standard Deviation of 5.91 in the pre-test and a Mean score of 47.25 and Standard Deviation of 10.02 in the post-test making a pre-test, posttest mean gain in the male students of 25.58. Female students taught basic science and technology with Conventional teaching methods had a mean score of 22.35 and Standard Deviation of 6.85 in the pre-test and a post-test Mean of 45.00 and standard deviation of 10.23, with a pre-test, post-test mean gain of 22.65. Also, male students taught with Information and Communication Technology had a mean score of 26.40 and Standard Deviation of 6.72 in the pre-test and a Mean score of 53.30 and Standard Deviation of 8.08 in the post-test making a pre-test, post-test Meangain in the male students of 26.90. At the same time, female students taught basic science and technology with Information and Communication Technology had a mean

score of 24.59 and Standard Deviation of 6.01 in the pre-test and a Mean score of 49.96 and Standard Deviation of 9.00 in the post-test making a pre-test, post-test Mean gain in the female students of 25.37. With these results male students taught basic science and technology with Conventional teaching methods and Information and Communication Technology had higher posttest mean scores than female students in the cognitive achievement test. Therefore, there is an effect attributed to gender on students' cognitive achievement in basic science and technology.

Research Question 3

What are the mean psychomotor achievement scores of students taught basic science and technology with the Information and communication technology (ICT) and those taught using the conventional teaching methods?

The mean of pre-test scores and post-test scores of the two groups are presented in table 3 below.

Table 3

Mean and Standard Deviation of Pretest and Posttest Scores of Conventional teaching methods, Information and Communication Technology Groups in the Psychomotor Achievement Test

Group	N	Pretest score		Posttest score		Mean Gain
		X	SD	X	SD	
CTM	58	23.12	5.25	51.51	23.03	28.39
ICT	60	24.92	6.26	57.05	17.84	32.13

Table 3 shows that Conventional teaching methods group had a Mean score of 23.12 and Standard Deviation of 5.25 in the pre-test and a Mean score of 51.51 and Standard Deviation of 23.03 in the post-test making a pre-test, post-test Mean gain of 28.39. ICT group had a mean score of 24.92 and standard deviation of 6.26 in the pre-test and a post test mean of 57.05 and standard deviation of 17.84, with a pre test, post test mean gain of 32.13. with these results, both conventional lecture method and ICT are effective in improving students psychomotor achievement in basic science and technology, however, the level of effectiveness of ICT is higher than that of

conventional Teaching Methods

Hypotheses

The following null hypotheses were tested at .05 level of significance.

Ho₁: There is no significance mean difference between the effect of Information and communication technology (ICT) and conventional teaching methods on student cognitive achievement in basic science and technology

Ho₂: There is no significant mean difference between the effect of gender (male and female) on students cognitive achievement in basic science and technology

Ho₃: There is no significant interaction effect of treatments given to students taught with Information and communication technology (ICT) and conventional teaching methods and their gender (male and female) with respect to

their mean scores in basic science and technology cognitive achievement test.

Summary of Analysis of Covariance (ANCOVA) test for hypotheses 1, 2 & 3 are presented in table 4 below.

Table 4

Summary of Analysis of Covariance (ANCOVA) for Test of Significance of Effect of Treatments (CTM and ICT), their Gender and Interaction Effect with Respect to their Mean Scores on Basic science and technology Cognitive Achievement Test

Source of Variation	Sum of Squares	DF	Mean Square	F	Sig.
Covariate	357.717 ^a	5	71.543	1.734	.133
Intercept	289850.574	1	289850.574	3.886E3	.000
Method	45116.214	2	22558.107	302.425	.000
Gender	51.460	1	51.460	.308	.310
Method*Gender	425.872	2	212.936	.045	.062
Error	8354.161	112	74.591		
Total	415636.000	118			
Corrected Total	60004.780	117			

*Significant at sig of $F < .05$

The data presented in Table 4 shows F-calculated values for three effects: treatment, gender and interaction effect of treatments and gender on students' cognitive achievement in basic science and technology. The F-calculated value for treatment is 302.425 with a significance of F at .000. Since the F-calculated value is higher than the significant F value, the null-hypothesis of no significant mean difference between the effect of Conventional teaching methods and Information and Communication Technology on students' cognitive achievement in basic science and technology is, therefore, rejected at .05 level of significance. The result implies that the mean difference between the effect of Information and Communication Technology and Conventional teaching methods was significant. The F-calculated value for gender as shown in Table 4 is .308 with a significance of F at .310. Since the F-calculated value is less than the significant F value the null hypothesis of no significant mean difference between the effect of gender (male and female) on students' cognitive achievement in basic science and technology is accepted at .05 level of significance. This means that there was no significant mean difference between the effects of gender on students' cognitive achievement in basic science and technology. The interaction of treatments and gender has F-calculated value of .045 with significance of F at .062. Since F-calculated is less than the significant F value, the null hypothesis of no significant interaction effect of treatments and gender is accepted. This means

that there was no significant interaction effect of treatments given to students taught with Conventional teaching methods and Information and Communication Technology and their gender with respect to their mean scores on basic science and technology cognitive achievement test.

Discussion

The purpose of this study was to determine the comparative effect of Conventional teaching methods and Information and Communication Technology on student's cognitive and psychomotor achievement as well as their effect on gender in basic science and technology. The findings that have emerged from the study are hereby discussed.

The data presented in Table 1 provided answer to research question one. It was revealed that Conventional teaching methods and Information and Communication Technology are effective in improving students' cognitive achievement in basic science and technology, but the effect of Information and Communication Technology in improving students' cognitive achievement in basic science and technology is higher than Conventional teaching methods. Analysis of covariance was used to test the first hypothesis (Table 4) at the calculated F-value (302.425), Significance of F (.000) and confidence level of .05. The result shows that the mean difference between the effect of Information and Communication Technology and Conventional teaching methods in basic science and technology cognitive achievement was statistically

significant. This means that Information and Communication Technology is more effective than Conventional teaching methods in improving students' cognitive achievement in basic science and technology.

The above findings are consistent with the findings of M-Adwan & Smedley (2012) who, in their separate studies in other subjects found that the Information and Communication Technology instructions had significant effect upon the students' cognitive achievement than other instructional formats. The findings of this study also support some literature evidence such as Tondeur, Vankeer, Van Break & Valake (2008) who stated that when learners are exposed to new ideas that are presented through different intelligences, they will have a better chance to learn, remember the information and apply their learning experiences to other situations which can lead to higher achievement. It implies that students in Information and Communication Technology group remembered and applied more of their learning in basic science and technology than the other group of students that were taught through Conventional teaching methods.

The data presented in Table 2 provided answer to research question two. Findings revealed that gender has influence on students' cognitive achievement in basic science and technology in favour of male students. However, analysis of covariance was used to test the second hypothesis (Table 4), at the calculated F-value of (.308), Significance of F (.310) and confidence level of .05. The result revealed that the null hypothesis of no significant effect of gender on students' cognitive achievement in basic science and technology was accepted since the F-calculated value is less than the significant F-value. This means that the difference between the mean scores of male and female students in basic science and technology cognitive achievement test was not significant. The result of this study on gender achievement in basic science and technology, which revealed that there is no significant difference between the mean scores of male and female students in basic science and technology cognitive achievement test, is at variance with the findings of Saud, Shuaibu, Yahaya & Yasin (2011), and Tokpah (2008) who reported a significant difference in the cognitive achievement test mean scores of male and female students taught by the constructivist method in favour of male students. Also, the finding of this study in respect of male and female students' achievement in basic science and technology does not support the writings of Ggunkunle, (2007)

who concluded that girls and women perform far below the level of boys and men in science and technology and the allied fields.

The data presented in Table 3 provided answer to research question three. It was revealed that Conventional teaching methods and Information and Communication Technology are effective in improving students' psychomotor achievement in basic science and technology, but the effect of Information and Communication Technology in improving students' psychomotor achievement in basic science and technology is higher than Conventional teaching methods. The result indicates that Information and Communication Technology is more effective in improving students' psychomotor achievement in basic science and technology.

The result of this study regarding students' psychomotor achievement could be explained by the fact that teachers' adoption of authentic instructional technique in Information and Communication Technology group.

Conclusions

Based on the results of this study, which shows that Information and Communication Technology is more effective in improving students' achievement in basic science and technology than Conventional teaching methods, there was an effect attributable to gender on students' achievement in basic science and technology. Also, the study found out no significant interaction effect of treatments given to students taught using Conventional teaching methods and Information and Communication Technology and gender on achievement of Junior Secondary School students in basic science and technology. This means that the effectiveness of Information and Communication Technology on students' achievement in basic science and technology does not depend on the levels of gender. Hence, irrespective of nature of gender, learners will record improved performance in achievement in basic science and technology when Information and Communication Technology is employed to teach basic science and technology. These results, therefore, show that Information and Communication Technology is a viable teaching method for teaching/learning basic science and technology in Junior Secondary School. Information and Communication Technology (ICT) will give teachers the opportunity to engage the students in the learning process, which will increase their self-esteem and enthusiasm and their willingness to take ownership and responsibility for their learning. Thus, if Information and Communication Technology is

adopted to teach basic science and technology in Junior Secondary School, the basic science and technology Students will, undoubtedly, be equipped with knowledge and skills that will help them easily adapt and apply their skills in basic science and technology as well as perform and cope more effectively with complexities in the vast changing basic science and technology world of work.

Recommendations

Based on the findings of this study, the following recommendations are made:

1. Workshops, seminars and conferences should be organized by State Science and Technical School Board and Ministry of Education to enlighten and train basic science and technology teachers on the application of Information and Communication Technology for improving students' achievement in studying basic science and technology.
2. National Board for Technical Education (NBTE) should consider the review of curriculum for basic science and technology with a view to incorporating activities that reflect students' Information and Communication Technology to enable students learn more effectively.
3. Basic science and technology teachers in Junior Secondary School should adopt Information and Communication Technology in their classroom teaching. This will help the teachers equip basic science and technology Students with the knowledge and skills needed to easily cope and perform more effectively in the basic science and technology world of work.
4. State Science and Technical School Board and Ministry of Education should equip computer lab in Junior Secondary School with relevant modern equipment, tools and machines. This will help improve students acquisition and mastery of psychomotor skills

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