INTEGRATING COMPUTER AIDED DESIGN (CAD) INTO THE CURRICULUM OF TECHNICAL EDUCATION IN COLLEGES OF EDUCATION

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Abstract
The fast technologies of information technology (IT) have revolutionized the way documents are generated and presented. Computer Aided Design (CAD) is an example of IT which had become widely used in the last decades offering the support of instruments such as rulers, squares, compasses and protractors. Various types of packages are now available that can be integrated in the NCE Technical Education programmes for better teaching of Technical Drawing and other graphic related courses. The current curriculum of NCE Technical Education was thoroughly examined and relevant information was obtained from lecturers/instructors and students of the department of Technical Education, Emmanuel Alayande College of Education, Oyo and Lanlate campuses. The results revealed that the curriculum has not given CAD the importance it deserves and lecturers/instructors and students are still using outdated techniques of manual drafting and design. The curriculum of technical education programmes should keep pace with the modern trend in drafting technology and lecturers/instructors need to be well grounded in taking up these challenges.

Introduction

Information Technology (IT) is defined as the use of electronic machine and programmes for the processing, storage, transfers and presentation of information (Bjork, 1999). IT encompasses many technologies such as hardware, software, networks, and telephone and fax machines. According to Rivard (2000), computers which are parts of IT gadgets have revolutionized the ways documents are generated and presented. The fast growing technologies have called for improved procedures in design and drafting by the invention of CAD application software packages.

The acronym CAD usually means either Computer-aided design or Computer-aided drafting. It is sometimes used to mean Computer aided drafting and design. According to Foote (2010), CAD is a graphic tool used to produce maps, diagrams, drawings, plans and charts. CAD systems are also used extensively in technical drawing, architectural drawings and renderings, mechanical and electrical designs, drawings used in civil and industrial designs. CAD is a highly valued technique because it does not only enable substantial increase in the productivity but also helps to achieve neater and clearer drawings than those produced using conventional manual drafting techniques (Neufert, 2000). The use of CAD has become widely popular in the last decades, leaving the support of instruments such as rulers, squares, compasses and protractors. The resources associated with the conventional way of drawing had been incorporated on software, making faster the whole process and more efficient.

The use of CAD is indubitably a versatile drafting technology as documented

from the experiences of the researchers in the table below. The table clearly summarizes the benefits of CAD over manual drafting. This shows that benefits are largely realized in the use of CAD for production of drawings. These are achieved through cost savings, cost avoidance and productivity gains as a result of reduction in time required to input the data.

Table 1 :
Benefits of CAD over Manual Drafting

Benefits	Performance
Productivity gains and time saving	After the initial investment of creating th e CAD drawings, updates can be generated without tedious or manual drafting.
Cost saving/cost avoidance	CAD drawings provide a more secured archiving system compared to manual drawings since multiple backups are cheap to produce. Such back -up will also require less storage than a large collection of drawings.
Better service	CAD drawings provide customized drawings as requested by users through the use of layers. CAD drawings are printed for specific needs of the users quickly and cheaply.
Increased accuracy	Compared to manual drafting, CAD encourages higher accuracy which results in better products and supports wide range of applications. This eliminates errors.
Improved consistency	CAD drawings provide a high degree of consistency through databases. Que rying the databases gives the same results.

Source: Authors' experiences on the use of CAD since 1999

It is therefore a common fact that today's CAD programmes have definitely reduced the need for manual drawings. All particulars of object that are two-dimensional (2D) or three-dimensional (3D) can be created or generated in a much shorter period of time than by the traditional way of manual drafting. The intention of this paper is therefore to prepare ground for the possibilities of integrating CAD packages in NCE Technical Education programmes with a view to responding to the challenges of modern world. The curriculum of Technical Education programmes should reflect both contemporary and future trends for society in teaching and learning computer use, particularly CAD.

Statement of the Problem

The current curriculum of National Commission for Colleges of Education (NCCE) Minimum Standards for Technical Education programmes still base its design on manual techniques of drafting similar to those used at the beginning of the last century. For long time, drawings and designs have been carried out using manual

sketching, drawing and physical modeling. Modern computer drafting aids have not been adopted into the teaching and learning of Technical Education programmes in order for the students to have necessary skills and comparative advantage. The study therefore provides insights into these concerns of integrating CAD packages into the Technical Education curriculum in order to improve teaching and learning of various disciplines that have made up the programme.

Purpose of the Study

The main purpose of the study is to investigate how CAD programmes can be integrated in Technical Education curriculum of Nigerian Colleges of Education. The study sought to assess:

(i) The nature of Technical Education courses in response to CAD packages;
(ii) The competency of lecturers and instructors; and,
(iii) ICT skills of students in readiness for the CAD programmes.

Research Questions

For the purpose of this study, three research questions were formulated:

(i) What is the nature of Technical Education courses in response to CAD technology?
(ii) What is the competency skill of the lecturers and instructors in Technical Education in using CAD packages?
(iii) Do students have requisite ICT skills that can prepare them for CAD programmes?

Methodology

A survey research design was adopted for the study. The population for the study consisted of all students and lecturers of Technical Education including full- time and part- time students and lecturers. Fifty lecturers/instructors/technologists were randomly selected from those who take part in the teaching of Full-time and Part-time Sandwich Programmes in Oyo and Lanlate Campuses of Emmanuel Alayande College of Education Oyo. One hundred students (Part-time and Full-time) were also randomly sampled for the study. A review of the new Minimum Standards for Technical Education (2012) was carried out. Teaching materials, questions and marking guides were also sampled from lecturers and question banks from the two campuses of Emmanuel Alayande College of Education (Oyo and Lanlate).

Instrumentation

Two instruments were used for this study, they are National Commission for Colleges of Education Minimum Standards for Nigerian Certificate in Education in Technical Education Courses and self developed questionnaires named Questionnaire on Integrating CAD into National Commission for Colleges of Education Program in Technical Education (QICNCCEPTE) for the students and lecturers. Nigerian Certificate in Education Minimum Standards for Technical Education Courses is however a valid document while the self developed questionnaire QICNCCEPTE was validated by two experts in CAD packages and two experts in curriculum to ensure face and content validity. Test-re-test method of reliability was adopted to ensure the reliability of the QICNCCEPTE. The test-re-test was done on an equivalent students and lecturers in a College of Education other than those under study and a correlation

coefficient of 0.82 and 0.77 were obtained respectively for students and lecturers . The NCCE minimum standard is a reliable document for training Nigerian Certificate in Education students.

The questionnaires were personally administered by the researchers to the students and the lecturers and were collected back the very day they were administered. Nigerian Certificate in Education Minimum Standards for Technical Education Courses was used to answer research question 1, the lecturers' questionnaire was adopted to answer research question 2 while students' questionnaire was used to answer research question 3.

Research Questions

Research Question 1: What is the nature of technical education in response to CAD technology?

Couse Code	Course Title	Units	Course Description
TED 116	Fundamentals of Technical Drawing	1	Graphics Language Drawing Equipment, Instruments, materials and setting out Lettering Geometrical Constructions e.g. Ellipse, Loci, Polygons, Angles, Triangles, Reduction and Enlargements. Introduction to Orthographic/ Pictorial Drawing Dimensioning Construction and use of plane and diagonal scales and scale drawing Career in Drawing industries
TED 126	Descriptive Geometry and Pictorial Drawing.	1	State the operation of clutch assembly transmission system Identify the components of the final drive Carry out repairs on the stated components Fundamentals of descriptive geometry Surface development Intersection of solids Pictorial drawing (Rendering, Oblique, Isometric) Orthographic projection

TED 215	Graphics	2	Working drawing Design process Jigs and fixtures Technical illustrations Auxiliary drawings, lines in space Perspective drawing
TED 226	Electrical/ Electronic Drawing	1	Identify various electrical/electronic symbols and drawings Interpret and convert circuit diagram to block diagrams and vice-versa Draw wiring diagrams for domestic building and school workshop Assembly drawings of Electrical/Electronic equipment to BS/N50 engineering practice requirement Sectional drawings of electrical equipment e.g. motor single phase transformer Electrical Electronic diagrams – common use: Single line, Schematic, Block diagram connection (wiring) and interconnection diagram Conversion of CCT diagram to block diagram and vice-versa Wiring diagram for domestic building and School Workshop Electrical/Electronic symbols Electrical/Electronic diagram to include schematic point to point, base line diagram, high way diagram Single line, schematic, block diagram connection (wiring) and interconnection diagram Simple electronic circuit and logic diagram e.g. basic power supply, single stage amplifier, culprits' oscillators etc. Blue print reading

TEB 324	Building Drawing	2	State basic responsibilities in design process Enumerate standard practices in building design List and state uses if drafting materials and equipment List basic principles and design Produce preliminary sketches and design of a simple building Make working drawings (to include standard symbols for plumbing) up to 1 storey building Produce blue printing Basic responsibilities in design process Preliminary sketch and de Working drawing (to include standard symbols for plumbing) up to 1 storey building sign Electrical service plan Preparation of schedules Production of blue printing **Introduction to Computer Aided Drafting (CAD)**
TEM 328	Mechanical Engineering Drawing	2	Students should be able to: Demonstrate the use of standard conventions for keys, studs, screw, bolts, nuts etc. Produce pictorial and orthographic sketches of machine parts involving of cams, gears etc. Make assembly drawing of given machine components Produce assembly drawing from exploded views of machine components and vice versa

Source: FRN (2012)

The analysis of table 2 above shows that CAD has not been given proper attention in the programme. Out of six courses that have to do with technical drawing or graphic communications, CAD is only mentioned as the last topic in TEB 324 – Building Drawing. Technical Education programmes which use drawing as medium of expressing ideas require full blown integration of this new modern technology of drafting and design.

Research Question 2: What is the competency skill of the lecturers and instructors in technical education in using CAD packages?

Table 3:
Lecturers/Instructors Responses on Competency Skill:

S/N	Question	Yes		No	
		Frequency	%	Frequency	%
1.	Are you computer literate?	48	96.00	2	4.00
2.	Do you have a personal computer?	28	56.00	22	44.00
3.	Do you have CAD software?	4	8.00	46	92.00
4.	Have you ever attended training or workshop on CAD?	8	16.00	42	84.00
5.	Are you good at using CAD?	2	4.00	48	96.00
6.	Have you ever introduced CAD to your students?	2	4.00	48	96.00
7.	Do you consider teaching of CAD necessary in Technical Education?	42	84.00	8	16.00
8.	Do you think that lecturers/instructors should acquire skills in CAD?	40	80.00	10	20.00

As can be seen in the table 3, 96% of the lecturers were computer literate and 56% had personal computers in form of desktops and laptops. Only 8% had CAD packages installed on their personal computers while 16% had attended CAD training or workshops. Lack of CAD literacy is reported as 8% possess the required proficiency which restrained the percentage (4%) that introduced the package to the students. A greater percentage (84%) of lecturers recognized the importance of CAD in teaching of Technical Education programmes and also 80% also agreed that lecturers and instructors should acquire relevant skills in CAD. Teaching in form of handout and drawings were sampled from the lecturers in Technical Education

Department. These teaching materials were in the form of textual data, drawings and other forms of graphics. Out of the 25 materials for various courses sampled, none of the drawings were presented in CAD format. Freehand drawings and scanning from other texts were majorly used in presenting these drawings to the students. The drawings attached to these materials lack originality because of the inability of the lecturers/instructors to handle CAD software.25 questions and marking guides were also sampled. Only 1 out of these had the drawings and diagrams in CAD format; which means only 4% of the total sampled. Majority of the lecturers still use freehand and photocopies/scanned drawings in the preparation of the marking guides and question papers.

Research Question 3: Do students have requisite skills that can prepare them for CAD programmes?

Table 4:
Students' Responses to Skills that can Prepare them for CAD

S/N	Question	Frequency	%	Frequency	%
9.	Have you ever used computer?	45	45	55	55
10.	Do you have training on how to use computers?	73	73	27	27
11.	Do you have personal computer?	10	10	90	90
12.	Do you have training on how to use general computer package?	65	65	35	35
13.	Are you aware of CAD software?	7	7	93	93
14.	Have you experienced drafting with CAD?	5	5	95	95

Results in table four revealed that the most problems are lack of awareness and experience in drafting using CAD with 93% and 95% respectively. The next is that majority of the students did not have personal computers. The 10% that had personal computers were in form of fairly used desktops. The students had trainings on ICT through facilities provided by the school in General Computer classes. 73% of the students had access to the training whether inside or outside the college premises while 65% also attended trainings or classes on how to use general computer packages.

Discussion of Findings

In the analysis of the course contents of Technical Education Programmes in Nigerian Colleges of Education, it could be deduced that less importance was given to CAD. The word CAD is mentioned at the end of the course description as an introduction, which means that the curriculum has not responded to the challenges in the modern world. The latest

NCE minimum standards, FRN (2012) does not even improve on FRN (2008). The contents remain the same. The curriculum should be dynamic in nature by forecasting present and future needs in order to meet challenges of the 21st century.

The lecturers and instructors are still lagging behind in the inclusion of CAD into the teaching of Technical Education programmes. Rapid changes in ICT require changes in educational process. According to Reffats (2007), a change in educational process is the new role of the teachers from transmission knowledge to thoughtful teaching, to knowledge, how students learn and why. Change in teaching process demands adaptation to new reality, flexibility and high degree of innovation. Raji (2011) opined that teachers should be well equipped with the knowledge of ICT for effective teaching and learning. Lecturers and instructors need not only be computer-literate but have ability to identify and use software packages for lifelong learning and problem solving.

Various initiatives have been implemented by the government to facilitate the transition of young people from school to work. A school-to-work can be defined as a system that would equip all young people with high level of academic and occupational knowledge and skills to find employment that uses their capacities (Stern, Bailey and Merritt, 1996). Students should be more equipped with the current technological needs. Technology is said to be the driver of the economy and human capital is the fuel (Moe and Boldget, 2000). In the present economic era, economic prosperity depends on Technical Education need to be exposed to application software like CAD. According to Kasworm and Londoner (2000), there are two types of ICT literacy skills sets. The first is generic ICT literacy skills such as keyboarding, word processing, using data bases, using spreadsheets, desktop publishing and using internet for research and communication; while the second ICT is an occupational specific. Example of these occupational specific skills includes the use of CAD and ability to operate digital equipment. Majority of the students are not aware of these current trends in drafting technology. Technology education is undergoing changes in the global economy which requires mastery of relevant computer software packages.

The huge benefits of CAD over manual drafting have also attested to the fact that lecturers and students need to be competent and confident in the use of CAD for teaching and learning. Busari (2000) advocated the inclusion of CAD packages into the training of Technical Education at tertiary levels because of the benefits that could be derived in designing and detailing. Nowadays, the design and construction industry ceased producing technical drawings by hand; instead, they complete those drawings on computers using CAD programmes. Ibrahim (2007) post-secondary curriculum should continue and struggle to keep up with the application of CAD in order to be relevant in the world of work.

Conclusion and Recommendations

CAD is an example of ICT which represents powerful potential of facilitating change and improvement in Technical Education Courses. CAD has become the standard of drafting tool used in the design and construction industry (Lu, 2008). CAD, now better meets the needs of various designs in the design process, and as such can be used as a design tool at the preliminary phase of the design (Hanna & Barber, 2001). The findings highlighted the

need for integration of CAD into NCE Technical Education Programme, hence the following recommendations are made in order to achieve the benefits and opportunities offered by it.

• The National Commission for Colleges of Education Minimum Standards for Nigerian Certificate in Education in Technical Education should keep up with the ongoing development of CAD. Design and communication graphics should replace manual Technical Drawing subjects. CAD courses should be introduced into the curriculum from 100 level.

• Computer courses offered in General Studies should be revised to take care of the needs of students in various departments. The courses should be more of occupational based than generic.

• There is the need for Colleges of Education to provide CAD studio, well equipped with functional hardware and software. This will enable active training of students in CAD packages which will make them relevant in today's world of work.

• Lecturers and instructors need to realise that the present and past teaching styles and methods are not necessarily incorrect but need to adapt to the current developments. Teachers' competency must be upgraded for effective use of CAD for training students.

• Lectures/Instructors and Technologists should be given in-house training in order to acquire CAD skills.

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