British Journal of Applied Science & Technology
12(1): 1-7, 2016, Article no.BJAST.19221
ISSN: 2231-0843, NLM ID: 101664541

SCIENCEDOMAIN *international*
www.sciencedomain.org

Effects of Computer Aided Design (CAD) in Teaching Electrical Drafting in Technical Colleges in Rivers State of Nigeria

Reagan N. Robinson[1*] and Anthony I. Amadi[1]

[1]Department of Technical Education, Rivers State University of Education, Rumuolumeni, P.M.B. 5047, Port Harcourt, Rivers State, Nigeria.

Authors' contributions

This work was carried out in collaboration between the two authors. Author RNR designed the study, performed the statistical analysis, wrote the protocol, wrote the first draft of the manuscript and managed the literature searches. Author AIA managed the analysis of the study and the literature searches. Both authors read and approved the final manuscript.

Article Information

DOI: 10.9734/BJAST/2016/19221
Editor(s):
(1) Chien-Jen Wang, Department of Electrical Engineering, National University of Tainan, Tainan, Taiwan.
Reviewers:
(1) Rajinder Tiwari, Amity University Uttar Pradesh, India.
(2) Samir Kumar Bandyopadhyay, University of Calcutta, India.
(3) A. Papazafiropoulou, Tzaneio General Hospital of Piraeus, Greece.
(4) Anonymous, Middle Technical University, Baghdad, Iraq.
Complete Peer review History: http://sciencedomain.org/review-history/11524

Original Research Article

Received 30th May 2015
Accepted 13th July 2015
Published 24th September 2015

ABSTRACT

The study was on the effects of Computer Aided Design (CAD) in teaching electrical drafting in technical colleges in Rivers State of Nigeria. A Quasi-Experimental design was adopted for the study. The population of the study was 89 students comprised of all the vocational 1 students in the 5 technical colleges in Rivers State of Nigeria. A purposive sampling technique was used to select two technical colleges for the study of which simple sampling technique was used to select 20 students (10 boys and 10 girls) in each school. The total sample size was 40 students. Two intact classes of experimental and control groups in each college were used. Two parallel instrument of Pre-DAT and Post-DAT were developed, validated and reliability duly taken before using them to collect data. The research questions were answered using mean and standard deviation while the hypotheses were tested at $P < 0.05$ using Analysis of Covariance (ANCOVA). The result of the data

**Corresponding author: E-mail: robinson_reagan@yahoo.com;*

analysis showed that, there was a significant difference between the experiment group and control group with the mean performance score of CAD group being more than the conventional group. There was no significant difference in the mean performance scores of male and female students taught using CAD. Based on the findings, some recommendations were made.

Keywords: Effects; Computer Aided Design (CAD); teaching; electrical drafting; technical college.

1. INTRODUCTION

As enshrined in the Federal Government of Nigeria policy on education [1], one of the goals of technical education programme is to provide trained manpower in technical skill that will lead trainees to the industry or self-reliant economically. This technical skill is expected to be developed in some specialised fields like; Mechanical Technology, Electrical/Electronic Technology, Building Technology etc. in technical institutions of which technical colleges is one [2].

This invariably means that, technical colleges in Nigeria train students to become skillful technicians in a specialised area of craft. The training qualifies them for jobs in both public and private sectors of the economy. Both sectors require well-trained and competent technicians [2] who can operate and maintain technical proficiencies. Therefore, there is a need for qualitative technical colleges in Nigerian education and training in order to produce graduates that can perform competently in their chosen vocation without a need for pre-employment training. The major goal for technical institution is to prepare students for successful employment in the labor market [3]. This condition can be met through a well packaged curriculum that is relevant and comprehensive with relevant training facilities. This well packaged curriculum offer opportunities for practical training of students in some skills like electrical drafting in electrical craft. It goes a long way to enhance future development of the key sectors of the economy in order to meet the basic needs of electricity, roads and machinery, among others. Electrical drafting in the field of electrical craft is an important part of the curriculum in technical colleges, but supportive enhancement of the present state is a fundamental requirement for the successful implementation of the curriculum [4,5].

Electrical drafting is a type of technical drawing [6] that shows detail information in power lines, lighting system, electrical specifications and communication for an electrical engineering project. It is sometimes referred to as electrical drawing or electrical working drawing. Electrical drafting/drawing consists of lines, symbols, dimensions, and notations to accurately convey engineering design to the workers, who installs electrical systems on job. It includes, electrical drawing for buildings, machines, power plants etc.

A complete set of working drawings for the average electrical system in large projects usually consists of a plot plan showing the building's location and outside electrical wiring; floor plans showing the location of electrical systems on every floor; Power-riser diagrams showing panel boards; Control wiring diagrams; Schedules and other information in combination with construction drawings. Electrical drafters prepare wiring and layout diagrams which is to be used by workers who erect, install, and repair electrical equipment and wiring in communication centers, power plants, electrical distribution systems, and buildings.

To draft any electrical circuit in a building for an example, the technician or engineer should possess the skill to draw, read and interpret lines, symbols and predict the voltages and currents at all point of utilisation within the circuit. But from the researcher's observation, the proficiency and productivity of technical college graduates in electrical drafting is too poor. They find it difficult to efficiently draw, neither read nor interpret electrical plans. Their skill in electrical drafting is not efficient enough to give expected results. Indeed, they are so slow, clumsy and inaccurate to the extent that employing their skills in drafting projects is becoming discouraging, hence rendering them jobless. The use of Computer Aided Drafting (CAD) in the teaching/ learning process in technical colleges will improve understanding in learning by enhancing students' skill in electrical drafting [7]. This is the rationale behind this study; trying to find out how effective the use of CAD would be in the teaching of electrical drafting.

Computer Aided Design (CAD), also known as Computer-Aided Design and Drafting (CADD), is

the use of computer systems to assist in the creation, modification, analysis, or optimization of a design [8]. Computer-aided drafting describes the process of creating a technical drawing with the use of computer software. CAD software is used to increase the productivity of the designer, improve the quality of drawings, improve communications through documentation, and to create a database for manufacturing. CAD output is often in the form of electronic files for printing or operations. CAD software uses either vector based graphics to depict the objects of traditional drafting, or may also produce raster graphics showing the overall appearance of designed objects, that is why it is the most suitable in facilitating electrical drawings/drafting [9].

Unlike the manual drafting of electrical drawings, the output of CAD conveys information such as materials, processes, shapes and tolerances, according to the application-specific conventions. Hence electrical drafting using manual can suffer so much errors in accuracy, dimension, lines, space and curves as compared to CAD in live projects. Hence, with the use of CAD all these errors can be eliminated. CAD is an important industrial art extensively used in many applications [10], including automotive, shipbuilding, industries, architectural and engineering and many more. Due to its enormous economic importance, CAD has become a major driving force for research in computational technology like electrical engineering, computer graphics (both hardware and software), and discrete differential geometry [11]. The design of technology and geometric models for object shapes, in particular, is occasionally called Computer-Aided Geometric Design (CAGD).

The goal of CAD systems is to increase efficiency [12], which means, if applied in electrical drafting, efficiency and productivity may be enhanced. Though CAD is not an easy method that gives newcomers flexibility on geometrical principles and solid modeling, but with consistency, learning is made easier. CAD is also used in the design of tools and machinery and in the drafting and design of all types of buildings, from small residential types (houses) to the large commercial and industrial structures (hospitals and factories).

There are different types of Computer Aided Design (CAD) software, each requiring the operator to think differently on how to use them and design their desired components in different manner. For an example; Auto CAD, Wireframe CAD, Solid Modeling CAD, Freeform Surface CAD etc. There are also many producers of the lower-end 2D systems, including a number of free and open source programs. Each of them provide an approach to drawing process without confusion over accuracy of scales in drawing, since drawings can be adjusted as required during the creation of the final draft. Giving the impression that, CAD may be the package that can turn around electrical drafting in technical colleges in Rivers State of Nigeria.

2. STATEMENT OF THE PROBLEM

The poor accomplishment of design specifications of electrical craft graduates from technical colleges in the world of work especially as touching the reading, interpretation and implementation of designed building plan revealed a very serious and disturbing problem. This is attributable to outdated conventional training pattern which is an utter neglect of electrical drafting/ drawing in the technical colleges and hence rendering them jobless [13].

Consequently, there is need to improve the training pattern of electrical drafting in the technical colleges by employing the use of computer software as an innovating pattern. Since the present 21st century has gone computerized by using computer aided design like Auto CAD in designing even the smallest electrical drawing, there is the need to introduce it in the technical colleges. The introduction of computer aided design in the training of students in electrical drafting, will improve the outdated conventional method which will help students cope with the present trend of design/drawing. This invariably means that the use of CAD henceforth in the training of electrical drafting in technical colleges will improve students' design specification in the world of work. This is the rationale behind this study. The study will take a look at the effects of CAD in teaching electrical drafting in technical colleges in Rivers state.

2.1 Purpose of the Study

The purpose of the study was to determine the effect of the use of Computer Aided Design (CAD) in teaching Electrical Drafting. Specifically, the study intends to;

1. Determine the effect of CAD in teaching electrical drafting when taught 'installation diagram' in technical colleges in Rivers State.

2. Find out the extent of influence gender has in the teaching of electrical drafting when taught installation diagram using CAD in technical colleges in Rivers State.

2.2 Research Questions

The following research questions were posed to guide the study;

1. What are the mean and standard deviation scores of Vocational 1 electrical students taught installation diagram with CAD and those taught same topic with conventional method in technical colleges in Rivers State.
2. What are the differences in mean and standard deviation scores of male and female vocational 1 students in Drafting Accessories Test (DAT) when taught installation diagram with CAD in technical colleges in Rivers State.

2.3 Hypotheses

The following hypotheses were tested at 0.05 level of significance.

1. Hypothesis 1(Ho_1): There is no significant difference between the mean scores of Vocational 1 electrical students taught installation diagram using CAD and those taught using the conventional method in technical colleges in Rivers State.
2. Hypothesis 2 (Ho_2): There is no significant difference between the mean scores of male and female Vocational 1 students in Drafting Accessories Test (DAT) using CAD in technical colleges in Rivers State.

2.4 Research Methodology

The design of the study was Quasi-Experiment design of the Pretest Posttest in an experimental and control groups. The study was carried out in Government Technical Colleges located in Port Harcourt and Ahoada Local Government Areas of Rivers State. The population of the study comprised of all the vocational 1 electrical craft students of government technical colleges in Rivers State, numbering 89. Purposive sampling technique was used to select 2 government technical colleges from the 5 government technical colleges present in Rivers State. A simple random sampling was used to select 20 students (10 girls and 10 boys) in each of the two selected technical colleges. The 20 students were randomly distributed equally into two intact classes of experimental and control groups. Hence, a total of 40 students were used as sample for the study.

The instrument used for data collection was the Drafting Accessories Test (DAT) being developed by the researcher. The DAT was of two types; the Pre-DAT and Post-DAT. Each of them has a 30 multiple choice items that were used on the students. The items were developed from 'Installation Diagram' as contained in the NABTEB syllabus. The instrument was subjected to both face and content validation. The reliability of the instrument was established by using a trial test carried out on a group of vocational 1 students who were not used in the study. A Pearson's Product Moment Correlation was used on the reliability and a 0.65 correlation coefficient was obtained.

In the administration of the instrument, two DAT test were actually administered. Prior to the treatment, the students were given a pre-test DAT. After the treatment, a post-test DAT was administered on the students in both the experimental and control groups. The main treatment for the students was the teaching of installation diagrams to vocational 1 students using CAD and conventional methods on the experimental and control groups respectively. The scripts were all marked and the scores were recorded. Mean and standard deviation were used to answer the research questions while Analysis of Covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance.

2.5 Data Analysis

Research Question 1: What are the mean and standard deviation scores of Vocational 1 electrical students taught Installation Diagram with CAD and those taught same topic with conventional method in technical colleges in Rivers State.

From Table 1 below, CAD method achieved higher with a gain score of 16.01 than the students taught with conventional method with a gain score of 7.76. Though the standard deviation score of 5.59 for the CAD method and 2.77 for the conventional method indicate that, the students' individual scores clustered more around the mean with conventional method than with the CAD.

Research Question 2: What are the differences in mean and standard deviation scores of male

and female vocational 1 students in Drafting Accessories Test (DAT) when taught Installation Diagram with CAD in technical colleges in Rivers State.

Table 1. Mean and standard deviation scores of students when taught with CAD and conventional method

Group	Type of test	Mean	Std. dev.	N
Conventional method	Pretest	5.74	2.49	20
	Posttest	13.50	2.77	
Cad method	Pretest	6.14	3.04	20
	Posttest	22.15	5.59	
Total		11.88	3.47	40

The Table 2 below shows that, the male students scored more than the female students, though with small margin in the posttest with a mean score of 22.30 and 22.15 respectively. However, the standard deviation scores of the male students are slightly more clustered around the mean than those of their female counterpart.

Table 2. Mean and standard deviation scores of male and female students using CAD

Group	Type of test	Mean	Std. dev.	N
Conventional				
Male -	pretest	6.4000	2.30217	20
	posttest	13.8000	2.20101	
Female -	Pretest	5.4000	3.43511	
	posttest	13.2000	1.98886	
Cad				
Male -	pretest	6.6000	1.81659	20
	posttest	22.3000	6.25478	
Female -	pretest	5.2000	3.63318	
	posttest	22.1500	5.58452	
Total		15.772	2.519	40

Hypothesis 1(Ho_1): There is no significant difference between the mean scores of Vocational 1 electrical students taught installation diagram using CAD and those taught using the conventional method in technical colleges in Rivers State.

From Table 3, the value of F-calculated for the effect of treatment of methods on students' achievement on DAT is 42.768 at 0.01 level of significant, which is less than 0.05 levels set for the study. The null hypothesis is therefore rejected. This means, there is a significant difference in the mean scores of electrical students taught with CAD and those taught with conventional method.

Hypothesis 2(Ho_2): There is no significant difference between the mean scores of male and female Vocational 1 students in Drafting Accessories Test (DAT) using CAD in technical colleges in Rivers State.

From Table 4, the value for F-calculated for the effect of gender on students' achievement is 0.035 at 0.853 level of significant, which is greater than 0.05 level set for the study. The null hypothesis is therefore accepted. This means there is no significant difference in the mean scores of male and female students in DAT using CAD.

3. DISCUSSION OF FINDINGS

The result of the analysis on Table 1 revealed that, students taught with Computer Aided Design (CAD) performed better in Drafting Accessories Test (DAT) than their counterparts who were taught using conventional method. This result was in agreement with other researchers' view that the use of CAD method can enhance electrical drafting more than the conventional method [14]. The relative superiority of CAD over the conventional method is on the fact that CAD method enhances the use of current and correct dimensions, symbols, speed, accuracy and self-learning on electrical drafting. In fact, use of DAT on drafting is over 90% error free while the conventional method is less than 40% error free. On this premise, it was not surprising that the treatment group (CAD) out-performed the control group in DAT.

Similarly in Table 2, the mean achievement score of male student was revealed to be slightly better than their female counterparts. Though the difference was not quite significant, but was in agreement with other researchers' view on gender [15] that there was no significant difference between the achievement of males and those of females.

Again, the analysis on Table 3 revealed that, there was a significant difference between experimental and control groups in their mean achievement scores. This invariably showed that, the CAD group scored significantly higher than the conventional group. In a similar dimension, Table 4 revealed that male students mean achievement score was slightly higher than their female counterpart. Hence, there was no significant difference in the achievement of male and female students in their mean achievement score.

Table 3. Analysis of covariance of students mean scores in DAT

Source	Type III sum of squares	df	Mean square	F	Sig.	Partial Eta squared
Corrected model	827.507[a]	2	413.753	25.761	.000	.582
Intercept	1494.713	1	1494.713	93.063	.000	.716
Pretest	79.282	1	79.282	4.936	.032	.118
Method	686.917	1	686.917	42.768	.010	.536
Error	594.268	37	16.061			
Total	14131.000	40				
Corrected total	1421.775	39				

Table 4. Analysis of covariance in male and female students mean scores in DAT

Source	Type III sum of squares	df	Mean square	F	Sig.	Partial Eta squared
Corrected model	828.504[a]	4	207.126	12.219	.000	.583
Intercept	1490.711	1	1490.711	87.944	.000	.715
Pretest	78.029	1	78.029	4.603	.039	.116
Gender	.589	1	.589	.035	.853	.001
Error	593.271	35	16.951			
Total	14131.000	40				
Corrected total	1421.775	39				

4. CONCLUSION

It has been found out that indeed there is an effect of Computer Aided Design CAD in teaching electrical drafting in technical colleges in Rivers State of Nigeria. It was found out that CAD was more effective than the conventional methods on students. The fact remained that, there was a significant difference between the experimental and the control groups in the mean achievement scores, while the mean achievement score of the male students was found to be slightly greater than their female counterpart but with no significant difference in their mean achievement scores.

5. RECOMMENDATIONS

Based on the findings, the following recommendations were made;

1. Since CAD has been found out to be an effective method of teaching electrical drafting in Technical Colleges, a formal means to enhance its learning should be established in all technical colleges in Nigeria.
2. CAD training has a lot to do with the computer; hence adequate computer system should be made available in all technical colleges in Nigeria.
3. Since the world is now going digital, and CAD is one of the means to digital; the curriculum of technical colleges should be re-developed to accommodate digital learning.

ACKNOWLEDGEMENT

The authors acknowledge the efforts of all our research assistance for their technical skills.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Federal Government of Nigeria. National policy on education. NERDC press. 4th edition; 2004.
2. Ndomi BM. Revisiting the learning experience of technical college farm machinery curriculum for empowerment of recipients in Nigeria. Journal of Nigerian Association of Teachers of Technology (JONATT). 2005;5(1):88-94.
3. Finch CR, Crunkilton JR. Curriculum development in vocational and technical education: Planning, content and implementation. 5th edition. Boston: Allyn and Bacon; 1999.
4. Bybee R, Loucks-Horsely S. Standard as catalyst for change in technology

education. The Technology Teacher. 2000; 59(5):14-17.

5. Onyejemezi DA. Quantity, quality, production and distribution of teaching resources/facilities. In Nnoli and Sulaiman ed. Reassessing the future of education in Nigeria. Abuja: ETF Publication; 2001.
6. Vanguard Newspaper. Neglect of technical vocational education increases youth unemployment (December 23); 2004.
7. Robinson RN. Electronics: An efficacious means to the delivery of technical and vocational educational. Journal of Vocational Education and Technology (JOVET). 2008;5(1):65-72.
8. Herron J. 3D model-based design: Setting the definitions straight. MCADCafe; 2010. Available:http://www10.mcadcafe.com/nbc/articles/2/867959/3D-Model-Based-Design-Setting-Definitions-Straight (Accessed 22 January 2012).
9. Narayan KL. Computer aided design and manufacturing. 4th ed. New Delhi: Prentice Hall; 2008.
10. Farin G. A history of curves and surfaces. 2nd ed. New Delhi: CAG Design; 2008.
11. Pillers M. MCAD renaissance of the 90's. Cadence Magazine; 1998. Available:http://www.edeinc.com/Cadence/98Mar/Article98Mar.html (Accessed 7 March 2012).
12. Carlson W. A critical history of computer graphics and animation. Ohio State University; 2003. Available:http://accad.osu.edu/~waynec/history/lesson10.html (Accessed 10 February 2012).
13. Dike E. Youth unemployment in Nigeria: The relevance of vocational and technical education. The Economic Indicators. 2006; 12(3):25-29.
14. Adeyemo SA. The need for skill development/ acquisition in science, technology and mathematics education (STEME) in Nigeria. Journal of Science and Technology Education Research. 2010;1(1):1-9.
15. Awariele PEO. Gender performance in physics: A case study in Auchi Polytechnic, Auchi. Nigerian Journal of Professional Teachers. 2006;1(2):223-234.

Peer-review history:
The peer review history for this paper can be accessed here:
http://sciencedomain.org/review-history/11524