

The Effect of Computer Simulation Instructional Package on Physics Students' Achievement in Jalingo Education Zone Taraba State.

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Abstract

This study investigated the effect of computer simulation instructional package on physics students' achievement in electrolysis. The study adopted a quasi-experimental design of non-equivalent non-randomized pre-test post-test. A total number of 108 students, consisting of 62 male and 46 female students participated in this study. Multi-stage sampling techniques were conducted in three stages. Firstly, purposive sampling procedure was adopted to obtain four (4) secondary schools in Jalingo Education Zone, Taraba State, Nigeria forming four intact classes. Secondly, students of the four (4) schools were assigned to experimental group (simulation group) and control group (traditional teaching methods) respectively. Thirdly, stratified sampling technique was used to select the one hundred and eight (108) SS2 students. Two instruments developed by the researcher were used in this study, which are Electrolysis Achievement Test (EAT) and Electrolysis Simulation Instructional Package (ESIP). The instruments were validated by experts in science education. The reliability coefficient of EAT was 0.77 using Pearson Product Moment Correlation Coefficient. Three hypotheses were generated to achieve the objectives of this study. The three hypotheses were tested using T-test and Analysis of Variance (ANOVA). Findings from the study showed that there was a significant difference in academic achievement among secondary school students taught physics with Computer Simulation Instructional Package and those taught with Lecture Method, there was a significant difference in academic achievement between male female students taught physics with Computer Simulation Instructional Package, and there was a significant difference in academic achievement among secondary school students taught physics with Computer Simulation Instructional Package and those taught with Lecture Method based on ability level. Based on these findings, it was concluded that there was a statistically significant effect of Computer Simulation Instructional Package on physics achievement. It's then recommended that physics teachers should try to establish a classroom environment that facilitates the use of simulation packages in teaching and learning of physics concepts.

Keywords: Achievement, Computer Simulation, and Physics.

Introduction

Physics is an international enterprise that plays a role in the future progress of humanity. Physics is an exciting intellectual adventure that inspires young people and expands the frontiers of knowledge about nature. Ogbole (2015) opined that Physics generates fundamental knowledge needed for future technological advances that will continue to drive the world's economic engine. In the view of Oche (2012), Physics improves the quality of life by providing the basic understanding necessary for developing new instrumentation and techniques for

medical applications such as computer tomography, magnetic resonance imaging, particle emission tomography and ultrasonic imaging. Thus, physics plays a vital role in health, economic development, education, energy and the environment. Based on the undisputable relevance of the subject, it is expected that the study of Physics and students' performances in the public examination would be on the increase. The importance of Physics as an essential requirement for the economic, scientific and technological development of any nation cannot be over emphasised. This implies that the development and sustenance of any form of technology will be a wild goose chase unless a solid foundation is laid for effective and efficient Physics education. However, a solid foundation cannot be applied unless more secondary school students offer Physics and perform impressively in national and international examinations. This is based on the fact that physics is a pre-requisite for many science and technology-related courses such as medicine, engineering, pharmacy, computer science, among others, in tertiary institutions.

However, it is disappointing to note that the students' performance in Physics at internal and external examination has left more to be desired despite the relative importance of Physics (Saage, 2010). Hence, necessary measures must be taken to address this issue. The present Nigeria Physics classroom does not provide the fun, hands-on, challenging, interactive and collaborative environment needed by a new generation of students exposed to internet, computer usage, hand-set and other sophisticated gargets. The use of simulation might be used to solve the problem of this nature.

In this 21st century, the adoption of technology-based instructional strategies that motivate, captivate, and enhance students' achievement and retention should be encouraged. One of such approaches, according to Yaki *et al.* (2014), is technology-enhanced learning such as multimedia presentation which could be either computer-based or video-based instruction. Computers can be used as a supplementary tool to facilitate education in order to achieve educational goals. It is reported that students' abilities and skills are affected positively by use of computers (Dantani, 2011). It is also stated that computers make students feel confident and helps them to discover interactions among the components of a complex system (Mihindi *et al.*, 2017). Great emphasis is placed on the computer-based science and technology laboratories and ordinary science laboratories in the educational curricula of the developed countries (Oguz, 2011). One of the aims of the science and technology course is to train individuals capable of keeping up the fast-growing and changing science world and capable of utilising the recent technological discoveries in every field. Therefore, the importance of using computers in a physics class may not be limited to the ability of computer simulation to improve learning; rather, computer simulation instruction adds another dimension to the teacher's repertoire of strategies, which may improve overall learning. Another important reason to include student to computer use in a Physics lesson is that most (if not all) students, especially those planning a career in Physics, will be required to be computer literate. As students interact with computers in various ways within their Physics courses, their degree of computer awareness and literacy will increase. Attractive and well-designed programmes can be motivational. Students can spend more time on tasks; assessment, diagnostics and remediation can be built into programmes to help learners achieve mastery of the concepts taught (Olele, 2008). CBSI can either be used to enhance practical investigation or as a virtual alternative to real practical work

where a simulation supports the exploration of the investigation model through a computerised representation of the phenomena under study.

Computer-based instruction refers to the process of transfer of knowledge and skills or for remediation presented on a computer. Computer-based instructions are interactive and can illustrate a concept through attractive animation, sound and demonstration. Computer simulation instructional strategy allows students to progress at their pace and work individually. According to Dematera (2017), Computer-based instruction is any curricula in which students interact with a computer as a key element of the learning process. So many researchers have used computer-assisted instructions in different subject areas to improve effective teaching and learning.

Nigerian Policy on Education (FRN, 2014) has made provisions to make education of the citizenry both functional and relevant to ensure all-round development. It also demands that teaching shall be practical, activity-based, experiential, Information and Communication Technology-based (ICT-supported). To that end, teachers must adapt to the new teaching strategy, especially Computer Based Learning Strategy, to make teaching a learner's centre. Specific provisions have also been made for different levels of education system so as to ensure effective curriculum delivery in schools. Orji and Uka (2012) argued that to actualise this in any society, there is the need to attend to certain unavoidable variables such as teaching materials, methods adopted, the curriculum, the teacher, and students' interest.

This means simulation is a computer program that allows the learner to interact with a computer representation of real-life experience. Simulation programs provide terms of real-life situations, phenomena or processes. Simulations are designed to be realistic, which helps students apply their knowledge in a realistic format. They are often used to teach subject areas such as science because they can imitate objects and explain processes as small as atomic interactions. Simulations help students solve problems and improve their thinking skills. Computer Simulation instruction adds another dimension to the teacher's repertoire of strategies, improving overall learning. This present study intends to use computer-based simulation instructional strategy to enhance students understanding of electrolysis.

Different authors have defined academic achievement in different ways. According to Hassinger and Plourder (2015), academic achievement refers to what the students have learned and is usually measured through standardised tests, performance assessments, and portfolio assessments. They further added that an individual does or realises at school, University or College in class, laboratory, library or field work. It does not include sport or music. The concept could be referred to as the measure of students' acquisition of certain skills at the end of teaching and learning activities. To Abdullahi and Duyilemi (2011), academic achievement is how well an individual has worn his cognitive tasks. In this instance, academic achievement results from an examination written by students which is often a reflection of learning. It is important for the successful development of young Physics in society; students who do well in the school are better able to transition into adulthood and achieve occupational and economic success.

The observed students' poor achievement in Physics is attributed to the use of inappropriate or ineffective teaching method by Physics teachers (Asikhia, 2010). Sam (2011) regrettably observed that the number of students meeting university requirements in science and technology in Nigeria is on the low side. To this effect, researchers (LongJohn, 2019; Igboegwu, 2015), have traced the cause of this consistent problem of failure in Physics and have attributed it to a number of factors. Some of these factors are lack of Qualified Personnel, lack of Teaching Materials and Equipment, Poor Classroom Management, lack of Interest on the part of the students, inappropriate medium of instruction, ineffective teaching strategies and students' perception of difficulty in some Physics concepts such as Electrolysis.

Electrolysis is the chemical decomposition of a compound brought about by the passage of a direct current through a solution or molten combination. Therefore, the process of electrolysis may greatly benefit from the use of computer-assisted instruction because the process manifests itself visibly. When regular teaching methods are used in teaching science subjects, students understand subject at a knowledge level and they usually memorise the science concepts without understanding the real meaning. As a result, students do not conceptualise the science concepts well as intended (Wesi, 2011). Such factors as understanding at knowledge level and memorising influence student's attitude, cognitive development and achievement in science and science education. It is known that it is not easy to eliminate misconceptions by just employing standard instructional methods. One of the ways to overcome this problem is to try to develop and use computer-assisted instruction. Computer-based instruction strategy plays a vital role in contemporary teaching and learning of science concepts (Chang, 2019). That is why this present study intends to use a computer simulation strategy to enhance students' understanding of the concept of electrolysis.

With particular reference to secondary education in Nigeria, various subjects have been included in the curriculum to enable students acquire knowledge and skills. Certain subjects are categorised as core while others are vocational or non-vocational electives. However, the teaching of Physics as one of the core science subjects in senior secondary school is not without problems. Poor achievement of students in Physics has been lamented by many researchers, parents and even the students themselves which in turn resulted to moral decadence that leads to insecurity, drop-out syndrome, frustration, examination malpractice and fear especially among female students.

Gender has been identified as one factor influencing students' academic achievement at secondary school level (Fagbemi *et al.*, 2011). This is why gender issue has received the attentions of many researchers across disciplines and at different levels of education (including the Senior Secondary Education level). Gender is the range of physical, biological, mental and behavioral characteristics of the feminine and masculine (female and male) population (Yusuf *et al.*, 2015). The importance of examining performance about gender is based primarily on the socio-cultural differences between girls and boys. Some vocations and professions have been regarded as men's (engineering, arts and crafts, agriculture etc.) while others such as catering, typing, nursing, and women's. As a result of this way of thinking the larger society has tended to see girls as weaker sex". Consequently, an average Nigerian girl goes to school with these fixed stereotypes. Fatokum and Odagboyi (2010) noted that some subjects such as physics,

chemistry and mathematics are branded masculine while others like home economic, secretarial studies are branded feminine.

Science deals with abstraction, conceptual thinking and generalization of facts, all of which require the use of cognitive process. For students to achieve this, the attainment of formal operational stage is important. At formal operational stage, the child can operate logically through seriation, classification, causality, time and space. He is also able to combine ideas, solve verbal and hypothetical problems, proportions and conservation of movement. He can transfer understanding from one situation to the other (Ajaja and Eravwoke, 2010). Most of what is taught in science requires ability to think. Many students find abstract subjects such as Physics and Chemistry difficult to learn, this is believed to be associated with their cognitive development. Nzewi and Osisioma (2010), observed that the difficulty is due to not having appropriate cognitive level of comprehension and application. The capacity of students to engage themselves meaningfully in any educational task which requires higher cognitive functioning depends on factors which include their academic potentiality. This could be tagged ability or level of academic attainment. Ability level involves the characteristic mode of functioning that an individual shows in intellectual activities in a highly consistent and persuasive way. Ajaja and Eravwoke (2010) identified three ability levels in relation to teaching-learning situation viz: High, medium and low. Fatokun & Odagboyi (2010) opined that high ability learners are more intelligent than the low or medium ability learners in solving task in science courses. Intelligence, according to them, is the general level of cognitive functioning as reflected in the ability to understand ideas and to utilize abstract symbols in the solution of intellectual problems. Owadara (2012) affirmed that some students who show interest to science courses are superior to the nonchalant ones in solving problems of Mathematics origin.

Statement of the Research Problem

In the recent past, it has been observed that secondary schools in Nigeria are not living up to expectations in delivering quality education (Adesulu, 2014). It has been observed that Physics as a Science subject in Secondary Schools in Nigeria faces severe problems about its curriculum content and delivery by the Physics teachers. It has been observed that teaching and learning of Physics in Secondary Schools was bedevilled with issues that impede successful implementation of the curriculum. Poor achievement of students in Physics at the Senior Secondary School Certificate Examination really leaves one in doubt about the effectiveness of the popular teaching method of Physics teachers. Science teachers have applied various techniques and strategies like discovery, questioning, field trips, lecture and discussion methods etc.. Yet, there has been poor performance among secondary school students in the certificate examination throughout the country (WAEC, 2011). The general public outcry against poor academic achievement of senior secondary school students in West African Examination Council (WAEC), National Examination Council (NECO) and similar bodies is illustrative of low-quality education and associated teachers' ineffectiveness to utilise new methods of teaching at this level. Secondary school teachers have been held responsible for the growing decline in students' achievement since the quality of education depends on the teachers as reflected in the performance of their duties (Nzeribe, 2012).

Teachers' ineffectiveness in using the new teaching strategy in classroom interaction with students could be responsible for the observed poor achievement of students and the widely acclaimed fallen standard of education in Nigeria, (Akiri and Ugborugbo, 2009). Therefore, it is against this background that the researcher intends to examine whether students' achievement in physics could be improved when a computer-based simulation instructional strategy is used in teaching the topic electrolysis to SS2 students in Jalingo Education Zone, Taraba State.

Aim and Objectives of the Study

The main aim of this study is to determine the effect of Computer Simulation Instructional Package on SS2 Physics Students' Achievement in Jalingo Education Zone Taraba State.

The specific objectives are to:

1. Determine the effect of Computer Simulation Instructional Package on the mean achievement scores of Physics students taught with Computer Simulation Instructional Package and those with Lecture.
2. Compare the difference of mean achievement scores of students taught Physics with Computer Simulation Instructional Package based on ability level.
3. Determine the effect of Computer Simulation Instructional Package on the mean achievement scores of male and female students in Physics taught with Computer Simulation Instructional Package.

Research Hypotheses

The following null hypotheses were formulated and tested at 0.05 level of statistical significance:

- HO₁:** There is no significant difference between the mean academic achievement scores of students taught Physics with Computer Simulation Instructional Package and those with Lecture Method.
- HO₂:** There is no significant difference between the mean academic achievement scores of students taught Physics with Computer Simulation Instructional Package based on ability level.
- HO₃:** There is no significant difference between the mean academic achievement scores of male and female students taught Physics with Computer Simulation Instructional Package.

Methodology:

The study adopted a quasi-experimental design of non-randomised non-equivalent pre-test post-test. The sample of the study was made up of One Hundred and Eight (108) SS2 Physics students of senior secondary schools in Jalingo Education Zone, Taraba State. The Experimental Group was made up of Sixty-two 62 (39 male; 23 female) students and Control Group forty-six 46 (23 male; 23 female) students. The groups were pre-tested using the same instrument. Then, the experimental group was exposed to treatment.

Results:

The results of the analyzed data are presented and interpreted in line with the research hypotheses.

Table 4 shows that male students had an achievement score of 73.13 and standard deviation of 25.89 while female students had a mean score of 46.30 and standard deviation of 21.98, with $t=4.160$ and $P=0.000$. Hence, hypothesis two is rejected. Therefore, there is a significant difference between the mean academic achievement scores of male and female students taught Physics with Computer Simulation Instructional Package at 0.05 level of significance.

Summary of Findings

From the data analysis and the results obtained from the research, the findings were recorded and summarized as follows:

1. There is significant difference between the mean academic achievement scores of students taught Physics with Computer Simulation Instructional Package and those with Lecture Method.
2. There is a significant difference between the mean academic achievement scores of male and female students taught Physics with Computer Simulation Instructional Package.
3. There was a significant difference between the mean academic achievement scores of students taught Physics with Computer Simulation Instructional Package based on ability level.

Conclusion

Based on the findings of this study, it can be deduced that the use of Computer Simulation Instructional Package is more effective in teaching of Physics as it has positive impact students' academic achievement in Physics. The Computer Simulation Instructional Package also improves both male and female students' academic performance, this implies that the strategy is gender-friendly. Through the use of this approach in teaching and learning of difficult concepts in Physics, lessons can be easily delivered to learners in inspiring, understandable and exciting ways. This will undoubtedly positively improve students' achievement in Physics.

Recommendations:

- I. Necessary attention should be accorded to computer literacy and operation in the secondary schools and relevant computer assisted instructional packages should be developed for use within the Nigeria school systems.
- II. In addition, Nigeria public schools should be equipped with necessary ICT facilities to leverage the potential of ICT in Nigeria schools.
- III. Government should ensure that the use of Computer Simulation Instructional Package is incorporated into the senior secondary school as one of current innovation trending in the global world which Nigeria cannot be exception.

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- Abdul-Gafoor, K &Akhilesh, P.T (2008). Misconception in Physics among secondary schools students. *Journal of Indian Education* 34(1) 77-90.

Hypothesis 1: There is no significant difference between the mean academic achievement scores of students taught Physics with Computer Simulation Instructional Package and those with Lecture Method.

Table 2: T-test analysis of the difference between the control and experimental groups

Group	N	Mean	SD	df	t	P
Control	46	42.94	19.89	106	1.459	0.000
Experimental	62	63.18	27.61			

Result from Table 2 shows that students taught with computer simulation instructional package had a mean score of 63.18 and standard deviation of 27.61 while students taught with lecture method had a mean score of 42.94 and standard deviation of 19.89, with $t\text{-cal}=1.459$ and $P=0.000$. Hence, hypothesis one is rejected. Therefore, there is significant difference between the mean academic achievement scores of students taught Physics with Computer Simulation Instructional Package and those with Lecture Method at 0.05 level of significance.

Hypothesis 2: There is no significant difference between the mean academic achievement scores of students taught Physics with Computer Simulation Instructional Package based on ability level.

Table 3: ANOVA analysis of the experimental group based on ability level.

Source of Variation	SS	df	MS	f-cal	P
Between Groups	44199.70	2	22099.85	565.594	0.000
Within Groups	2305.35	59	39.07		
Total	46505.10	61			

Table 3 showed that analysis of variation for the experimental group based on ability level yielded F-ratio of 565.594 and significant value of 0.000. Hence, hypothesis three is rejected. Therefore, there was a significant difference between the mean academic achievement scores of students taught Physics with Computer Simulation Instructional Package based on ability level at 0.05 level of significance.

Hypothesis 3: There is no significant difference between the mean academic achievement scores of male and female students taught Physics with Computer Simulation Instructional Package.

Table 4: T-test analysis of the mean difference of male and female students taught with Computer Simulation Instructional Package.

Group	N	Mean	SD	df	t	P
Male	39	73.13	25.89	60	4.160	0.000
Female	23	46.30	21.98			

Table 4 shows that male students had an achievement score of 73.13 and standard deviation of 25.89 while female students had a mean score of 46.30 and standard deviation of 21.98, with $t=4.160$ and $P=0.000$. Hence, hypothesis two is rejected. Therefore, there is a significant difference between the mean academic achievement scores of male and female students taught Physics with Computer Simulation Instructional Package at 0.05 level of significance.

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1. There is significant difference between the mean academic achievement scores of students taught Physics with Computer Simulation Instructional Package and those with Lecture Method.
2. There is a significant difference between the mean academic achievement scores of male and female students taught Physics with Computer Simulation Instructional Package.
3. There was a significant difference between the mean academic achievement scores of students taught Physics with Computer Simulation Instructional Package based on ability level.

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