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Impact of Instructional Technology Equipment on Teaching and Learning of Physics at Senior Secondary School (SSS) in Bauchi State, Nigeria

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Abstract
This study sought to establish the impacts of instructional technologies equipment (Smart and Flannel boards) on effective teaching and learning of physics at Secondary Schools. It was guided by two research questions and two hypotheses. The population of the study is 120 physics students and a sample of 60 students was used. The researchers employed experimental research design, grouping the sample into three (3) groups of 20 students each, and with equal gender distribution. Two of the three groups were experimental groups while the other one was control group. The experimental groups 1 and 2 were taught using Instructional Technology Equipment (ITE) while the control group was taught using the conventional method for three (3) weeks. The instrument used for data collection was Physics Achievement Test (PAT); pre-test and post-test were administered before and after instruction respectively. The scores obtained were analyzed using mean scores and t–test. The results revealed that ITE had positive impacts on learning of physics. The students taught using ITE were found to perform significantly better than those taught using conventional method. Recommendations were made that physics teachers should be professionally trained on how to utilize ITE for their lessons, among others.
Keywords: instructional, technologies, equipment, ITE, teaching, learning, physics

Introduction

Physics is a core subject in science and technology since it studies the essence of natural phenomena and helps people to understand the rapidly changing technological society (Zhaoyao, 2002 cited in Wambugu & Changeiyuo, 2008). Despite the significant place of physics in technological development, research over the years have shown that students' enrollment in physics is low, and even the few that enrolled perform poorly in physics examination (Ogommoh & Nzewi, 2003; Aina & Akintunde, 2013). Acquiring knowledge of science through experience can

easily be achieved if the teacher explores and utilize the various appropriate instructional materials and teaching methods available depending on the situation and what to teach (Oginni & Owolabi, 2012).

As Nigeria strives towards technological breakthrough, the study of physics at the secondary school level of education needs to be given adequate attention (Imo, 2009). Although, physics is everywhere around us and makes our lives easier from the technological aspect, physics has not been taught efficiently, as many teachers in secondary schools still rely on the use of conventional teaching methods (Denga, 2001).

Gender has continued to be an issue of great concern to science educators and researchers. Presently, there is gender imbalance in sciences, particularly in physics. In line with this fact, researchers remarked that girls under-achieve and are under-represented in the sciences, especially in physics. Also the fact that boys recorded higher percentage of credit passes than girls in physics in the West African Examinations Council ordinary level examination between 2005 and 2011 is an evidence of gender inequality of performance in physics (Ogunleye & Babajide, 2011). This gender imbalance could be noticed in both public and private schools in Bauchi State.

Instructional technology equipment is the basis of any impressive lesson that ensures a stamped experience. This seems to be true because the utilization of instructional technology equipment serves as a reminder to learners as they see the pictures in their minds and associate them to their ideas. Most of the physics concepts, laws and theories learnt by memorization, which can easily be forgotten by learners, can be easily remembered by the use of ITE which helps students to learn with ease and retain them in their memory for a very long period because it impresses physics students in classroom activities. Smart Board and digital projector is an example of Instructional Technology Equipment. It is an interactive whiteboard that can project images one interacts with by writing on it or moving it around. This allows teachers to teach subject in a way that students can understand easily. It is connected with a computer and works with a projector; it can accommodate different learning styles. Digital Projector is a specialized computer display that projects an enlarged image on a movie screen and is commonly used in presentations generally.

Macmillan (2011) investigated the "effect of Computer-Assisted Instruction on Secondary School Students Achievement in Physics in Pankshin Local Government Area of Plateau State, Nigeria". The results show that CAI significantly enhances student's achievement in physics. The researcher therefore recommended that government and stakeholders should provide conducive teaching/learning environment with all the necessary materials/equipment. More so, Mandung (2011) conducted a study on "the effect of laboratory aided instruction on senior secondary school students' performance and acquisition of scientific skills in physics in central educational zone of Plateau State, Nigeria". The results show that there is no significant influence of gender on students' performance following the use of

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laboratory aided instruction. This indicates that performance has nothing to do with gender differences.

The present study therefore sought to establish the effect of ITE in the teaching/learning of physics, and also to establish if gender has any influence on the effectiveness or otherwise of the use of ITE in physics.

Objectives of the study

1. To investigate the impacts of Instructional Technology Equipment (ITE) on Secondary School Students' performance in physics.
2. To investigate if gender has any influence on the students' performance in physics in the two experimental groups.

Research Questions

1. Does the use of Instructional Technology Equipment (ITE) by teachers in teaching improve the students' performance?
2. Is there any difference between males and females' performance in physics in the two experimental groups?

Research Hypotheses

Ho1: There is no significant difference in the mean achievement scores of students in the experimental groups and those in the control group.

Ho2: There is no significant difference in the mean achievement scores of male and female students in the two experimental groups.

Research Methodology

This study adopted an experimental research design with two experimental groups and one control group from the same school. This research was carried out in a public Senior Secondary School in Katagum Zonal Education Area of Bauchi State. The school has a population of about 5400 students at the three arms of the Senior Secondary school of which only 120 students of equal strata are offering Science as subject and they are the target group. Proportional stratified sampling and simple random sampling techniques were used to draw a sample of 60 students comprising of 30 males and 30 females.

One instrument, Physics Achievement Test (PAT), which the researchers developed, was used for data collection. The PAT is a paper and pencil test framed and developed by the researchers. The developed Physics Achievement Test (PAT) was based on the Senior Secondary Schools Two (SSS II), ordinary level physics curriculum/syllabus. The instrument consists of eighteen (18) questions, each carrying two marks making a total of 36 marks. The questions were based on the Blooms taxonomy of educational objectives as shown in table one below.

Table 1: Specification Based on Blooms Taxonomy of Educational Objectives

Educational Objectives	Number of Questions
Knowledge	3
Comprehension	3
Application	3
Analysis	3
Synthesis	3
Evaluation	3
Total	18

Table Source: Design and Developed by the Researchers

Content validation was carried out to establish whether questions developed were based on the physics SSS II curriculum/syllabus, and also, the instrument items/questions were given to three (3) experts for corrections and inputs. In order to ensure reliability of the instrument, test-retest method of reliability measurement was conducted in this study on a separate group that was not part of the original study. The test scores were correlated. The correlation coefficient calculated which provides the measure of stability known as stability coefficient or test-retest coefficient was calculated using the below formula

$$r_s = 1 - \frac{6\Sigma d^2}{N(N^2 - 1)}$$

(Digital Bridge Institute, 2018).

In order to collect data for this study, the sample was divided into three groups of 20 subjects each and of equal gender distribution; the groups were labelled A, B and C. Each group was assigned to a class and each class has three periods in a week. A pretest was administered to all the three groups, that is group A and C (i.e. experimental 1 & 2) and Group B (control) before instruction. An intensive teaching was carried out on each of the groups for three weeks. The groups A and C (experimental groups 1 & 2) were taught using Smart Board and Digital Projector respectively while the control group B was taught using conventional method. A post-test was therefore administered on the three groups after the three-week period of teaching.

The data gathered was analyzed using t-test statistics.

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{S_1^2}{N_1} + \frac{S_2^2}{N_2}}}$$

Presentation of results

The data collected were analyzed as presented below, based on the proposed hypotheses.

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Ho1: There is no significant difference in the mean achievement scores of students in the experimental groups and those in the control group.

The hypothesis was tested using t-test statistical tool at $\alpha = 0.05$ and degree of freedom (df) = 58. Table 2 shows the summary of results.

Table 2: t-test on significance of difference between experimental and control groups

Mean	Variance	t-calculated	t-critical
$\bar{x}_A = 29.5$	$S^2_A = 12.37$		
		$t_{AB} = 5.88$	1.68
$\bar{x}_B = 23.9$	$S^2_B = 5.78$		
		$t_{CB} = 10.57$	1.68
$\bar{x}_C = 25.7$	$S^2_C = 7.17$		

From table 2, the results of the findings show that the mean score ($\bar{x}_A = 29.5$) of the experimental group 1 is higher than that of the experimental group 2 ($\bar{x}_C = 25.7$) and both are higher than that of the control group ($\bar{x}_B = 23.9$). This implies that there is a difference in performance between the groups. Comparing the mean score of the experimental group 1 ($\bar{x}_A = 29.5$) to that of the control group ($\bar{x}_B = 23.9$), the result shows that group 1 perform better than the control group. The t-calculated ($t_{AB} = 5.88$) is greater than the t – critical, ($t_c = 1.68$), as such the null hypothesis (Ho1) is rejected and the alternative hypothesis (H_1) is accepted. Also on comparing the mean score of the experimental group 2 ($\bar{x}_C = 25.7$) to that of the control group ($\bar{x}_B = 23.9$), the result shows that group 2 perform better than the control group. The t-calculated ($t_{CB} = 10.57$) is greater than the t – critical ($t_c = 1.68$), as such the null hypothesis (Ho1) is rejected and the alternative hypothesis (H_1) is accepted.

Ho2: There is no significant difference in the mean achievement scores of male and female students in the two experimental groups.

The hypothesis was tested using t-test statistical tool at $\alpha = 0.05$ and degree of freedom (df) = 18. Table 3 consists the results of t-test on significance of difference between male and female students of the same group in the two experimental groups.

Table 3: t-test on significance of difference between male and female students of the same group in the two experimental groups

Mean	Variance	t-calculated	t-critical
$\bar{x}_{Amales} = 29.2$	$S^2_A = 9.95$		
		0.19	1.73
$\bar{x}_{Afemales} = 29.8$	$S^2_A = 14.09$		
$\bar{x}_{Cmales} = 25.5$	$S^2_C = 4.94$		
		0.32	1.73
$\bar{x}_{Cfemales} = 25.9$	$S^2_C = 10.1$		

From table 3, the mean achievement score for the experimental group 1 for males and females are $\bar{x}_{\text{AMales}}$ = 29.2 and $\bar{x}_{\text{AFemales}}$ = 29.8. Also, the mean achievement score for males and females in Experimental group 2, are $\bar{x}_{\text{CMales}}$ = 25.5 and $\bar{x}_{\text{CFemales}}$ = 25.9. The respective t – values calculated for males and females of experimental group 1 is $t_{\text{A Males and Females}}$ = 0.19 while that of group 2 is $t_{\text{C Males and Females}}$ = 0.32. In each situation the t-calculated were all less than the value of t - critical (t = 1.73). By this the null hypothesis in both situations (Ho2) is accepted and the alternative hypothesis (H_2) is rejected.

Discussion of the findings

The findings from hypothesis one indicated that there is a significant difference in the mean achievement scores of students in the experimental groups and those in the control group. This implies that the use of ITE has a significant effect in the teaching and learning of physics. This finding agrees to that of Macmillan (2011) who investigated the "effect of Computer-Assisted Instruction on Secondary School Students Achievement in Physics in Pankshin Local Government Area of Plateau State, Nigeria," and reported that CAI significantly enhances student's achievement in Physics.

The second finding of the study from hypothesis two indicated that there is no significant difference in the mean achievement scores of male and female students in the two experimental groups. This implies that the use of ITE in teaching and learning of physics has effect across gender divide; that means that ITE impact is felt by both the male and female students in the teaching/learning process. This finding agrees to that of Mandung (2011) who reported that there is no significant influence of gender on students' performance following the use of laboratory aided instruction.

Conclusion

The research result revealed that ITE had positive impacts on learning of physics irrespective of gender disposition. The students taught using ITE were found to perform significantly better than those taught using conventional method.

Recommendations

Based on the findings, the following recommendations are considered vital:

1. Teachers should endeavour to utilize ITE at their disposal for teaching.
2. Teachers should always make provisions for students' active participation in both the teaching and learning activity.
3. Stakeholders of education should regularly organize workshops and seminars to help teachers update their knowledge about the content and modern equipment available for teaching.

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