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WEB-BASED APPLICATION OF ELECTRICAL INSTALLATION AND MAINTENANCE WORK INTELLIGENT TUTORING SYSTEM IN WEST AFRICAN TECHNICAL COLLEGES

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ABSTRACT: *Digital technology has provided an effective instructional delivery paradigm in technical education, which enhances the attainment of cognitive, affective, and psychomotor skills. The purpose of an intelligent tutor as a computer-aided learning system is to complement teacher activities by providing students with relevant information via a computer interface. This study aims to develop a web-based artificial intelligence tutoring system for practical electrical installation and maintenance work for teachers in Nigerian technical colleges. Specifically, the study sought to develop the Electrical Installation Intelligence Tutor (EIIT) software, determine the effect of the tutor on students' acquisition of practical skills, and determine students' interest in studying electrical installation. Two research questions and two null hypotheses guided the study. The study adopted R&D design. From a population of 263 electrical installation students, 20 were selected to use the stand-alone method and 18 to use the web-based method. The instrument for data collection was lesson plans based on three of the components of electrical installation namely, domestic and industrial installation, and cable jointing topics as listed in the National Board for Technical Education syllabus. An achievement test and interest survey were developed and built into the software. Validation of the content of the achievement test was determined to be 0.67, while the internal consistency of the survey was 0.89. The null hypotheses were tested through analysis of covariance at the 0.05 significance level. Results show that use of the tutor caused the students to be more highly interested and motivated. Thus, the authors recommend intelligent tutor*

KEYWORDS: Web-Based, Electrical Installation, Intelligent Tutoring, Technical Colleges

INTRODUCTION

Technological innovation has been incorporated into many areas of human endeavor such as travel, home life, communication, industry, and assisted learning. Education is no exception. Computer-aided learning (CAL) has long been used to assist in technical education as a means of instructional delivery. CAL consists of a developed program or series of programs with the explicit aim of replacing current methods of instruction, often referred to as computer-based instruction (Nwana 2008). Nwoji (2013) defines CAL as educational strategies that can be integrated into a particular subject with respect to the pedagogical advantages in areas of learning where other strategies are falling. A well-designed and properly integrated CAL tool presents materials in an effective way that facilitates communication between teachers and students, enables collaboration and easy access to resources, encourages self-paced learning, and provides online assessment. Development of such tools, however, requires academic expertise and knowledge of information technology (IT) (Abdl-El-Aziz, 2013). To enable a computer to perform a task that is performed by a human being requires intelligence, which is typically provided by a rule-based expert system.

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An expert system requires human expertise to be transferred to the computer, which involves integration of human knowledge in the system through application of artificial intelligent (AI) techniques. According to Romos et al. (2009), AI is the ability of computer-developed programs to allow a machine to perform functions normally requiring human intelligence, as a tool in the teaching and learning process. Intelligent tutors are software applications that use electronic technologies for personalized instructional delivery. Tutoring is an individualized one-on-one teaching and learning mechanism that uses AI technologies for instruction. AI attempts to simulate a teacher who guides the student lesson flow (Keles et al. 2009). The learner interacts with the system through an interface system, receiving information, providing responses to questions, and even generating dialogue by asking questions (Moursund 2009). Learners view the Internet as a crucial information-gathering system.

The Internet allows computer users to locate and view multimedia documents on any subject. There is currently much excitement about the use of the Internet, a global network of computers that links the information world. Web-based applications provide the interactivity and responsiveness that users typically expect of desktop applications. According to Deitel and Deitel (2007), a web-based application generates web content for the web. Browser and client web applications include Google maps, Yahoo, Flickr, and many more that separate the user interaction portion of the application from its server interaction enabling both to proceed asynchronously. The entire page can be submitted and reloaded with every user interaction on the web in parallel, thereby saving time and resources.

Thus, the performance of web-based applications is now similar to that of desktop applications, eliminating the traditional performance advantage of the latter. The system must then respond to the student in a manner appropriate to the individual's pattern of queries and subsequent responses that it has received. The system plays the exclusive role of the task expert, controlling the selection of tasks or problems, while the student is responsible for answering them (Huseyin 2003). This shift from the desktop to web open-source software, inexpensive computers, and exploding Internet bandwidth, has provided the major growth phase for educational delivery, offering greater flexibility and allowing students to control their own concordance of study, yet still following the learning sequence set by the teacher (Chappell 2002). Therefore, an intelligent tutor as the instruction medium tracks the student's work tailoring feedback and hints along the way. It also encourages the shift from teacher- to student-centered instruction, where learners become active students. Schiaffino et al. (2008) asserted that when students are actively involved in their learning, they are more likely to remember what they did rather than what they read or heard. The ultimate test of a good technical educational program is not how much factual information students can remember, but what technical skills they possess or can perform in a technical field of employment coupled with rapid technological changes in the world (Okoro 2006).

Electrification is one of the fields of human endeavor where technology changes very rapidly. Electricity involves many hazards; Ogbuanya (2005) described electricity as a good servant but a bad master. Anyone can be exposed to these hazards: at home, at school, at work, or even outdoors. Therefore, electrical installations can only be carried out by appropriately qualified or trained personnel who are able to recognize electrical hazards or potentially unsafe conditions. Ogbuanya et al. (2012) maintained that despite the risk and hazards involved in electrification, teaching and learning has a major role to play in the provision of electricity for industries. It is expected that students should possess skills that enable them to perform in their areas of discipline. Osuala (2001) observed that there are many vacant skilled job opportunities

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in industry. Oranu (2001) stated that the graduates of technical colleges are weak in the practice of their trades. Furthermore, the standard of performance of Nigeria technicians in general is currently very low, thereby retarding the overall productivity of the Nigerian economy (Okorie 2001). There have been persistent reports of high failure rates among graduates of the colleges (FGN 2001; NABTEB 2006). One probable cause of this high failure rate in recent years according to the NABTEB (2002) chief examiner's report is the methods employed to teach the students. Therefore, the poor skills of the electrical installation students are a reflection of the quality of electrical installation teachers in the colleges.

Because these teachers attended different institutions, they have different qualifications and experience. Some of the skills they possess at graduation become obsolete as time goes by, while others need updating. Electrical installation training is extremely complex and expensive, and requires practical knowledge, understanding, and experience before it can be transferred in a fully effective and professional manner. It is well known that there is a serious shortage of competent qualified electrical installation teachers in all the states in Nigeria; however, this can be remedied by the use of innovative technology, known as intelligent tutoring systems (ITS). An ITS is not a substitute for good teaching; rather it is a complementary software application package that can assist teachers in effective instructional delivery.

A software application or package is a set of related programs that achieve a particular task, such as a word processor, SPSS word star, spread sheet, graphic package, Matlab, and GMAT, amongst many others, and are sold and used as a single unit (Sarrafzadeh et al. 2008). Thus, it is a collection of instructions that control the functionality of the computer to achieve a single purpose. According to D'Mello et al. (2012), an ITS consists of four component-based models, namely, domain, student, tutor, and user interface models. In constructing the tutor, we adopted the steps of the waterfall model's sequential design process often used in software development processes: conception, initiation, analysis, design, construction, testing, production/implementation, and maintenance. A user interface was developed to provide communication between the student and the website by means of typing and reading from the screen. This is necessary because most programs use non-verbal techniques (that is, typing, clicking on buttons, and reading from the screen). Machines that can converse with students are clearly more flexible than those supporting more restrictive interaction. The modules deliver the content of the subject matter to the student in a dynamic and personalized style. The courseware presentations are determined based on the previous interaction of the student with the tutor (recorded by the student model). The lessons are presented to the student in the order specified by the teacher in the instruction module (Schiaffino et al. 2008). The student is said to have "completed" a lesson only after attaining the threshold specified by the teacher in the quiz for that particular lesson. The passing criterion specified for each lesson is 50 marks in the corresponding quiz. This is to ensure that a student can enroll in a lesson only if he has a fair understanding of its prerequisite lesson in electrical installation work.

Electrical installation and maintenance work is one of the courses offered in technical colleges in Nigeria. It comprises basic electricity, battery charging, domestic installation, industrial installation, cable jointing, and winding of electrical machines as contained in the NBTE 2001 curriculum. An electrical installation according to Gubta (2013) is an installation in a building, which comprises various kinds of electrical apparatus fixed in a position ready for use, together with the necessary connecting wires and control gears. Gubta (2005) listed the following as types of electrical installations: bare conductor wiring, conduct wiring, rubber sheathed wiring, polyvinyl chloride (PVC) wiring, used in sheathed wiring earthed concentric installations,

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mineral insulated installations, and electrical machine installations. Hence, the installation type seen to be the most suitable for a particular condition or environment can be employed. According to Abdullahi (2010), none is regarded as the best for all situations or environments. Furthermore, domestic installation is concerned with installation of electrical components or equipment in a building. Such electrical components include home appliances fixed in position ready for use. Domestic installation involves surface wiring, conduit wiring, as well as maintenance of electrical fittings, such as illumination lamps used in homes, mostly in the 0.50–415 V range (Ogbuanya 2005). Industrial installation, however, involves industrial consumption of high tension conductors made from aluminum or copper and alloy. High voltages from 415 V and above are transmitted through over-head conductors, underground, and trunking, as either alternating current or direct current for machines and equipment through cable joints with control gears for protection. Cable jointing according to Cosmas (2010) means one or more conductors with or without insulating covering in different types, sizes, and shapes such as armored cable, over-head conductors, boss bars, and commercial cable joints, or termination in transmission. Transmission is the means of conveying, distributing, and installation for effective use in homes and industries.

Technical colleges are institutions where students are trained to acquire relevant knowledge and skills in different occupations for employment in the real world (NBTE 2007). According to the Federal Ministry of Education (FME) (2004), technical colleges form part of technical and vocational education designed to produce artisans at the secondary school level and master artisans at the advanced craft level. The goals of technical colleges are to provide trained workers in the applied sciences, technology, and business particularly at the advanced craft and technician levels. Technical colleges, regarded as the principal vocational institutions in Nigeria (Okoro 2006), are expected to put learning into practice using newer methodologies of applying devices, materials, tools, equipment, machinery, and other resources to enable expert electricians to solve practical problems. These include the manipulation of materials or objects in the form of work tasks, such as lighting a lamp, tightening or unscrewing a socket outlet as part of the complex process of dismantling and re-assembling a burned distribution chamber in an electrical installation. Hence, complementary techniques of instructional delivery motivate students to learn well.

This is then followed by an evaluation process, where the learner responds to questions posed by the tutor. Immediate feedback is given to improve comprehension and future performance, while at the end of each unit, an overall evaluation is conducted to assess whether the learner should advance to the next topic or review the stated acquired information. The tutor analyzes a leaner's prior knowledge and provides the leaner with remediation that is more extensive. In remediation, the information that has already been covered in the learner's program is repeated, allowing a leaner who had not paid attention to the instructor during the training to be exposed to the information again. The assessments usually test the practical application of theoretical understanding, whose validation according to Weisgerber and Butler (2010) is confirmation by examination and the provision of objective evidence that the particular requirement for a specific intended use has been fulfilled. Frankel et al. (2012) stated that interest in the process of collecting and analyzing evidence to support such confirmation is an important part of the overall validation of input/output of a web-based application design to ensure that all aspects of the tutor conform to the needs and intended use of the user. An intelligent tutor as described above, has however, prompted a parallel upsurge in the design and development of diverse software according to the institution's interest.

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Interest has been described as the attraction that forces or compels a learner to respond to a particular stimulus. Because interest increases learning, promoting interest in the classroom increases students' intrinsic motivation to learn (Martens and Kirschner 2004). Abdullahi (2011) stated that the provision of an engaged learning environment promotes students' interest in learning. This means that when learners are involved in the learning process, learning is facilitated and achievement can be enhanced. Students' interest in any learning activity can therefore, be sustained by the active involvement of the learner in all aspects of the learning process. In other words, a learner's interest in an activity increases the strength of ego-involvement of the learner, and prevents the learner from being distracted by trivial extraneous events around him. Obodo (2004) maintained that interest controls the motivation to learn, and thus, has a direct relationship to a student's achievement in any school subject.

A learner's achievement in trade subjects is symbolized by the score or grade on an achievement test. According to Frankel et al. (2012), achievement or ability measures an individual's knowledge or skills in the given areas or subjects, while performance includes the ability to acquire and develop productive/manipulative skills based on the cognitive domain. Arroyo (2004) pointed out that student achievement is dependent on several factors, including the instructural methods and learning environment. Hence, it is essential that electrical installation teachers should adopt teaching methods that allow active involvement in learning and provide a suitable learning environment to improve achievement, stimulate interest, and improve performance of electrical students in learning electrical installation and maintenance practice.

The development and validation of the ITS was completed in two ways: a web-based application and a stand-alone application accessible via a CDROM. Both applications included the same electrical installation content as well as the evaluation and multimedia examples to determine the extent to which the motivation, feedback, and practical demonstration techniques of the tutor benefitted the user and thus, to extract the efficacy of the tutor as a web-based individualized instruction package. Thus, there is an urgent need for the design and development of web-based application software that best suits the peculiar needs of the developing environment in Nigeria to fill the current gap in the literature.

The study aimed to develop and validate an intelligent tutor for electrical installation work in the technical college program. Specifically the study sought to:

1. Compare the performance of practical skills in electrical installation using the tutor as a stand-alone application.

2. Compare student's interest in learning electrical installation using the tutor as either a stand-alone or web-based application.

The following null hypotheses of the study were tested at the 0.05 significance level.

H_{01} There is no significant difference between the mean performance of students taught electrical installation using the stand-alone application and those taught using the web-based one.

H_{02} There is no significant difference between the mean interest of students taught electrical installation using the stand-alone application and those taught using the web-based one.

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METHODOLOGY

From a review of related literature, previous research focused on theoretical framework approaches to AI tutoring systems (AITS) as the instructional delivery means for computer-assisted leaning. The development of the tutor involved creating an electrical installation and maintenance software package as well as processes for an AITS based on related empirical studies. Hence, our special objectives were the development of the software for the Electrical Installation Intelligence Tutor (EIIT) trial and testing to determine its effect. Based on the two research questions concerning (i) the students' performance, and (ii) their interest in acquiring practical skills of electrical installation students, two hypotheses were tested at the 0.05 significance level.

The intelligent tutor EIIT, implemented in the Java programming language and incorporating a validated nine lesson plan on electrical installation, was accessible through stand-alone and web-based versions. The study adopted a research and development design that involved the waterfall model. A reliability coefficient of 0.80 was also realized. Validation took place by means of a pre-test, post-test, and non-equivalent control quasi-experiment. The EIIT was developed in a topic-based format using the Advanced National Technical Certificate (ANTC) syllabus. The sampling population consisted of 263 ANTC electrical installation students. Sampling without replacement was used to draw two sets of students from centers registering students for the ANTC. The sample for the study consisted of 38 students, comprising 20 stand-alone and 18 web-based participants. The instrument for data collection consisting of 53 items was given to all students immediately on completion of the registration process. Both stand-alone and web-based participants were presented with the test that was programmed not for student feedback; the same test was repeated at the end of the tutoring. After 4 weeks of administration of the stand-alone tutor, the results were retrieved from the desktop application. The web application was programmed to send the research results via an email to the researchers. Having retrieved and analyzed the results of the study, we used the mean values to answer the two research questions, and an analysis of covariance (ANCOVA) to test the hypotheses at the 0.05 level of significance using the Statistical Package for Social Science (SPSS) version 17.

RESULTS

What is the effect of the ITS on electrical installation students' performance in acquiring practical skills?

Table 1: Mean pre- and post-test scores of treatment groups in the electrical installation performance test

Treatment Groups	N	Pre-test Mean	SD_1	Post-test Mean	SD_2	Mean Gain
Stand-alone	20	24.27	1.62	54.87	4.42	30.60
Web-based	18	27.07	5.64	59.36	9.82	32.29

SD_1= standard deviation of pre-test
SD_2= standard deviation of post-test

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The data in Table 1 show that the treatment group using the stand-alone tutor in learning electrical installation had a pre-test mean score of 24.27 with standard deviation of 1.62 and a post-test mean score of 54.87 with standard deviation of 4.42, giving a pre-test/post-test mean gain of 30.6. The treatment group that used the web-based tutor had a pre-test mean score of 27.07 with standard deviation of 9.82, and a post-test score of 59.35 with standard deviation of 9.82, giving a pre-test/post-test mean gain of 32.29. These results show that the use of a web tutoring system to complement teaching and learning of electrical installation is effective in improving students' performance. The effect was greater in the group that used the web-based tutor than the group using the stand-alone tutor.

What is the effect of the ITS on the students' interest in acquiring practical skills in electrical installation?

Table 2: Means of pre- and post-test scores of treatment groups in the electrical installation interest test

Treatment Groups	N	Pre-test Mean	SD_1	Post-test Mean	SD_2	Mean Gain
Stand-alone	20	67.15	9.11	62.85	6.88	-4.30
Web-based	18	61.72	4.46	61.78	8.42	0.06

SD_1= standard deviation of pre-test

SD_2= standard deviation of post-test

The data presented in Table 2 show that the treatment group using the stand-alone tutor for learning electrical installation had a pre-test mean score of 67.15 with standard deviation of 9.11 and a post-test mean score of 62.85 with standard deviation of 6.88, giving a pre-test/post-test mean gain of −4.30. The treatment group that used the web-based tutor had a pre-test mean score of 61.72 with standard deviation of 4.46, and a post-test mean score of 61.78 with a standard deviation of 8.43, giving a pre-test/post-test mean gain of 0.06. These results show that the use of a web tutoring system to complement the teaching and learning of electrical installation is effective in improving students' interest. This effect was higher in the group that used the web-based tutor than those using the stand-alone application.

Hypothesis one

There is no significant difference in the mean performance scores of electrical installation students using the web-based tutoring system and those using the stand-alone one in terms of skills acquisition in electrical installation in the performance test.

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Table 3: Performance score of skills acquisition in electrical installation tutors

Source of variation	Type III sum of squares	DF	Mean score	F	Sig	Eta squared
Corrected Model	149,430	2	74.715	1.275	296	0.089
Intercept	2998.699	1	2008.699	34.280	0.000	0.569
Pre-test	3.412	1	3.412	0.058	0.811	0.002
Error	115.890	1	115.890	1.978	0.171	0.071
Treatment	1523.536	26	58.598			
Total	9600.000	29				
Corrected total	1672.966	28				

a. R squared = 0.089 (adjusted R squared = 0.009)

b. Significant at sig of F<0.05, not significant at sig of F>0.05

c. P (1.26) = 1.98. p=17 partial eta squared = 0.09

The data presented in Table 3 show the results of a one-way between-groups ANCOVA conducted to compare the effect of the developed AI tutor on two different groups of students, that is, those using the web-based and stand-alone tutors, respectively, in acquiring practical skills for electrical installation according to the performance test. The independent variable was the type of treatment group (web-based vs. stand-alone) while the dependent variable was the score on the electrical installation performance test after the experiment was completed, that is, the post-test. The students' scores on the pre-test administration of the installation test were used as the covariate in this analysis. The F-value with 1.26 degrees of freedom is 1.98 with a significance value of 0.171, given the above cut-off threshold of 0.05. Thus, the null hypotheses (H_{O2}) is accepted at the 0.05 significance level, which implies that there is no significant difference between the mean performance scores of students using the web-based and stand-alone tutors for acquiring practical skills, on the electrical installation performance test. Therefore, the use of the web-based tutor is effective in acquiring practical skills in electrical installation.

Hypothesis two

There is no significant difference in the mean interest scores of electrical installation students using the web-based tutoring system and those using the stand-alone one for skill acquisition in the electrical installation interest test.

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Table 4

Interest scores of skills acquisition in electrical installation tutors

Source of variation	Type III sum of squares	DF	Mean score	F	Sig	Eta squared
Corrected Model	243.978	2	121.989	2.008	0.149	0.103
Intercept	1324.287	1	1342.287	22.100	0.000	0.387
Pre test	159.973	1	159.973	2.634	0.114	0.070
Error	2125.838	35	60.738			
Treatment	12.501	1	12.501	0.206	0.653	0.006
Total	298581.000	38				
Corrected total	2369.816	37				

a. R squared = 0.103 (adjusted R squared = 0.052)
b. Significant at sig of F<0.05, not significant at sig of F>0.05
c. P (1.35) =0.21, p=0.65 partial eta squared = 0.10 c

The data in Table 4 show the one-way between-groups ANCOVA conducted to compare the effect of the developed AI tutor on the interest of two different groups of students, those using the web-based and stand-alone tutors, respectively, for acquiring practical skills of electrical installation. The independent variable was the type of treatment group (web-based vs. stand-alone) while the dependent variable consisted of the score on the electrical installation test after the experiment was completed, i.e., the post-test. Students' scores on the pre-test were used as the covariate in this analysis. The F-value with 1.26 degrees of freedom is 1.98 with a significance value of 0.171. Given the above cut-off threshold of 0.05, the null hypotheses (H_{O2}) is accepted at the 0.05 level of significance. This implies that there is no significant difference between the mean interest scores of students using the web-based and stand-alone tutors in acquiring practical skills of electrical installation. Therefore, the use of a web-based tutor is effective in acquiring practical skills of electrical installation.

DISCUSSION

The use of stand-alone and web-based tutors to complement instructional delivery was effective in improving students' performance in electrical installation; however, the effect was higher in the group using the web-based tutor.

The use of a web-based ITS was slightly effective in improving the students' interest in learning electrical installation when used as complementary instructional delivery; however, the stand-alone system was not effective.

The mean performance scores in the performance test of students using the web-based system were higher than those of students using the stand-alone system. Therefore, the use of a web-based tutor is effective in acquiring practical skills in electrical installation practice.

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There was a significance difference between the mean interest scores of electrical installation students using the web-based tutor and those using the stand-alone system in learning electrical installation.

CONCLUSION

We have developed an intelligent tutor for teaching electrical installation work in technical colleges. The ITS using a web-based tutor improves performance and enhances interest slightly more than that using a stand-alone system. The intelligent tutor enhances the interest of students in learning electrical installation.

RECOMMENDATIONS

1. To implement a web-based approach successfully in the educational system, there is an urgent need to train and retrain technical teachers through regular seminars, workshops, and in-service training on how to develop and maintain a website in their area of specialization to keep them aware and up-to-date with current trends in their field of study.

2. All stakeholders in technical education programs and professional practitioners in electrical industries should continue to explore ways of developing web applications that most promote critical thinking, disposition, and skills in every part of the program.

REFERENCES

Abdl-El-Aziz, A. A. (2013). Affect of computer-based instruction on students achievement and retention in auto-mechanics in technical colleges. International Journal of Educational Research, Official Journal of the Faculty of Education, University of Nigeria, 12(2-4) p , .

Abdullahi, M. L. (2012). The imperative for enhancing global competiveness. APOS Asian. http://www.apotokyo.org/..../078 prod.htm. Accessed 23 February 2013.

Abdullahi, S. (2010). Electrical installation competencies required by electrical/electronic teachers in Bauchi and Gombe State technical colleges. Masters of Education thesis, University of Nigeria, Nsukka.

Arroyo, I. (2004). Web-based intelligent multimedia tutoring for high stakes achievement tests. Computer Science Department Faculty Publication Series, Paper 111. http://scholarworks.umass.edu/cs_faculty_pubs/111

Chappell, D. (2002). Understanding .Net a tutorial and analysis. Indianapolis: Pearson Education Inc.

Cosmas, I. A. (2010). Electrical Transmission media and antennas. Enugu, Nigeria: Fiac Publishers.

D'Mello, S., Olney, A., Williams, C., & Hays, P. (2012). Gaze tutor: a gaze-reactive intelligent tutoring system. International Journal of Human-Computer Studies, 70(5), 377–398.

Print ISSN: ISSN 2059-1187, Online ISSN: ISSN 2059-1195

Deitel, P., & Deitel, H. (2011) Visual Basic 2010: How to program. Upper Saddle River, NJ: Pearson Education Inc.
Deitel, P., & Deitel, P. (2007) Java: how to program. Upper Saddle River, NJ: Pearson Education Inc.
Federal Government of Nigeria (2004). National policy on education (revised edition). Abuja, Nigeria: Federal Ministry of Education.
Frankel, J., Wallen, N.E., & Hyun, H. (2012). How to design and evaluate research in education (8th edition). New York: McGraw Hill Inc.
Gall, M.D., Gall, J.P., & Borg, W.R. (2007). Educational research: an introduction (8th edition). New York: Pearson Education Inc.
Gupta, E. A. (2005). Electrical power concept, principles and practice (5th edition). New Delhi, India: Moore Man Publishers.
Gupta, E. A. (2013). Electrical power concept, principles and practice (6th edition). New Delhi, India: Moore Man Publishers.
Huseyin, Y. (2003). Intelligent Tutoring System: a tool for testing the research curiosities of artificial intelligence researchers. Turkish Online Journal of Educational Technology, 2(3)(6-8).
Keles, A., Ocak, R., & Gulcu, A. (2009). ZOSMAT: web-based intelligent tutoring system for teaching-learning process. Expert Systems with Applications, 36, 1229–1239.
Martens, R. L. & Kirschner, P. A. (2004). What predicts intrinsic motivation? Presented at the 2004 AECT convention, Chicago.
Moursund, D. (2006). Brief introduction to educational implications of artificial intelligence. http://darkwing.uoregon.edu/~moursund/dave/index.htm Accessed on July 15, 2014.
National Business and Technical Examination Board (2001). Condition for award of National Technical Certificate (NTC) and National Business Certificate (NBC). NABTEB Newsletter, 2(7), 14.
National Business and Technical Examination Board (2006). Chief examiners report of National Technical Certificate (NTC) and National Business Certificate (NBC). NABTEB Newsletter, 4(6), 21.
Nwana, E. S. (2008). Information and communication technology: ICT a continuity in educational technology. Onisha: West and Solomon Publishing Co. Ltd.
Nwoji, Q. J. (2013) Production and utilization of teaching materials. Nsukka, Nigeria: Fulladu Publishing Company.
Obodo, G. C. (1990). The differential effect of three teaching models on performance of junior secondary school students in some algebraic concepts. Ph.D thesis, University of Nigeria, Nsukka.
Ogbuanya, T. C. (2005). Electrical energy for home appliances. Enugu, Nigeria: Cheston Agency.
Ogbuanya, T. C., Abdullahi, S., & Ado Y. K. (2012). Electrical installation competencies required by electrical/electronic teachers in Northern Nigerian technical colleges. Nigerian Vocational Association Journal (NVAJ), 17(2)(255-269.
Okorie, J. U. (2001). Vocational industrial education. Bauchi League of Researchers in Nigeria. ATBU University printing press Bauchi.
Okoro, O. M. (2006). Principles and methods of vocational and technical education. Nsukka, Nigeria: University Trust Publisher.
Oranu, R. N. (2001). Vocational and technical education in Nigeria. Presented at the International Bureau of Education (IBE) sub regional seminar and workshop on strategies for teachers coping with the new curriculum on Nov. 17 2001 scan publishers, Badagry Lagos.

Print ISSN: ISSN 2059-1187, Online ISSN: ISSN 2059-1195

Osuala, E. C. (2001). Introduction to research methodology (3rd edition). Onitsha, Nigeria: Africana Fep Publishers Ltd.

Ramos, C., Frasson, C., & Ramachandran, S. (2009). Introduction. Special issue on real world applications of intelligent tutoring systems, 2(2), 62–63.

Sarrafzadeh, A., Alexander, S., Dadgostar, F., Fan, C., & Bigdeli, A. (2008). How do you know that I don't understand? A look at the future of intelligent tutoring systems. Computers in Human Behavior, 24(4), 1342–1363.

Schiaffino, S., Garcia, P., & Amandi, A. (2008). eTeacher: Providing personalized assistance to e-learning students. Computers & Education, 51, 1744–1754.

Weisgerber, C., & Butler, S. (2010). Editor's introduction to the special issue on communication pedagogy in the age of social media. Electronic Journal of Communication, 20(1–2), 1. http://www.cios.org/www/ejc/v20n12toc.htm. Accessed on 25 November 2011.

Print ISSN: ISSN 2059-1187, Online ISSN: ISSN 2059-1195