EFFECTS OF COMPUTER SIMULATION ON NIGERIA CERTIFICATE IN EDUCATION STUDENTS' PSYCHOMOTOR ACHIEVEMENT AND INTEREST IN ELECTRONICS TECHNOLOGY

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Abstract
This study explored the effects of Computer Simulation on Nigeria Certificate in Education Students' Psychomotor Achievement and Interest in Electronics Technology. The study adopted quasi-experimental design. Two research questions and two hypotheses guided the study. The population of the study was made up of 75 NCE II students offering Electrical/Electronics courses in Federal College of Education (Technical) Bichi, Kano State. Two instruments; Electrical/Electronics Technology Psychomotor Achievement Test (EETPAT) and Electrical/Electronics Technology Interest Inventory (EETII) were constructed, validated and used for the study. The inter-ratter reliability of EEPAT was determined using Kendall's coefficient of concordance and it yielded 0.81. Cronbach's Alpha was used to determine the reliability of EETII and was found to be 0.86. Mean statistics was used to answer the two research questions and ANCOVA was used for testing the null hypotheses at 0.05 level of significance. One of the findings of the study was that Multisim, a computer software for simulating electronic circuits, was more effective for teaching practical skills in Electronics Technology than Conventional Laboratory Method. The study also found that there was a significant difference between the mean scores of students in Electrical/Electronics Technology Psychomotor Achievement Test when taught with Multisim and those taught with Conventional Laboratory Method. It was recommended that lecturers of Electrical/Electronics Technology courses at the NCE level should incorporate computer simulation in the teaching of the practical contents in Electronics Technology.

Keywords: *Multisim, Simulation, Nigeria Certificate in Education, Psychomotor Achievement, Interest, Electronics Technology*

Background to the Study

Computer Simulation is one of the recent technological advances introduced into instructional media which have the capacity to aid students, especially at the tertiary level, to grasp new concepts faster and better in engineering related disciplines. Computer simulation is the process of using a computer to imitate the operation of a real world process or facility according to appropriately developed assumptions taking the form of logical, statistical or mathematical relationships which are developed into a model (Mchaney, 2009). Computer simulation was defined by Raghuwanshi, Singh and Mokhariwale (2012) as an attempt to model a real-life or hypothetical situation on a computer so that it can be studied to see how the system works. Hence, Computer simulation may be defined as the manipulation of the variables of a system on a computer by the use of a prototype of a real-life situation so that predictions about the system can be made. Electronics Technology is capital intensive in nature, and the funds required for procuring equipment and consumables are not often readily available. Consequent upon this, lecturers and teachers in growing economies such as Nigeria, often seek out alternative ways of carrying out successful impartation of knowledge to their teaming students. Ogbuanya and Okoli (2014) observed that teachers and lecturers often have had to resort to improvisation in order to improve their productivity.

In Electronics Technology, one of the ways of improvising with a view of creating real life situations in order that students would get the best from their teachers is through computer simulation. This becomes necessary because as Guy and Lownes-Jackson (2015) revealed, computer simulations promotes student interest and involvement, foster retention of information, and offers opportunities for affective and behavioral learning. These come through repeated practice and immediate feedback, transfer of knowledge, skills, and abilities from classroom to real world environments is enhanced. Computer Simulation offers both lecturers and students the following advantages: it is cheaper to procure, accidents and damages to man and machine are almost absent, it is inexpensive to maintain and it is portable (Mchaney, 2009; Lawson, Itami, Gimbelt and Manning, 2006). There are a number of computer

simulations software programmes relevant to Electronics Technology, they are; Simulated Programme with Integrated Circuit Emphasis (SPICE), Powersim (PSIM), Science Laboratory (SCILAB), Electronics work Bench, Matrix Laboratory (MATLAB) and Multisim. But this work concentrated on Multisim.

Multisim is an industry-standard, best-in-class simulation environment. It is the cornerstone of the National Instruments (NI) circuits teaching solution to build expertise through practical application in designing, prototyping, and testing electrical circuits (National Instruments, 2016). Multisim is an interactive electronic circuits' simulations software with a number of user-friendly features. National Instruments (2016) revealed that Multisim can be useful in the following ways: for teaching a variety of courses like electronics in the field of Technology, it offers a faster understanding of circuits, it uses industry-renowned tools, it can handle multiple circuits' applications at a time. It can be used to teach foundational analogue, digital, and power circuits concepts, it is a useful tool in research in electronics and power electronics design can be done with greater ease.

One of the most valuable features of Multisim is that the behaviour of circuits when sources are connected and functionality of measuring instruments is similar to those of actual electronics laboratory. Additionally, the procedures that are used in obtaining data are very similar to those of the "real world." Hence, it closely approaches the concept of an ideal "virtual laboratory." For example, the test and measurement models contain voltmeters, ammeters, a multimeter, a function generator with several output waveforms, a two-channel oscilloscope, a frequency counter, a distortion analyzer, and other instruments. These instruments must be wired into the circuit in essentially the same fashion as in an actual laboratory. Thus, good laboratory skills can be taught very easily using a computer and the software. Since Multisim has been effective to its developer, National Instruments, for training its staff, it would be good for it to be tried in Nigeria on Nigeria Certificate of Education (NCE) Electronics Technology students.

NCE students are students undergoing Technology Education training programme in a College of Education in Nigeria in order to become teachers of Electrical/Electronics Technology related topics at the Junior Secondary School level (National Commission for Colleges of Education (NCCE), 2012). The main objectives of Technology Education program at the NCE level are to produce: Qualified Technical Teachers and Practitioners of technology capable of teaching Basic Technology in the Junior Secondary Schools; Technical NCE Teachers who will be able to inculcate Scientific and Technological attitudes and values into the Society (NCCE, 2012). Upon graduation, the students are awarded NCE (Technical) Electrical/Electronics Technology. The cumulative grade point aggregate (CGPA) of students is computed to reflect their academic achievements over the six semesters of the course and used for their certification.

Achievement, in this context, refers to the realization of the educational objectives of a student. It is usually denoted by a score, this score is obtained through testing. The type of testing employed for a discipline like Electronics Technology, measures cognitive as well as psychomotor achievements. Cognitive achievement is the realization of educational intellectual goals in the cognitive domain. While psychomotor achievement reveals how well the educational objectives in the psychomotor domain have been realized by a student. In the field of Electronics, psychomotor skills are paramount. Since the goal of educational research such as this one is to improve academic achievement, it has been therefore emphasized that teachers should endeavour to adopt instructional techniques that incorporate resources that are capable of stimulating students' interests (Onyekwerre, 2001).

Works (1999) defined interest as a social construction developing within the dynamic relationship between the individual and the situation. Students' interest in learning is linked with their anxiety to learn. It consists of feelings and tendencies towards a concrete matter. A characteristic feature of interest is a manifestation of a different preference toward actions, events or plans. A student's interest in academic achievement will induce him to behave and act in a certain way towards his studies (Ogbuanya and Owodunni, 2013). The use of computer simulations such as Multisim in the teaching of Electronics Technology could open new frontiers in the provision of a rich environment that would stimulate interest among Electronics Technology students in Colleges of Education. Hence, the psychomotor achievement and interest of NCE students in electronics technology vis-a-vis their exposure to Multisim is worthy of investigation.

Statement of the Problem

The computer simulation software Multisim has been successfully used by National Instruments (NI) for teaching designing, prototyping, and testing electrical circuits to her workers for many years (National

Instruments, 2016). Based on this success recorded by NI and the fact that it has never been used in Nigeria on NCE students, it is not known whether it would enhance the acquisition of practical skills in Electronics Technology among NCE students. It is this gap that necessitated this study. Therefore, the problem of this study is: can the use of the computer simulation software, Multisim, enhance the psychomotor achievement and interest of NCE students in Electronics Technology?

Aim and Objectives of the Study

The study explored the effects of Computer Simulation on Nigeria Certificate in Education Students' Psychomotor Achievement and Interest in Electronics Technology. Specifically, the study determined the:

1. Effect of Multisim on NCE students' psychomotor achievement in Electronics Technology.
2. Effect of Multisim on NCE students' interest in Electronics Technology.

Research Questions

The following research questions guided the study. What is the:

1. Effect of Multisim on NCE students' psychomotor achievement in Electronics Technology?
2. Effect of Multisim on NCE students' interest in Electronics Technology?

Hypotheses

The following null-hypotheses were formulated and tested at 0.05 confidence level:

H_{o1} There is no significant difference between the mean scores of students in Electrical/lectronics Technology Psychomotor Achievement Test when taught with Multisim and those taught with Conventional Laboratory Method.

H_{o2} There is no significant difference between the mean scores of students in Electrical/Electronics Technology Interest Inventory when taught with Multisim and those taught with Conventional Laboratory Method.

Research Methodology

The study employed a quasi-experimental design. The design uses pre-test, post-test, non-equivalent control group research design. The design was considered suitable because the study is an experiment where random assignment of subjects to experimental and control groups is not possible, so intact classes were used.

Population of the Study

The population of the study was made up of all the 75 (71 males and 4 females) NCE II students offering Electrical/Electronics courses in Federal College of Education (Technical) Bichi, Kano State.

Instrument for Data Collection

The instruments used in this study; Electrical/Electronics Technology Psychomotor Achievement Test (EETPAT) and Electrical/Electronics Technology Interest Inventory (EETII), were constructed by the researchers. The EETPAT that was used to test students' psychomotor achievement was developed based on TED 223 (Electrical and Electronics Devices) of NCE curriculum. It contained one performance test question, with ten tasks to be performed and scored 5 marks each for a total of 50 marks using the researchers constructed competency rating guide designed based on process assessment technique. The Electrical/Electronics Technology Interest Inventory (EETII) was also developed by the researchers. The 30 items of the interest inventory were based on Likert scales of Strongly Agreed (SA), Agreed (A), Undecided (U), Disagreed (D) and Strongly Disagreed (SD). The research instruments were face validated by five experts. Three of them are lecturers of Electrical and Electronics Technology Education and the remaining two are lecturers of Measurement and Evaluation.

After the validation of the instruments, a pilot study of EETPAT and EETII were conducted using equivalent sample of NCE II Electrical/Electronics Technology students in College of Education Minna, Niger State. To determine the reliability of the EEPAT, three ratters guided by the EEPAT competency guide rated 15 NCE II Electrical/Electronics Technology students in College of Education Minna, Niger State. The inter-ratter reliability was calculated using Kendall's coefficient of concordance. This yielded a reliability coefficient of 0.81. This indicated that there was high agreement between the three ratters who rated the students. For the computation of the reliability coefficient for the Electrical/Electronics Technology Interest inventory, Cronbach Alpha was used and it yielded 0.86.

Lecture Plan

The researcher prepared two (2) sets of lecture plans for teaching of the four Electronics Technology topics selected for the study. Each set contained four lecture plans that were used to teach the students. Each contact lasted for two hours. This spanned over a period of four weeks. One set of the lecture plans was prepared based on Multisim, and was used by the course lecturer to teach the experimental group throughout the stages of the treatment period. The other set of the lecture plans were prepared based on Conventional Laboratory Method and were used by the subject teacher to teach control group throughout the stages of the treatment period.

Experimental Procedure

The study took place during the normal school setting. The lecture time table was followed without alteration. A research assistant was trained on the use of Multisim for one week. He was then given detailed instructions with lesson plans on Electrical and Electronics Devices. On the first day, the pre test was administered to both groups scores were obtained and kept in the custody of the researchers. Then the experiment commenced immediately and lasted for four weeks. The experimental group was exposed to Electrical and Electronics Devices through Multisim, while the control group was exposed to Electrical and Electronics Devices through Conventional Laboratory Method. At the end of the treatment period, a posttest was administered, scores were obtained from both groups and kept with the researchers for the purpose of analyses.

Method of Data Analysis

The Data collected for the study were analyzed using mean statistics and Analysis of Covariance (ANCOVA). Mean statistics was used to answer the two research questions that guided the study. Since the study involved an independent variable (teaching methods), a dependent variable (post-test scores) and a covariate, ANCOVA was used for testing the null hypotheses at 0.05 level of significance. In addition, ANCOVA was considered suitable because it is the statistical tool that can control for initial group difference. Statistical Package for the Social Sciences (SPSS) version 20 was used to perform all the statistical calculations for the purpose of enhancing speed and accuracy.

Results

The results are presented according to the research questions and null hypotheses that guided the study.

Research Question One

What is the Effect of Multisim on NCE students' psychomotor achievement in Electronics Technology?

Table 1:
Pre-test and Post-test Mean Scores of Treatment Groups Taught Electronics Technology with Conventional Laboratory Method and Multisim in the Psychomotor Achievement Test.

Group	N	Pretest $\bar{X}$	Posttest $\bar{X}$	Mean Gain $\bar{X}$
Experimental Group	37	24.8	44.6	19.8
Control Group	38	25.3	33.8	8.5

Table 1 shows that Experimental group (group treated with Multisim) had a pre-test mean score of 24.8 and a post-test mean score of 44.6, this gave a mean gain of 19.8. However, Control group (group treated with Conventional Laboratory Method) had a pre-test mean score of 25.3 and a post-test mean score of 33.8, giving a gain of 8.5. With these results, the students in Experimental Group performed better in the psychomotor achievement test than the students in Control Group. Hence, Multisim is more effective than Conventional Laboratory Method for imparting practical skills in Electronics Technology.

Research Question Two

What is the Effect of Multisim on NCE students' interest in Electronics Technology?

Table 2:
Pre-test and Post-test Mean Scores of Treatment Groups Taught Electronics Technology with Conventional Laboratory Method and Multisim in the Interest Inventory.

Group	N	Pretest $\bar{X}$	Posttest $\bar{X}$	Mean Gain $\bar{X}$
Experimental Group	37	2.30	4.65	2.35
Control Group	38	2.32	2.89	0.57

Table 2 shows that Experimental group (group treated with Multisim) had a pre-test mean score of 2.30 and a post-test mean score of 4.65, this gave a mean gain of 2.35. However, Control group (group treated with Conventional Laboratory Method) had a pre-test mean score of 2.32 and a post-test mean score of 2.89, giving a mean gain of 0.57. These results show that the students in Experimental Group demonstrated higher interest levels in Electronics Technology than the students in the Control Group. Hence, Multisim is more effective than Conventional Laboratory Method for improving students' interest in Electronics Technology.

Hypotheses

H_{01} There is no significant difference between the mean scores of students in Electrical/Electronics Technology Psychomotor Achievement Test when taught with Multisim and those taught with conventional Laboratory method.

Table 3:
Analysis of Covariance (ANCOVA) Result on students' scores in Electrical/Electronics Technology Psychomotor Achievement Test

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	250.356	2	125.178	8.839	.000
Intercept	587.383	1	587.383	41.474	.000
Pretest	11.973	1	11.973	.845	.361
Treatment	248.307	1	248.307	17.533	.000
Error	1019.705	72	14.163		
Total	98959.555	75			
Corrected Total	1270.061	74			

The data in Table 3 shows the F-calculated and 'sig' values for *effect of treatment on* NCE students' mean scores in Electronics Technology Psychomotor Achievement Test. The F-calculated value for treatment is 17.533 with a significance of F at .000 which is less than .05. This result shows that there is a significant difference between the mean scores of students in Electrical/Electronics Technology Psychomotor Achievement Test when taught with Multisim and those taught with conventional Laboratory method. The null-hypothesis is therefore rejected at .05 level of significance. Since the mean score of students treated with Multisim was higher in the psychomotor test, it means that Multisim is more effective for teaching practical skills in Electronics Technology than Conventional Laboratory Method.

H_{02} There is no significant difference between the mean scores of students in Electrical/Electronics Technology Interest Inventory when taught with Multisim and those taught with conventional Laboratory method.

Table 4:
Analysis of Covariance (ANCOVA) Result on students' scores in Electrical/Electronics Technology Interest Inventory

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	24.412	4	6.103	76.774	.000
Intercept	38.800	1	38.800	488.088	.000
EETII	.011	1	.011	.133	.715
Group	9.165	1	9.165	115.290	.000
Error	16.137	72	.079		
Total	1730.885	75			
Corrected Total	40.550	74			

Table 4 shows the F-calculated and sig values for *effect of treatment on* NCE students' mean scores in Electronics Technology Interest Inventory. The F-calculated value for treatment is 115.290 with a significance of F at .000 which is less than .05. Hence, the null-hypothesis is therefore rejected at .05 level of significance. This means that there is a significant difference between the mean scores of students in Electrical/Electronics Technology Interest Inventory when taught with Multisim and those taught with conventional Laboratory method. Since the mean of students treated with Multisim was higher in the Interest Inventory, it means that Multisim is more effective for improving students' interest in Electronics Technology than Conventional Laboratory Method.

Findings of the Study

The following findings emerged from the analyses of data collected for the study:

1. Multisim was more effective for teaching practical skills in Electronics Technology than Conventional Laboratory Method.
2. Multisim was more effective for improving students' interest in Electronics Technology than Conventional Laboratory Method.
3. There was a significant difference between the mean scores of students in Electrical/Electronics Technology Psychomotor Achievement Test when taught with Multisim and those taught with conventional Laboratory method.
4. There was a significant difference between the mean scores of students in Electrical/Electronics Technology Interest Inventory when taught with Multisim and those taught with conventional Laboratory method.

Discussion of Findings

Table 1 revealed that the use of Multisim for teaching practical skills in Electronics Technology was more effective in enhancing students' psychomotor achievement than Conventional Laboratory Method among the NCE students. This was deduced for the fact that the experimental group had higher mean gain score of 19.8 in the psychomotor achievement test than the control group which had a mean gain score of 8.5. This indicates that the use of Multisim affected the students' practical skills more positively than the Conventional Laboratory Method. The null-hypothesis postulated on the mean scores was tested at 0.05 confidence level, table 3, and it revealed that the observed difference in the psychomotor achievements of the two groups was statistically significant.

These findings are supported by Safo, Ezenwa and Wushishi (2013) and Gambari, Ezenwa and Anyanwu (2014) who reported that the use of computer-assisted instruction helped students to learn mathematics concepts. Similarly, the findings were supported by Rahman (2014) who revealed that students do indeed benefit from the use of Multisim. The implication of this is that with Multisim, students can embark on realistic Electronics circuits problem solving; they can learn how to construct complex circuits with various components, and verify the functionality of their design. If peradventure, their constructed simulated circuit fails to work as planned, they can easily debug it by troubleshooting it for design issues and thereafter come up with functional alternatives which would solve the problem.

Similarly, Table 2 revealed that the use of Multisim for teaching practical skills in Electronics Technology was more effective in enhancing students' interest in Electornics Technology than Conventional Laboratory Method among the students. This is because the experimental group had higher mean gain score of 2.35 in the interest inventory than the control group which had a mean gain score of 0.57. This is an indication that the use of Multisim produced more positive effects on the students' interest in learning practical skills in Electronics Technology than the Conventional Laboratory Method. The second null-hypothesis, postulated on the interest scores was tested at 0.05 level of significance, table 4, and it showed that the observed difference in the interest inventory of the two groups was statistically significant.

These findings were consistent with the findings of Furo (2015) and Basturk (2005) whose works revealed that *computer assisted instruction* has a strong positive influence on students' interest in sciences. The implication is that computer assisted learning environment such as the one provided by Multisim, has the capacity to attract and sustain student interest in disciplines such as Electronics Technology, widely believed to be difficult, towards enabling them to study with a greater chance of recording greater success.

Conclusion

The need to embrace and incorporate computer simulation into the teaching of subject matter like Electronics Technology in the field of Technical and Vocational Education is long overdue. This is due to the fact that computer simulation has the capacity to stimulate and sustain students' interest whilst providing them the opportunity of practicing construction of projects in the comfort of their hostel rooms. This study found out that the use of Multisim as an instructional tool more effective in improving NCE students' psychomotor achievement and interest in Electronics Technology. Hence, it should be embraced by Electrical/Electronics Technology teachers Technical Education.

Recommendations

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

i. Lecturers of Electrical/Electronics Technology courses at the NCE level should incorporate computer simulation in the teaching of the practical contents in Electronics Technology.

ii. National Commission for Colleges of Education (NCCE) should consider incorporating computer simulation into the NCE Electrical/Electronics Technology minimum standards in the next curriculum review.

iii. Colleges of Education running Electrical/Electronics Technology programme should endeavour to organise training for their lecturers handling courses in the field on how to use computer simulation softwares as well as provide them with laptop computers.

iv. NCE students should endeavour to acquire personal laptops and install computer simulation softwares that would boost their psychomotor skills and interests, in them. Instead of using their laptops for playing games and watching films.

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