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Effect of the Use of Information and Communication Technology on The Instruction of Physics in Secondary Schools in Awka Education Zone of Anambra State

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Abstract: This study examined the effect of the use of information and communication technology on the instruction of physics in secondary schools in Awka Education Zone of Anambra state. The study was guided by the three research questions and three hypotheses. The population for the study was 19, 153 SS3 physics students in all the secondary schools in the study area. A sample size of 110 SS3 physics students were selected (59 males and 51females). The research instrument used for the study was a Physics Achievement Test (PAT). PAT was validated by three experts, one lecturer from science education department, one from educational foundations department and one from computer science department, all from Nnamdi Azikiwe University Awka. A reliability coefficient of 0.86 was gotten using Kudar- Richarson's reliability formula. The mean and standard deviation were used to answer the research questions while Analysis of Variance (ANOVA) was used to test the null hypotheses at 0.05 level of significance. The findings of the study showed that students taught physics with ICT performed higher than their counterparts that were taught physics without ICT. Gender interaction effect showed that the male students taught with ICT performed higher than their female counterparts. Based on the findings of this study, it was recommended among others that physics teachers should be encouraged to use ICT in teaching physics, since the method is more effective in learning physics compared to the conventional lecture method Also the federal ministry of education should organize workshops and seminars for science teachers to strengthen their knowledge of the use of ICT in teaching.

Keywords: Information and Communication Technology, Instruction, Physics, Computer

I. Introduction

The importance of physics cannot be overemphasized as it forms the basis for technological advancement of any nation. Its study can lead to several scientific fields and professions such as engineering, manufacturing, mining and construction industries. Also, the knowledge of physics plays a very significant role in the economic development of any nation (Adegbija, 2012). Physics occupies a unique position in the school science curriculum. It has a link to other science subjects such as Biology, Chemistry, Geography, Basic Science and Mathematics. Physics, a part of science curriculum provides a range of balanced learning experiences through which students develop the necessary scientific knowledge, understanding, skills and life processes. Science students in secondary schools have in recent times shown a very low interest in physics due to poor performance in science subjects in general and physics in particular and this can be caused by poor quality of science teachers, overcrowded classrooms, lack of suitable and adequate science equipment and most importantly the ill knowledge and non- usage of information and communication technology in our teaching methodology. The global trend is now wheeling around technological advancement in all areas of human development (Ebere, 2016). There is no doubt that modern life is dominated by technology and each nation is either a powerful producer of technology or a consumer of other nation's technology efforts (Samphina Academy, 2023).

The major emphasis nowadays is on the use of information and communication technology in all works of life. Introducing technology in teaching and learning have contributed so much to the school system and also helped the teachers and students in many ways. Technology can provide the appropriate medium for teachers to nurture higher- level thinking in students, which is the key element of the 21st century skills for learning (Shelly, 2012). However, most of the time, technology in education is used as a source of information rather than as a process based means for knowledge construction. In such cases, technology is employed as a tool rather than as a pedagogical tool in science teaching and learning. Information, communication and technology (ICT) is a set of technological tools and resources used to communicate and manage information. The information dissemination is made possible through the use of technologies in teaching and learning such as in the learning of physics in secondary schools. Markauskaite (2012) added that the introduction of computer technology in teaching and learning is a giant stride towards quality education.

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Computer has become an important tool in today's society. Computer is now being used to do virtually everything in both public and private sectors. Information and communication technology (ICT) have become key tool and had a revolution impact on how we see the world and how we live in it. Today the place of ICT in education and the world in general cannot be undermined. There is universal recognition of the need to use ICT in education as we enter the era of globalization where the free flow of information via satellite and the internet hold sway in global information dissemination of knowledge (Aduwa- Ogiegbaen and Iyamu, 2005). ICT is a revolution that involves the use of computers, internet and other telecommunication technology in every aspect of human endeavors (Bandele, 2016). ICT tools for teaching physics and other sciences includes internet, databases, presentation programs, digital camera, word processors, spreadsheets etc (Hilkemeijer, 2023). There are now several ICT packages on different topics in physics to assist the teacher's in the effective teaching and learning of physics in the classroom.

However, physics as a science oriented course or discipline is known for its abstract nature (having non- material existence). Sometimes the physics teacher does not have adequate knowledge on the practical which leads to contradictions with what the physics theory says or meant. Students are left on their own, even when they are to read on their own, they find no material to read. Where the materials are available, most of them are obsolete. Hence, the students lose interest, motivation and passion for physics; this causes frustration to set in and students abandon the subject for another so there is need for the physics teachers to use ICT in teaching physics to make the subject interesting to the students.

II. Statement of the Problem

In Anambra state and Nigeria at large, the performance of the students in science especially physics has been poor for some years. Evidences from West African Examination Council (WAEC) Chief Examiners report revealed that only 35.42%, 33.40%, 45.60%, 41.20% and 46.20% candidates have credit passes in physics from 2015 – 2019 (PPSSC Awka, 2019). With this evidence, it has been shown that students don't do well in their physics external examination. This poor performance could be due to many causes of which lack of the use of information and communication technology instruction to teach physics to maintain a statuesque of contemporary society could be one of them. In other to mitigate this problem in science education (physics), this recent work seeks to determine the effect of the use of Information and Communication Technology (ICT) on the instruction of physics in secondary schools in Awka education zone of Anambra state.

Purpose of the study

The study examined the effect of information and communication technology on the instruction of physics in secondary schools in Awka Education Zone of Anambra state. Specifically, the study:

1. Examined the difference in the mean achievement scores of secondary school physics students taught physics using ICT and those taught physics without the use of ICT.
2. Ascertained the difference in the mean achievement scores of male and female students taught physics using ICT in secondary schools.
3. Examined the difference in the mean achievement scores of high achievers and low achievers physics students taught physics using ICT and those taught without using ICT

Research Questions

The following research questions guided this study:

1. What is the difference in the mean achievement scores of secondary school students taught physics with ICT and those taught physics without ICT?
2. What is the difference in the mean achievement scores of male and female secondary school students taught physics with ICT?
3. What is the difference in the mean achievement scores of high and low achievers physics students taught physics using ICT and those taught without ICT in secondary schools?

Null Hypotheses

The following null hypotheses guided the study:

HO_1: There is no significant difference in the mean achievement scores of secondary school physics students taught physics with ICT and those taught physics without ICT.

HO_2: There is no significant difference in the mean achievement scores of male and female secondary school physics students taught physics with ICT.

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$H0_3$: There is no significant difference in the mean achievement scores of high achievers and low achievers secondary school physics students taught physics using ICT and those taught without ICT.

III. Methodology

The design for this study is quasi-experimental design that shows the relationships between pre-test and post-test. Quasi-experimental research design is a scientific method which involves observing the participants in an intact classroom. The study was carried out in Awka Education Zone, which is one of the six education zones in Anambra state. A total population of 19, 153 SS3 physics students in all secondary schools in the study area was used for the study. Using purposive sampling technique, four secondary schools were selected for the study. Two schools were used as experimental group while two were used as control group. A total of 110 physics students in the samples schools were used for the study. 26 females and 30 males were in the experimental group, while 25 females and 29 males were in the control group. The instrument used for data collection was Physics Achievement Test (PAT). PAT was adapted from topic waves from WAEC and NECO past question papers and also from physics textbooks. PAT consisted of fifty (50) items with multiple choice of letters A-D, each carrying one mark (1 mark) and was used for pre-test and post-test. The PAT was validated by three experts (one lecturer from science education department, one from educational foundations and one from computer science department all from Nnamdi Azikiwe University, Awka. A reliability coefficient of 0.86 was gotten using Kudar- Richardson's reliability formula. The mean and standard deviation were used to answer the research questions while Analysis of Variance (ANOVA) was used to test the null hypotheses.

IV. Data Analysis and Results

Research Question 1: What is the difference in the mean achievement scores of secondary school students taught physics with ICT and those taught without ICT?

Table1: Descriptive statistics on difference between the mean scores of the students taught waves concept in physics using ICT instruction and those taught using the conventional lecture method

Variable	Group	N	Mean	S.D	Mean difference
Pre-test	Experimental	51	21.9	2.14	
Post-test			24.7	4.21	2.08
Pre-test	Control	59	10.6	2.29	
Post-test			11.1	3.14	0.05

Table 1 showed that differences existed between the mean scores of students taught waves in physics using ICT instruction and those taught using the conventional lecture method. The computed performance mean scores for the experimental and control groups were 21.9 and 10.6 for pre- test and 24.7 and 11.1 for post- test respectively and their mean difference were 2.08 and 0.05 respectively. This implies that those students in the experimental group had higher mean scores compared to those in the control group.

Research Question 2: What is the difference in the mean achievement scores of male and female secondary school students taught physics with ICT instruction?

Table 2: Descriptive statistics (Mean and Standard Deviation) results of the difference in academic achievement of male and female physics students taught physics using ICT instruction

Variable	N	Mean	S.D	Mean Difference
Male pre-test	59	83.28	8.64	
Post- test		84.10	8.42	0.82
Female pre-test	51	70.06	7.33	
Post -test		70.17	7.41	0.11

Table 2 showed that the males in the experimental group had mean scores of 83.28 for pre-test and 84.10 for post-test. Their standard deviations were 8.64 and 8.42 respectively. Also the mean pre-test for females' students was 70.06 with standard deviation of 7.33

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while their mean post-test was 70.17 with standard deviation of 7.41. The mean difference was 0.82 for males implying that the male students had higher mean scores because they performed better than their female counterparts with mean difference of 0.11

Research Question 3: What is the difference in the mean achievement scores of high achievers and low achievers physics students taught physics using ICT and those taught without using ICT?

Table 3: Mean scores of high and low achieving physics students taught with ICT and those taught without ICT

	Variables	**Sample size**	**Mean score**	**Standard Deviation**
Pre-Test	ICT Approach	110	33.30	3.01
	No ICT Approach	110	17.27	1.71
Post-Test	ICT Approach	110	35.33	4.52
	No ICT Approach	110	20.31	2.35

Table 3 revealed that the high achievers physics students performed better than their low achievers counterparts even when they were taught with or without ICT and both high and low achievers improved their academic achievement when ICT was used in teaching them physics

Hypotheses

The following hypotheses guided the study

Hypothesis 1: There is no significant difference in the mean achievement scores of secondary school students taught physics with ICT and those taught without ICT

Table 4: t-test comparison of post-test scores of the experimental and the control groups

Variable	**Groups**	**N**	**Mean**	**S.D**	**df**	**t-cal**	**P**	**Remark**
Post-test	Exp.	110	24.7	4.21	200	36.4	0.0	Rejected
Post-test	Control	110	11.1	3.14				

Table 4 showed that there was a significant difference between the mean scores of the students taught waves concept in physics using ICT and those taught without using the ICT. This is because the calculated t-value of 36.4 is higher than the 1.96 t-critical values at 0.05 level of significance. This implies that students of the experimental group achieved better than their counterparts in the control group. Therefore null hypothesis one was rejected

Hypothesis 2: There is no significant difference in the mean achievement scores of male and female secondary school students taught physics with ICT

Table 5: t-test comparison of the post-test mean scores of male and female students taught physics using ICT

Variable	**N**	**Mean**	**S.D**	**Df**	**t-cal**	**P**	**Remarks**
Male	59	84.10	8.42				
				110	17.51	0.67	Retained
Female	51	70.17	7.41				

*Not significant at p> 0.05

Table 5 revealed that the calculated p-value is 0.67 which is greater than the significant level at 0.05 with df =110. This means that there was no significant difference between the post-test scores of male and female students taught physics using ICT. Therefore hypothesis two was rejected

Hypothesis 3: There is no significant difference in the mean achievement scores of high achieving and low achieving secondary school students who were taught physics with ICT and those taught without ICT

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Table 6: ANOVA statistics analysis on the test of significance difference in the mean score for post- test of secondary school students who are high achievers and those that are low achievers taught physics using ICT or without ICT

Mean Achievement Test	Type111 Sum of Squares	DF	Mean Square	F- Value	P-Value
High Achievers post-test	7065.162	2	3032.581	250.05	0.02
Intercept	229.742	1	229.74	20.35	0.00
Low Achievers Post-test	23.100	1	23.10	1.43	0.02

Results of the ANOVA on table 6 revealed that the p-value is less than 0.05, therefore the null hypothesis of no significant difference between the mean scores of high and low achieving physics students used for the study was rejected so there is a significant difference in the mean scores of the high and low achievers.

V. Discussion of Results

The results of the study was discussed according to the research questions and hypotheses

The result in table 1 indicated that those students taught physics with ICT achieved significantly higher than those taught without ICT hence their mean difference were 2.08 and 0.05 respectively. This implies that those students in the experimental group had higher mean scores compared to those in the control group. The findings was in agreement with the study of Azih (2014) which showed that English students taught using ICT instruction performed higher than those students taught English without using ICT. Also Ugwuani and Eze (2012) in their study found out that those mathematics students taught using simulation approach through ICT gadgets achieved and retained more than the students taught without the ICT hence the use of ICT in teaching physics students improved their academic achievement

Results in table 2 revealed that male students taught physics with ICT achieved significantly better than their female counterparts who were also taught using ICT instruction. This is in contrary to the findings of Okoyeuzu (2013) who found out that female student performed higher than their male counterparts when ICT was used to teach them basic concepts of physics. However the study is in agreement with the study done by Ongowo (2015) who found out that male students performed higher than their female counterparts when taught using ICT in physics. Results in table 5 showed that the t- cal was higher than the critical value showing that there was no significant difference between the post-test scores of male and female students taught physics using ICT

Results in table 3 revealed that the high achieving students taught physics with and without ICT performed better than the low achieving students who were also taught physics with or without ICT. This is in agreement with the work of (Fabiyi and Adetoro, 2016) who found out that high achievers biology students performed better than their low achievers counterparts. Results in table 6 revealed that the p- value is less than 0.05 therefore the null hypothesis was rejected and there was a significant difference in the mean scores of the high and low achieving physics students

VI. Conclusion

The findings of this study revealed that ICT has a positive influence on the academic achievements of students in physics. Also there was a significant gender difference between male and female students academic achievement in physics when ICT instruction was used. Thus males performed better than their female counterparts when taught the concept of waves in physics with ICT. The findings revealed that ICT positively affects student's academic accomplishments and retention in physics. ICT is becoming progressively significant in education as well as in our everyday life therefore ICT should be adopted for teaching in schools to realize improved performance in physics in particular and other subjects for students to develop interest and have fun in their learning. Also ICT is an instrument for the economic and technological development in the 21st century; therefore, Nigeria cannot afford to be on the wrong side of the digital divide.

VII. Recommendations

Based on the findings of this study, the following recommendations were made

1. Physics teachers should adopt the use of ICT in physics instruction since it favours both boys and girls and makes learning of physics interesting to the students

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2. The Government should equip schools with enough ICT gadgets and help employ suitable and qualified teachers to handle and utilize the ICT gadgets and facilities provided in their schools
3. The ministry of education should organize workshops, seminars for science teachers to strengthen their knowledge on the use of ICT in teaching
4. School administrators should be encouraged to improve on the management of academic programme by providing necessary facilities required for instructional purposes specifically variety of textbooks, ICT gadgets and practical lessons using laptops to promote ICT instruction learning
5. Policy makers in the field of education should make sure that physics teachers are encouraged to use ICT instruction since the method is more effective in learning physics compared to the conventional lecture method without ICT most teachers are currently using.

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