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DEVELOPMENT OF A COMPUTER-AIDED INSTRUCTION FOR EFFECTIVE TEACHING OF ELECTRICAL AND ELECTRONIC DEVICES AT NIGERIA CERTIFICATE IN EDUCATION TECHNICAL LEVEL IN NORTH EASTERN NIGERIA

Samaila Yakubu (Ph.D)[1*], Makinde, A.A. (Ph.D)[2] and Zambwa Joseph(Ph.D)[2]

[1]Department of Electrical and Electronics Technology, College of Education, Science and Technology, Bama, Nigeria.

[2]Department of Electrical Technology Education, Modibbo Adama Unversity of Technology, Yola, Nigeria.

ABSTRACT: *The purpose of this study was to develop a Computer-Aided instruction (CAI) for teaching Electrical and Electronic Devices at N.C.E. level in North Eastern Nigeria. A flowchart for the CAI was developed by describing the steps in words and representing them by symbols. Connections between events were represented by lines with arrowheads to show the direction or order in which they occur. The CAI was developed and written in visual Basic.Net (VB, NET) targeting the .Net framework 3.5. The user interface was developed using Windows Presentation Foundation (WPF). Procedural programming was used and the CAI was tested by using it to teach an experimental group (S1), while control group (S2) was taught using lecture method. The results obtained from the two groups were then compared. Two research questions and one null hypothesis guided the study. A population of 268 students was used. A total of 80 students formed the sample for the study. A purposive sampling technique was used. A researcher-made achievement test (RMAT) was used as instrument for data collection. The instrument was validated by five experts and pilot tested outside the study area in order to establish its reliability. Reliability coefficient of 0.92 was obtained for the RMAT. The mean was used to answer research question two. Z-test was employed to test the null hypothesis at 0.05 level of significance. Statistical package for Social Sciences (SPSS) version 17 was used for the data analysis. Results of the study revealed that there was variation between the mean scores of students taught Electrical and Electronic Devices at N.C.E. II level using CAI and students taught using lecture method. The null hypothesis was rejected, indicating that there was a significant difference between the mean achievement of students taught Electrical and Electronic Devices at N.C.E. II level using CAI and students taught Electrical and Electronic Devices at N.C.E. II level using lecture method. Students taught using CAI performed better than the students taught using lecture method. The CAI was found to be effective in teaching Electrical and Electronic Devices at N.C.E. II level. It was recommended that lecturers of electrical and electronics technology at N.C.E. level be encouraged to use CAI in teaching N.C.E. II Electrical and Electronic Devices.*

KEYWORDS: Development, Computer Aided Instruction; Effective, Teaching, Electrical and Electronics Technology, N.C.E. Programme.

INTRODUCTION

Technical Education, especially as provided at the Nigeria Certificate in Education (N.C.E.) level in Nigerian Colleges of Education, leads to the production of qualified technical teachers and practitioners of technology capable of teaching Introductory Technology in the Junior

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Secondary Schools and Technical Colleges. The technical teachers and practitioners of technology are also expected to inculcate scientific and technological attitudes and values in the society (Okorie, 2001). Okorie further stated that in order to have sufficient number of technical teachers for secondary school system, some polytechnics offer N.C.E. programmes in Technical Education. However, the pattern and curriculum of the N.C.E. programme in the polytechnics are the same as that of Colleges of Education. Electrical and Electronic Devices is major course in Electrical and Electronics Technology Curriculum at N.C.E. level (National Commission for Colleges of Education [N.C.C.E.], 2008).

Students offering Electrical and Electronic Devices at N.C.E. level in Colleges of Education should be able to describe and perform simple tasks or operations using oscilloscope, ammeter, ohmmeter and voltmeter, among others; this is the expectation of Planners and Stakeholders in the Education Sector. To impart basic skills and problem-solving attitudes to learners, appropriate teaching method must be considered. Teaching, according to Anderson (2004) is an intentional and reasoned act. It is an intentional act because teachers always teach for some purpose, primarily to facilitate learning. It is reasoned act because teachers teach their students what they regard as useful. Enemali (2006) and Ozuruake (2006) stated that teaching is effective when the extent to which presentation, explanation, discussion and arrangement of the elements of the task to be learned are most suitable for the student. They further pointed out that the ultimate criterion for effective teaching is the teacher's impact on the student's learning. In the same vein, Vanier in Baraka (2006) observed that all teaching acts are conceived to produce learning and so the best test of effective teaching, is the amount of learning that occurs and is noticed through change in behaviour of the learner.

However, the current method of teaching (teacher centred method) which puts more emphasis on teacher's activities than those of students used for teaching Electrical and Electronic Devices at N.C.E. (Technical) level requires more emphasis on the practical components. According to Newsam (2007) teacher-centred method of teaching assumes that there is predetermined body of knowledge that the teacher should pass on to the students. It uses testing and competition to evaluate and motivate students. In the teacher-centred method of teaching, teachers are the key source of information and transmitters of knowledge while students are passively receiving information (Semenov, 2005). This method of teaching may need to be complemented, more especially in this Information and Communication Technology (ICT) era, where the role of a teacher shifts from being the key source of information and transmitter of knowledge to that of becoming a collaborator and co-learner. The role of the student changes from passively receiving information to being actively involved in their own learning (Semenov, 2005).

Computer-Aided Instruction (CAI) is central in the field of Educational Technology. It is the use of computers and software applications to teach concepts or skills (Puthawala, 2002). It is the product of a careful development process resulting in a reproducible sequence of instructional events, which has been demonstrated to produce measurable and consistent learning by students (Tiemann & Markle, 2007). Computer-Aided instruction is an electronic mode of sharing knowledge and transmission, which may not necessarily involve physical contact between teacher and student. The concepts of computer-aided teaching and computer-aided learning have given birth to Computer-Aided instruction, which represents a combination of both teaching and learning (Mac-Ikemenjima, 2005; Ittelson, 2007). According to Jaehnig and Miller (2007) Computer-Aided instruction is teaching technology. Amold (2007) stated that CAI is made up of the following components: (i) an ordered sequence of items, either

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statements or questions to which the student is asked to respond (ii) the student's response, which may be in the form of filling in the blank spaces, choosing from among a series of answers, or solving a problem, and (iii) provision for immediate confirmation of response. According to Find-health-articles (FHA, 2010) CAI is a self-teaching technique, usually online, involving interaction of the student with programmed instructional materials. FHA further pointed out that CAI is also called computer based instruction (CBI), computerized self-instruction programme (CSIP), among others. In the same vein, CAI is a method of presenting new subject matters to students in a graded sequence or controlled steps. Students work through the programmed material by themselves at their own speed, and after each step they test their comprehension by answering questions. The students are then immediately shown the correct answers or given additional information. Computers and other types of teaching machines are often used to present the materials (Tiemann & Markle, 2007). However, in this study the researcher viewed CAI as an instructional package which uses computer to teach students in order to complement the effort of the teacher in the overall teaching process.

CAI enhances teaching in several ways: (1) Computer programs are interactive and can illustrate concept through attractive animation, sound, and demonstration, (2) It allows students to progress at their own pace and work individually or in a small group, (3) Computer provides immediate feedback, letting students know whether their answer is correct, (4) Computers offer a different type of activity and a change of pace from teacher-centred instruction, (5) Computer-Aided instruction improves instruction for students with disabilities because students receive immediate feedback and do not continue to practise the wrong skills, (6) Computers capture the students attention because the programs are interactive and engage the students' spirit of competitiveness to increase their performances and, (7) Computer-Aided instruction moves at the students' pace and usually does not move ahead until the students have mastered the skill (Tiemann & Markle, 2007; The Access Centre, 2010).

Hence, if the teaching and learning of Electrical and Electronic Devices is to make a desirable impact in the lives of the Electrical and Electronics students, then it must be done with the use of Computer-Aided instruction in which the students will be active participants and not mere passive recipients of verbal teaching. Teaching without adequate instructional materials make students invariably have their imagination stretched too far due to the teacher's excessive use of words to convey meanings, techniques or procedures, a practice that is discouraged especially in Technical Education (Bednar & Sweeder, 2005). For teachers of Colleges of Education to continue to teach topics in areas such as Electrical and Electronic Devices, without necessary facilities needed for demonstration is professionally a failure. Hence the need for supplementary instructional package such as computer–aided programmed instruction to supplement the teacher-centred method of teaching. This was the concern of this study with respect to Electrical and Electronic Devices.

Statement of the Problem

Effective implementation of the N.C.E. Technical Curriculum presupposes the availability of adequate equipment and instructional materials for teaching the subject. A group of well-qualified technical teachers who are versatile in the application and use of these instructional materials are also required. However, with the increasing number of Colleges of Education in Nigeria to train N.C.E. teachers in technical fields, it is pertinent that much emphasis must be placed on the effective teaching and learning of all technical subjects, including Electrical and Electronics. The teaching of Electrical and Electronic Devices, as a course in Electrical and Electronics Technology in Colleges of Education is done with difficulty due to inadequate

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teaching materials and equipment such as functional oscilloscopes, digital trainers, 3-phase A.C. motors, radio and television transmitters to meet up with the increasing number of students enrolled in Electrical and Electronics Technology courses at N.C.E. level.

Ndomi (2006) noted that other facilities needed for effective teaching of Vocational and Technical Education subjects are workshop and laboratory equipment, tools and materials for practical. Ndomi further pointed out that these facilities are inadequate in most Nigerian institutions. This resulted into teaching of such courses using teacher- centred method. According to Baraka (2006) "The most typical example of the teacher-centred method of teaching is the chalkboard and talk method. Others include the textbook, lecture, question and answer method'' (p. 31). Thus, a research on development of a Computer-Aided instruction will complement the existing instructional materials and as well help in motivating both the teachers and students in the teaching–learning process.

The question is, should the teaching and learning of Electrical and Electronic Devices be conducted with minimum students' active participation in the learning process due to inadequate instructional packages, whereas teachers can develop Computer-Aided instruction for supplementing the much desired instructional methods that can enhance instruction? If the current method (teacher-centred) of teaching is not supplemented, products of schools would be rated low in creativity, critical thinking and problem solving, because the schools have not developed such skills in the students through integration of computer-aided instruction program. There was therefore, the need for the current study.

Purpose of the Study

The main purpose of this study was to develop a Computer-Aided Instruction for Effective teaching of Electrical and Electronic Devices at N.C.E. (Technical) level. Specifically, the study sought to:

1. Develop flowchart for the CAI;

2. Develop learning materials incorporating students' activities and students' feedbacks in

   Electrical and Electronic Devices for N.C.E. II students based on the national objectives ;

3. Test the CAI.

Research Questions

To achieve the purpose of the study, the following research questions were answered:

1. How is the flowchart for the CAI developed?

2. What is the result of testing the CAI?

Hypothesis

The following hypothesis was formulated to guide the study:

HO_1: There is no significant difference between the mean achievement score of students taught Electrical and Electronic Devices at N.C.E.II level using Computer-Aided Instruction and students taught Electrical and Electronic Devices at N.C.E. II level using Lecture method.

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METHODOLOGY

The pre-test – post-test control group experimental design was adopted for this study. Gay (1993), Akuezuilo and Agu (2003), and Sambo (2005) in Medugu (2011) pointed out that studies which attempt to establish cause and effect relationships and whose variables can be manipulated by the researcher should best use the pre-test – post-test control group experimental design. The pre-test – post-test control group, controls most of the threats to internal validity of true experimental study, hence they are called true experimental designs (Sambo, 2005). In the same vein, Osuala (2005) stated that a pre-test is necessary whenever there is the possibility that subjects may drop out of the experiment. In this design two groups of subjects are involved: Experimental group (S_1) and control group (S_2). The subjects are assigned to the two groups by randomization. Randomization ensures that the two groups are equal before the treatment of the experimental group. The design is diagrammatically presented as follows:

S_1	R	Q_1	X	Q_2
S_2	R	Q_3		Q_4

Where S_1 = Experimental group; S_2 = Control group; R = Subjects are assigned to the group at random; Q_1 and Q_3 = Results of the pre-test scores; Q_2 and Q_4 = Results of the post-test scores; X = Treatment given only to the experimental group (Medugu, 2011).

In this study, the design is as follows:

	Randomly Assigned	Pre-test	Treatment	Post-test
S_1	R	T_1	X_1	T_2
S_2	R	T_1		T_2

Where:

S_1 = Experimental group; S_2 = Control group; T_1 = Pre-test scores; X_1 = Teaching using Computer-Aided Instruction (CAI); T_2 = Post-test scores.

The population of the study was 268 students of Electrical and Electronics Technology in all State and Federal Colleges of Education accredited by N.C.C.E. in North Eastern Nigeria. It consisted of 268 N.C.E. II (Tech) students offering Electrical and Electronics Technology during the 2011/2012 academic session. The choice of N.C.E. II (Tech) was deliberate because of the strategic position it occupies in the N.C.E. (Tech) programme. It serves as the distributing point of students to different areas of specialization at the N.C.E. III (tech) level. The sample of this study was 80 N.C.E. II (Tech) students from Federal college of Education (Technical) Potiskum and college of Education Bama. The 80 students were equal to 30% of the entire population. Purposive sampling technique was used to sample the population of the students. Purposive sampling is a type of non-probability sampling in which the researcher consciously selects specific elements or subjects for inclusion in a study in order to ensure that the elements will have certain characteristics relevant to the study (Uzoagulu, 1998; Keane, 2003; Dibal, 2006). Hence, the choice of the sampling technique and subsequent selection of students from College of Education Bama and Federal college of Education (Technical) Potiskum. Students were randomly assigned to two groups: Experimental (S1) and Control (S2) groups. The two groups were pre-tested using RMAT to determine their entry behaviours.

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Two instruments were used for data collection: Researcher-made Achievement Test (RMAT) and Computer-Aided Instruction (CAI). A RMAT containing 50 items was used for data collection. Each of the 50 items had five options (a) to (e) out of which the student selects one. Each item carrying 2% of the total score (100%) of the instrument made up the RMAT. These items were drawn from Electrical and Electronic Devices taught at N.C.E. II level during instruction. The topics were from the approved N.C.E. Curriculum provided by N.C.C.E in the Table of specification. The RMAT instrument sought data for answering research question two, and testing hypothesis one. The same RMAT instrument was administered again on the students as post-test. This was to determine the effects of treatment on groups S1 and S2. To ensure that students did not reproduce answers to their earlier testing the numbering sequence of the test items on the RMAT instrument was changed during the post-test.

To ensure the appropriateness of the instrument, the developed Researcher-Made Achievement Test (RMAT) was given to five experts from Modibbo Adama University of Technology, Yola, Federal College of Education (Tech) Gombe , Federal College of Education (Tech) Potiskum, and College of Education Bama for face and content validation. The five experts have been teaching Electrical and Electronics Technology courses at different levels of education for more than ten years. They are very familiar with contents of Electrical and Electronic Devices. Most of the experts have been external examiners for this course at different times. Hence, their choice as validators. The experts were given copies of the purpose of the study and research questions for their guidance. They were requested to vet the appropriateness of the language used, sequential presentation of topics and content coverage of the subject matter among others. A total of 50 items were submitted to the experts and 50 items with some corrections were returned. All the suggestions and recommendations of these experts were used to improve the final copy of the instrument.

Pilot testing of the instrument (RMAT) was conducted at Federal College of Education (Technical) Bitchi Kano, where 40 students from Electrical and Electronic Devices class were involved in the exercise. This College is in the North West sub-region, with similar characteristics but was outside the study area. The pilot study was basically carried out to determine the reliability of the instrument. The Rationale Equivalent Reliability (Kuder Rechardson Formula) was employed. According to Okoro (2000) and Akezuilo (2003) in Medugu (2011), the purpose of a pilot study is to tryout any instrument on a smaller number of target population, with a view to determining the effectiveness of such instrument before using it for the actual study.

The reliability coefficient for the instrument was determined by using Kuder-Richardson formula 21 (KR_{21}). KR_{21} according to Uzoagulu (1998) is used for estimating the internal consistency of instrument developed by an individual such as test, questionnaire, and rating scale among others. A reliability coefficient of 0.92 was established for the instrument. According to Iheanacho (1997) in Medugu (2011) a reliability coefficient of 0.70 and above is desirable. In the same vein, reliability coefficient of 0.85 to 0.89 is considered very good (Balian, 1988). The reliability of the RMAT was therefore high and acceptable.

Students were individually assigned to either experimental group (S_1) or Control (S_2) randomly, by having them to pick from a basket containing pieces of paper on which either S_1 or S_2 was written. This was done by providing an equal number of S1 and S_2. The researchers and the research assistants personally collected the data for the study.

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Data collected from the respondents were analyzed using Mean and Z-test. Mean was used to analyze the data for answering research question two. The hypothesis was tested using the Z-test at 0.05 level of significance. Kuder-Richardson was used to compute reliability. Olaitan and Ndomi (2000) pointed out that Z-test is a significance test which is based on the Z-distribution and usually used in testing hypotheses involving two population means when the sample size of each population is greater than or equal to 30. Hence the choice of the Z-test for the study. The data for the study were analyzed using computer programme of statistical package for social science (SPSS). If the calculated Z-value was greater than or equal to the critical Z-value, then the null hypothesis was rejected; otherwise the null hypothesis was accepted (Olaitan & Ndomi, 2000).

Program Codes for the CAI

The CAI was developed and written in Visual Basic .Net (VB.NET) targeting the .Net framework 3.5. The user interface (UI) was developed using Windows Presentation Foundation (WPF). WPF is a Microsoft technology that provides developers with a unified programming model for building rich Windows Smart Client user experiences that incorporate UI, media and documents. The CAI consists of the following parts/Windows: Register Student, Login, Main Window, Learning Materials Reader, Student Activity Reader, Splash Screen, Question Reader, and Explanation Reader Windows. In addition, it has the following models/Data layers which include Data Base Management (DBMA), Learning Material, Student, Student Activity Response, Topic Response, and Persistence Mechanism models. Procedural Programming was used in developing the CAI; a list or set of instructions telling a computer what to do step by step, and how to perform from the first code to the second code were developed

RESULTS AND DISCUSSION

Research Question 1: How is the flowchart for the CAI developed?

Figure 1 shows three different types of symbols used in developing the CAI. They are oval shapes (Terminals), rectangular shapes (Process symbols) and diamond shapes (Decision symbols). The terminal symbols are used to represent the “start” and “end” of the flowchart; while the process symbols represent arithmetic operation and data manipulations. The decision symbols are used to represent operations in which there are two alternatives, YES or NO (True or False).

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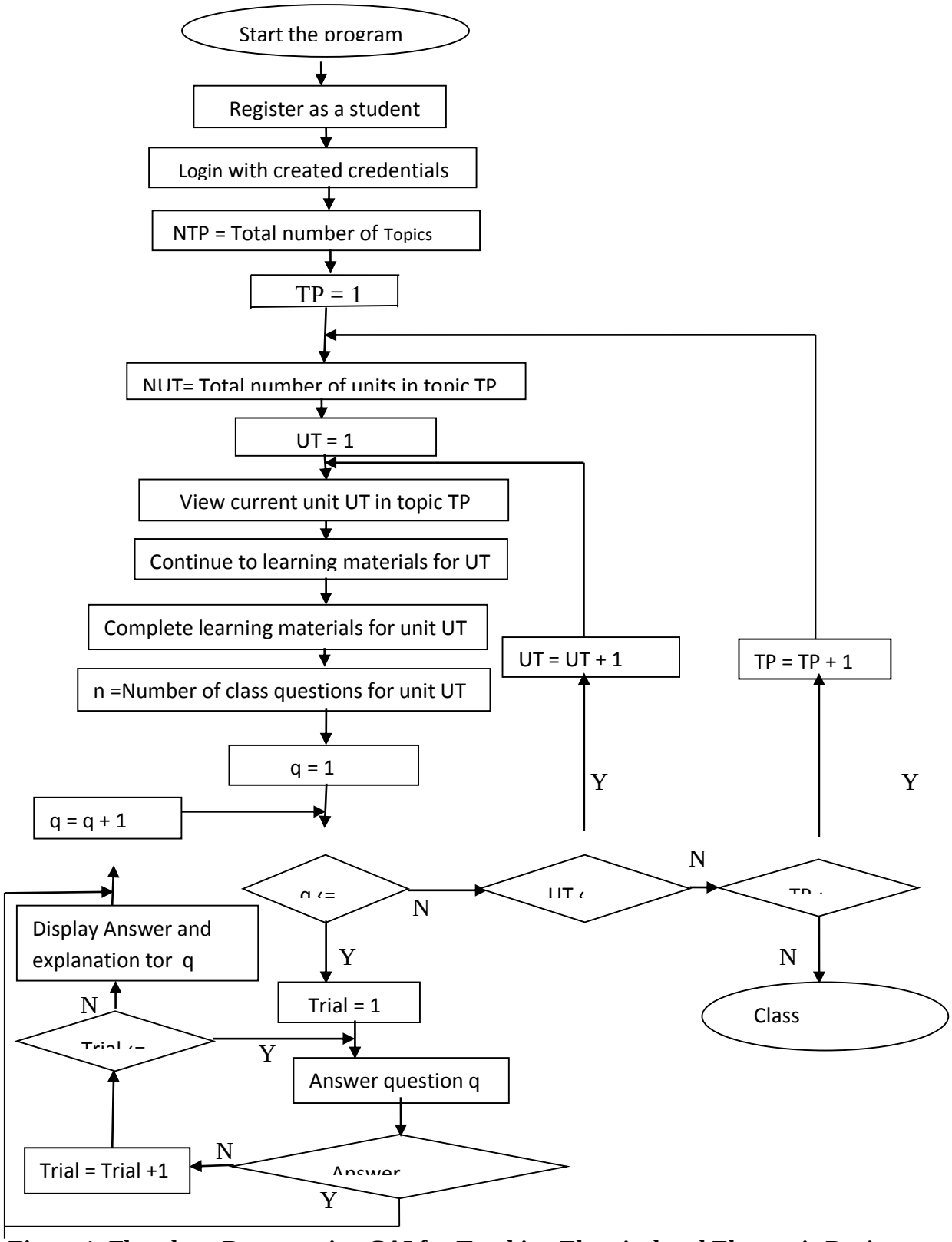

Figure 1: **Flowchart Representing CAI for Teaching Electrical and Electronic Devices at N.C.E. Level.**

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Research Question 2: What is the result of testing the CAI?

In order to answer research question 2, the CAI was tested to determine whether there was difference in the mean scores of the experimental and control groups for Electrical and Electronic Devices.

Testing for Mean scores of Experimental and control groups in Electrical and Electronic Devices, students were randomly assigned to experimental (S1) and control (S2) groups respectively. The S1 group was taught Electrical and Electronic Devices using the developed CAI and the S2 group was taught Electrical and Electronic Devices using Lecture method. Identical post-test was administered on the two groups after instruction. The scores obtained from the post-test of the two groups were used to compute the mean scores. A summary of the result is presented in Table 1

Table 1 shows the mean ($\bar{x}_1$) scores of experimental (S1) and control (S2) groups. Results indicate that the mean score of S1 is 21.40, while the mean score of S2 is 18.70

This shows that the mean score of S1 is greater than the mean value of S2. It means that the mean scores of students taught electrical and electronic devices using CAI and those students taught using the lecture method vary.

Table 1: Mean Scores of Experimental (S1) and Control (S2) Groups

Groups	N	$\bar{X}_1$	SD
Experimental (S1)	40	21.40	3.69
Control (S2)	40	18.70	3.32

N = Sample size of individual group; $\bar{X}_1$ = Mean score in Electrical and Electronic Devices; SD = Standard deviation.

Hypothesis 1 (HO_1): There is no significant difference between the mean achievement scores of students taught Electrical and Electronic Devices at N.C.E. II level using Computer-Aided Instruction and students taught Electrical and Electronic Devices at N.C.E. II level using Lecture method.

In order to test hypothesis 1, N.C.E. II (Tech) students were randomly assigned to experimental (S1) and control (S2) groups respectively. The S1 group was taught Electrical and Electronic Devices using Computer-Aided Instruction and the S2 group was taught Electrical and Electronic Devices using Lecture method. Identical post-test was administered on the two groups after instruction. The scores obtained from the post-test of the two groups were used to test the hypothesis using Z-test. A summary of the result is presented in Table 2.

Table 2 shows the mean ($\overline{X}$), standard deviation (SD), Z calculated value (Z-cal), Z critical value (Z-crit) of the Z – test of difference between mean achievements of the experimental (S1) and control (S2) groups. Results indicate that Z calculated value is 3.49, while Z critical value is 1.96. The Z- cal (3.49) is greater than Z-crit (1.96). Therefore, the null hypothesis (HO_1) was rejected. It means that there is a significant difference between the mean achievement scores of students taught Electrical and Electronic Devices at N.C.E. II level using Computer-Aided

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Instruction and students taught Electrical and Electronic Devices at N.C.E. II level using Lecture method.

Table 2: Z – Test of Difference between the Mean Achievement of the Experimental (S1) and Control (S2) Groups in Electrical and Electronic Devices at N.C.E. II level.

Groups	N	$\overline{X}$	SD	Z-Cal	Z-Crit	Remarks
Experimental (S1)	40	21.40	3.69			
				3.49	1.96	Rejected
Control (S2)	40	18.70	3.32			

N = Sample size of individual group; X = Mean; SD = Standard deviation; Z-Cal = Z Calculated value; Z-Crit = Z critical value.

Findings of the Study

The following were the findings of this study:

1. The flowchart for the CAI was developed with the use of 25 symbols as shown in Figure 1. The symbols comprised of 2 - terminal, 18 - process, and 5 - decision symbols.
2. When the developed CAI was used, there was difference in mean scores of the experimental and control groups in electrical and electronic devices as revealed in Table 1.
3. There was a significant difference between the mean achievement of students taught Electrical and Electronic Devices at N.C.E. II level using CAI and students taught Electrical and Electronic Devices at N.C.E. II level using lecture method.

DISCUSSION

The discussion of the findings has been done in line with the research questions and hypothesis that guided the study. Research question one centred on the flowchart for the CAI. Findings in respect of research question one as shown in Figure 1, indicated that 25 symbols were used in developing the flowchart. The 25 symbols comprised of 2 oval shapes (Terminal symbols), 18 Rectangular shapes (Process symbols) and 5 Diamond shapes (Decision symbols). This finding led to the conclusion that the symbols used are standard and accepted symbols for constructing flowchart. The finding confirms with that of Sonmez (1986) who reported on standard symbols for developing flowchart.

Research question two was on test result of the CAI. Findings in respect of research question two shows that there was difference in the mean scores of the experimental and control groups in Electrical and Electronic Devices. This finding led to the conclusion that the students who were taught using the CAI performed better than those students taught using the lecture method. The finding confirms with that of Ozofor (2001) and Chawla and Deshwal (2013) who in their individual studies stated that students who used CAI performed better than the students who did not use CAI.

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Findings in respect of hypothesis one indicated that the null hypothesis was rejected. This means there was a significant difference between the mean achievement of students taught Electrical and Electronic Devices at N.C.E. II level using CAI and students taught Electrical and Electronic Devices at N.C.E. II level using lecture method. This finding led to the conclusion that the students who were taught using the CAI performed better than those students taught using the lecture method. The finding confirms with that of Mulligan and Wood (1993), Hobson, Carter, Hall and Atkiris (1998) who in their individual studies reported that students who used CAI performed better than the students who did not use CAI.

CONCLUSION AND RECOMMENDATIONS

In this study a Computer-Aided instruction (CAI) for teaching electrical and electronic devices at N.C.E. II level has been developed. It was established that students taught using CAI performed better than the students taught using lecture method. It means that electrical and electronic devices can be taught more effectively using CAI to complement the existing lecture method currently used. This would also enable the students to learn the skills they ought to learn, thereby improving their performances on the job.

Based on the findings of the study, the following recommendations were made: (1). Lecturers of electrical and electrnics technology at N.C.E. level should be encouraged to use CAI in teaching N.C.E. II electrical and electronics devices to complement the existing lecture method, as CAI has been found to be more effective. This can be done by making the use of CAI in teaching as a requirement for accreditation of N.C.E. (Tech) programme. (2). National Commission for Colleges of Education (N.C.C.E.) to adopt the CAI, modify it and use it for the commission's services with the view to improving teaching effectiveness.

REFERENCES

Access Centre (2010). *Computer-assisted instruction and Mathematics*. Retrieved April,22, 2010 from http://www.k8acesscentre.org/default.aspt

Akuezuilo, I.O. & Agu, J. (2003). Instructional materials improvement in social studies. Asaba Journal of Education Studies: 1(1), 57-61.

Amold, D.N. (2007). Computer-aided instruction. Microsoft® Encarta®2008. Redmond: Microsoft Corporation.

Anderson, L.W. (2004). *Increasing teacher effectiveness*. Paris: UNESCO: International Institute for educational planning. Retrieved from http://www.UNESCO.org/iiep

Balian, E.S. (1988). *How to design, analyse and write doctoral or masters research (2nd ed)*, London: MD, university press of America inc.

Baraka, M. N. (2006). Strategies for teaching and learning vocational and technical skills. *Journal of Vocational and Technical Educators, 1 (4), 29 - 31.*

Bednar, M. J. &Sweeder, J. J. (2005). Defining and applying idea technologies: A systematic, conceptual framework for teachers. *Computers in schools, 22(3).*

Chawla, A. & Deshwal, P. (2013). Effectiveness of computer assisted instruction on academic achievement of students in social science. *Darpan international research analysis, 1(6): 1- 4.*

Dibal, N.P. (2006*). Basics of research methods*. Kaduna: Apani publications.

ISSN: 2059-1187, ISSN 2059-119

Enemali, J. O. (2006). Effective teaching and learning of technical vocational skills. *Journal of Vocational and Technical Educators, 1 (4), 9-10.*

Find-health-articles.com (2010). Computer-assisted instruction. *Research news and information.* Retrieved from http://www.find-health-articles.com/

Gay, L.R. (1993). *Educational research competences for analysis and application.* Colombia: Charles E. Merril publishing co.

Hobson, R.S., Carter, N.E., Hall, F.M. & Atkins, M.J. (1998). A study into the effectiveness of text-based computer-assisted learning program in comparison with seminar teaching of orthodontics. *Euro Journal of Dental Education, 2:* 154-9.

Ittelson, J.C. (2007). Audio-visual education. Microsoft® Encarta®2008. Redmond: Microsoft Corporation.

Jaehnig, W. & Miller, M.L. (2007).Feedback types in programmed instruction: A systematic review. *The psychological record*. Retrieved July 1, 2010, from http://www.ighbeam.com/The+psychological+Record/publication.aspx?date=200703

Keane, M. (2003). *Encyclopedia and dictionary of medicine, nursing, and allied health, Seventh edition:* Saunders, an imprint of Elsevier, Inc.

Mac-Ikemenjima, D. (2005). E-education in Nigeria: Challenges and prospects a presentation at the 8th UN ICT task force meeting, April 13-15, Dublin-Ireland.

Medugu, J.D. (2011). *The Effectiveness of a Virtual Oscilloscope for the Teaching of some Radio, Television and Electronics Work Concepts at Technical College level.* Unpublished Ph. D thesis, Abubakar Tafawa Balewa university Bauchi.

Mulliagan, R. & Wood, G.J. (1993). A controlled evaluation of computer-assisted training Simulations in geriatric dentistry. *J. dent educ*; 57:16-24

National Commission for Colleges of Education (2008). *The Minimum standards for Nigeria certificate in education: Vocational and technical education (4th ed)*. Abuja: N.C. C. E.

Ndomi, B.M. (2006). An overview of teaching and learning vocational and technical education courses in Nigeria. *Journal of Vocational and Technical Educators, 1(4),* 4-5

NewSam, P. (2007). Teaching and learning. Microsoft ® Encarta ® 2008. Microsoft corporation.

Okorie, J.U. (2001). *Vocational industrial education*. Bauchi: League of researchers in Nigeria.

Olaitan, S.O. & Ndomi, B.M. (2000). *Vocametrics*: *A high-tech problem solving quantitative text with computer skills.* Onitsha: Cape publishers international limited.

Osuala, E.C. (2005). *Introduction to research methodology*. Onitsha: Africana-first publishers limited.

Ozofor, N.M. (2001).*Effect of two modes of computer-aided instruction on students' achie ement and interest in statistics and probability.* University of Nigeria Nsukka, pg thesis abstract website. Retrieved http:/www.UNN-edu.Net/postgrad/pg-fac-of-education.htm

Ozuruoke, A. A. (2006). The comparative analysis of teacher-career enhancement system among institutions of higher learning for growth and development in Rivers State-Nigeria. *Nigerian Journal of Professional Teachers, 1 (4), 125.*

Puthawala, M.M. (2002). Computer assisted instruction. *Computer sciences*. Retrieved from Sonmez, V. (1986). *Teachers' handbook in program development*. Yargi publications, Ankara.http://www.encyclopedia.com/doc/1g2-3401200346.html

Sambo, A.A. (2005). *Research methods in education*. Lagos: Stirling Horden publishers (Nig) Ltd.

ISSN: 2059-1187, ISSN 2059-119

Semenov, A. (2005). *Information and communication technologies in schools: a hand-book for teachers or how ICT can create new, open learning environments*. Paris: UNESCO.

Tiemann, P.W. & Markle, S.M. (2007). Programmed instruction. Microsoft® Encarta® 2008. Redmond: Microsoft Corporation.

Uzoagulu, A.E. (1998). *Practical guide to writing research project report for tertiary Institutions*. Enugu: John Jacob's classic publishers ltd.

ISSN: 2059-1187, ISSN 2059-119