INSTRUCTIONAL ISSUES IN IMPLEMENTING COMPUTER–ASSISTED COMPONENT OF SENIOR SECONDARY SCHOOL TECHNICAL DRAWING CURRICULUM IN BENUE STATE

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Abstract

The study sought to unravel the instructional issues in implementing computer-assisted component of senior secondary school Technical Drawing curriculum. Four (4) research questions and two (2) null hypotheses guided the study. The population was 145(108 technical drawing instructors &37administrators). A sample size of 90 was used. A disproportionate stratified random sampling procedure was used to select 64 Technical Drawing instructors and 26administrators from 50 secondary schools across educational zone A, B and C in Benue State. A Technical Drawing facilities requirement checklist obtained from Nigeria Education Research and Development Council (NERDC) was used to gather data on research question 2. Also, a22-item self-structured closed ended questionnaire was deployed to collect data on research question 1, 3 and 4. The questionnaire was face validated by three academic in the area of technology education from Benue State University, Makurdi, Benue State. Cronbach's alpha technique was used to establish the internal consistency of the questionnaire which yielded a reliability index of 0.78. In line with the study design, the descriptive statistics of frequency and percentages was used to answer research question 1 and 2 whilst mean was used to provide answers to research question 3 and 4. The inferential statistics of t-test for independent sample was used to test the null hypotheses at 0.05 level of significance. Findings of the study revealed that the required facilities for implementing computer-assisted technical drawing are not available and the instructional methods used for teaching computer-assisted technical drawing are not suitable. The study recommended among others that Government, school heads and administrators should partner with appropriate private organization to assist in procuring the needed facilities for the successful implementation of the Computer-Assisted Technical Drawing component of the TD curriculum at the secondary school level.

Keywords: Computer Assisted Instruction, Technical Drawing, Instructors, Senior Secondary School, Curriculum.

Introduction

Innovation in Computer Technologies (CTs) has dramatically altered the working pattern of diverse occupations. A significant number of industries, businesses, professions and organizations now find solace in the use of computer (an electronic device) for the conduct of its activities and operations. Al-Qawasmi (2005) corroborated that computers have transformed the way and manner people conduct businesses and perform their daily tasks. Similarly, Ukoha (2018) posited that the advent of computer among other new technologies in industries have transformed job contents and brought about novel work practices and procedures. Consequently, the practice of Technical Drawing (TD) has equally been affected with the application of computers; as there are several computerized TD packages now available for use (Labe &Upwa, 2017). TD sometimes denoted with nomenclatures such as Building/Engineering Drawing (BED), Technical Graphics Communication (TGC), Engineering Drawing (ED) and many more is so old that its history is virtually that of humanity, and it closely parallels human technological progress (Bertoline & Wiebe, 2003).

Regardless the nomenclature, be it BED, TD, TGC or ED, the contents and practices finds a common domain. According to Bertoline and Weibe (2003), TD is a real and complete language used in the design process by engineers, technologists, technicians, crafts persons and other technical personnel for visualization, communication and documentation of designs. Adadu; Aho; Nevkar; Jatau and Jibrin (2018) averred that TD is the common language understood by architects, builders, quantity

surveyors and all fields of engineering when it concerns construction or manufacturing or production. Drawingsare key component in engineering, construction and manufacturing industries. For any product to be manufactured, produced or constructed, it must first and foremost, be conceptualized as a design idea with all the necessary sketches put in place (Leach, 2000). Researchers such as Bertoline and Wiebe (2003); Oyebode, Adebayo and Olowe (2015); Adadu, *et al* (2018) observed that long before now, TD were manually created with the aid of instruments such as drawing board, T-square, drawing sets, lettering templates, scale rule, protractor, compass to mention but a few. However, the advent of computer technologies in the field of engineering has shifted attention from the use of primitive instruments and tools as mentioned above to the use of Computer-Aided Drawing (CAD) software for engineering graphics design and drafting purposes. The use of computers for production of TD has changed the methods and tools, as well as the standards and conventions, evolving from instruments to drafting machine to CAD (Bertoline & Wiebe, 2003). According to Becker (as cited in Labe &Upwa, 2017), CAD as a refinement of manual design and drafting techniques is now widely used in the engineering industry and its future use will no doubt increase. Buttressing further, the (Nigerian Educational Research and Development Council [NERDC], 2007)statedthat increased use of computer technologies in the field of engineering means that secondary school programmes should emphasized the use of Computer-Assisted Technical Drawing (CATD) if they wish to prepare students to use contemporary technology such as CAD.

In realization that only the inculcation of 21stcentury knowledge and skills can really position her school children to be abreast with global trends upon graduation, the Federal Republic of Nigeria (FRN) through (NERDC, 2007)restructured the curriculum of Senior Secondary School (SSS) with a view to accommodating contemporary scientific and technological innovations. The prominent feature in the said curriculum as observed by Labe and Upwa (2017) was the inclusion of CAD within TD which isone of the technology subjects at SSS level. The (Federal Republic of Nigeria [FRN],2014) through its National Policy on Education (NPE) in section 3, paragraph 35, p.17describes Senior Secondary Education (SSE) as a Post-Basic Education and Career Development (PBECD) education that children receive after successful completion of ten years of Basic Education (BE) and passing the Basic Education Certificate Examination (BECE) and Junior Arabic and Islamic Studies Certificate Examination (JAISCE). The NPE further states that, PBECD includes: (i) Senior Secondary Education and; (ii) Higher School Education as a means of preparing individuals for the world of work, wealth creation and entrepreneurship. According to Labe and Upwa (2017),the introduction of CAD into SSS curriculum was to enable the trainees get themselves acquainted with the basic working tools of CAD software and develop requisite modern day drafting skills in preparation for picking up draughtsmanship jobs and, or further their studies in the area of engineering and technology at the tertiary education level.

CAD as described by Bertoline and Wiebe (2003), Narayan (2008), Tickoo, Bhatt, Kishore and Verma (2014)is the use of computer systems or workstations to aid in the creation, modification, analysis, or optimization of TD. CAD software is used to increase the productivity of the designer, improve the quality of design, improve communications through documentation, and to create a database for manufacturing and construction (Narayan, 2008). Leach (2000) observed that CAD produced drawings are capable of attaining 100% accuracy; an attribute that cannot be found in manual drafting, because CAD recognizes and store values to 14 decimal places which depict high precision level. The ability to use computer technologies for design and drawing are very essential part of the skill requirements of SSS graduates who offer TD. This is the reason TD is made one of the technology subjects at SSS curriculum and compulsory for all construction trades and engineering crafts students in Science and Technical Colleges (National Board for Technical Education [NBTE], 2011).

CATD is a component of the SSS TD curriculum.Tanner and Tanner (as cited in Afaor; Upwa; Tyav; Shinshima & Nule, 2016) defined curriculum as planned and guided learning experiences and intended learning outcomes formulated through the reconstruction of knowledge and experiences systematically developed under the auspices of the school, to enable the learner to increase his or her control of knowledge and experience. Ahmadi and Lukman (2015) defined curriculum as the set of courses and its contents offered at a school. According to the duo, curriculum is prescriptive and is based on a more general syllabus, which merely specify what topics must be understood, and to what level it is to achieve a particular grade or standard. According to Utulu (2007), curriculum can be

conceptualized in three ways:(i) as a course of study especially in higher institutions like university, (ii) document kept by schools containing the content (subject) to be taught to learners; in this case TD, and (iii) as the entire programme of study and activities supervised by the school. The TD curriculum was developed with the specific objectives of: (i) provide an understanding of theories and concepts relating to the use of ICT to facilitate visual communication of ideas in the construction and production industries; (ii) provide introduction to modern drawing studio practice; (iii) lay the foundation for technological development and further studies in building and engineering and , (iv) stimulate, develop and enhance entrepreneurship skills in the diverse areas of drawing studio practice (NERDC, 2007).

According to Akuezuilo (2006), no matter the rich content of a curriculum, only its proper implementation can cause the desirable impact. Ojonugwa (2018) viewed curriculum implementation as putting into practice the officially prescribed courses of study, syllabuses and subjects. Ojonugwa further noted that the process involves helping the learner to acquire knowledge or experiences as contained in the curriculum through instructional strategies. Instruction is the manner in which the teacher selects and mixes the various aspects of knowledge contained in the curriculum document or syllabus andpresents to the learner to acquire the planned or intended experiences, knowledge, skills, ideas and attitudes that are aimed at enabling the same learner to function effectively in the society (Asebiomo & Sanusi, 2011).Despite several efforts to intensify the implementation of the CAD component of the TD curriculum in SSS, there are however, some challenges such as availability of requisite infrastructures, use of effective instructional strategies, qualification/experience of teachers and assessment/evaluation methods used in CATDamong many other challenges.

Statement of the Problem

The advent of Computer Aided Drafting (CAD) in the construction and production industry has replaced manual drafting techniques since its inception in 1982 (Yare, 2012). Becker (as cited in Labe &Upwa, 2017) noted that increased use of CAD in industry suggest that students need to be trained on the use of CAD in schools before graduation. In an attempt to catch up with global trends, the (NERDC, 2007) introduced CAD into the curriculum of SSS with a view to inculcating 21st century skills among students. Consequently, being able to measure whether SSS students are acquiring skills in CATD upon exist from school would be of great interest in such endeavour as examination, job recruitment, job training and project personnel allocation and value judgement. In such contexts, issues bordering on availability of requisite infrastructures, use of effective instructional strategies, qualification/experience of teachers and assessment/evaluation methods among many other challenges in CATD component of the SSS TD curriculum has to be urgently looked into. This is to ascertain whether students are acquiring 21st skill in TD that could better position them to compete globally. To neglect these issues that have been raised, will shut the possibility of making empirical data available to stakeholders in the educational sector for policy redirection and consideration, particularly as it concern CATD in SSS TD curriculum.

Purpose of the Study

The major purpose of this study wasto look at issues of instruction in implementing Computer-Assisted component of senior secondary school Technical Drawing curriculum. Specifically, the study sought to:

1. Ascertain the qualification/experience of Computer-Assisted Technical Drawing (CATD) instructors;
2. Determine the infrastructural facilities available for teaching Computer-Assisted Technical Drawing (CATD);
3. Determine the instructional methods used in teaching Computer-Assisted Technical Drawing (CATD) and,
4. Determine the assessment methods used in assessing students learning outcomes in Computer-Assisted Technical Drawing (CATD).

Research Questions

1. What is the qualification/experience of CATD instructors?
2. What are the facilities available for teaching CATD?
3. What are the instructional methods used in teaching CATD?
4. What are the assessment methods used in assessing students learning outcomes in CATD?

Research Hypotheses

1. There is no significant difference between the mean response of TD instructors and Administrators on the instructional methods used in teaching CATD
2. There is no significant difference between the mean response of TD instructors and Administrators on the assessment methods used for assessing students learning outcomes in CATD

Methodology

The study used a descriptive survey design. The population was 145 which comprised108 TD instructors and37Administratorsdrawn from 310 Senior Secondary Schools within educational zone A, B and C in Benue State (Benue State Ministry of Education, Science & Technology Statistics Department [BSMEST], 2019). Hence the population was a heterogeneous one, Taro-Yamane's (2004) formula ($n = N/1+N\ [E]^2$) was employed to obtain a sample size of 90. A disproportionate stratified random sampling procedure was used to select 64TD instructors and 26 administratorsfrom 50 secondary schools across educational zone A, B and C. A TD facilities requirementchecklist obtained from NERDC TD curriculum was used to gather data on research question 2. Also, A 10-item self-structured closed ended questionnaire weighted across a 4-point rating scale of Very Often (VO) = 4, Often (O) = 3, Rarely Used (RU) = 2 and Never Used (NU) = 1 was deployed to collect dataon research question 1, 3 and 4. The questionnaire was face validated by three senior academics in the area of technology education from Benue State University, Makurdi, Benue State. Cronbach's alpha technique was used to establish the internal consistency of the questionnaire which yielded a reliability index of 0.78.

In line with the study design, the descriptive statistics of frequency and percentages was used to answer research question 1 and 2 whilst mean and standard deviation was used to provide answers to research question 3 and 4. A percentage score of 50% and above was considered as 'Available' and 49% and below was regarded as 'Not Available' as decision rule for research question 1 and 2. Bench mark mean response for deciding on research question 3 and 4 was determined by adding the weight assigned to each response and dividing by 4 *(4+3+2+1 = 10/4 = 2.50)*. Items with mean response of 2.50 and above were considered as 'Used' and items with mean response of 2.49 and below were regarded as 'Never Used'. The inferential statistics of t-test for independent sample was used to test the null hypotheses at 0.05 level of significance. The $\rho - value$and $\alpha - value$ were compared to decide whether a null hypothesis is to be retained or rejected. When $\rho \leq \alpha$, the null hypothesis was rejected and when $\rho > \alpha$, the null hypothesis was retained. The researchers conducted the analysis with the aid of Statistical Package for the Social Sciences (SPSS) 20.

Results and Discussion of Findings

Research Question One

What is the qualification/experience of CATD instructors?

Table 1: Qualification/Experience of CATD Instructors

S/N	Variable	Frequency (N)	Percentage (%)
	Qualification		
1	NCE (Tech)	32	66.67
2	HND/First Degree	13	27.08
3	Master's Degree	3	6.25
4	Doctorate Degree	Nil	
	Experience		
5	1-2years	8	16.66
6	2-5years	14	29.17
7	5-10years	9	18.75
8	10years Above	17	35.42

Result of data presented in Table 1 shows that 66.67% of TD instructors are holders of NCE (Tech), 27.08% holds HND/First Degree and 6.25% possessed Master's Degree. However, none of the 48 sampled TD instructors holds Doctorate Degree.

Research Question Two

What are the facilities available for teaching CATD?

Table 2: Frequency and Percentage of Facilities Available for the Teaching of CATD

S/N	Facilities	Available		Not Available	
		N	%	N	%
1	Computer Laboratory	**30576.25**		**95**	**23.75**
2	Public Electricity Supply	**84**		**316**	**79.00**
		21.00			
3	Electricity Generator	**21**	**5.25**	**379**	**94.75**
4	2D & 3D CAD Software	**15**	**3.75**	**385**	**96.25**
5	Multi-media Projectors	**14**	**3.50**	**386**	**96.50**
6	2D & 3D Printers	**0**	**0.00**	**400**	**100.00**
7	Scanning Machine	**5**	**1.25**	**395**	**98.75**
8	Laminating Machines	**4**	**1.00**	**396**	**99.00**
9	Spiral Binding Machines	**2**	**0.50**	**398**	**99.50**
10	Internet Services	**5**	**1.25**	**395**	**98.75**
11	Interactive Boards	**2**	**0.50**	**398**	**99.50**
12	Video Clips	**2**	**0.50**	**398**	**99.50**
13	Video cassette recorder/Player	**1**	**0.25**	**399**	**99.75**
14	Drawing Sheets	**301**	**75.2**	**99**	**24.75**
15	Compact Disk-Read Only Memory (CD-ROMS)	**12**	**3.00**	**388**	**97.00**
16	Flash Drive	**24**	**6.00**	**376**	**94.00**
17	Speakers	**18**	**4.50**	**382**	**95.50**

Result of data presented in Table 2 shows that ofall the facilities needed for the effective and efficient implementation of CATD, only computer laboratory (76.25%) and drawing sheets (75%) are available in the sampled schools. Essential facilities such as public electricity (23.75%), electricity generator (79%), 2D & 3D CAD software (96.25%), multi-media projectors (96.50%) and internet services (98.75%) are not available among many others.

Research Question Three

What are the instructional methods used in teaching CATD?

Table 3: Mean of TD Instructors and Administrators on Instructional Methods used in Teaching CATD

S/N	Instructional Methods	M_1	M_2	M_t	Remarks
1	Demonstration with practice	2.84	3.42	3.13	Used
2	Activity-oriented teaching	2.05	1.08	1.57	Never Used
3	Competency-based teaching	2.00	1.43	1.72	Never Used
4	Lecture method	1.89	2.00	1.95	Never Used
5	Individual project method	2.02	1.58	1.80	Never Used
6	Group project method	2.00	1.89	1.95	Never Used
7	Design studio visits	1.50	1.08	1.29	Never Used
8	Discussion method	2.78	2.89	2.84	Used

Key: M_1= Mean of TD instructors, M_2= Mean of administrators, M_t= Average mean

Result of data presented in Table 3 revealed that the most common instructional methods deployed by TD instructors for the teaching and learning of CATD is demonstration with practice (3.13) and discussion methods (2.84). However, suitable methods such as design studio visits (1.29), competency-based teaching (1.72) and activity oriented teaching (1.57) are not used by TD instructors in delivering CATD to students.

Research Question Four

What is the assessment methods used in assessing students learning outcomes in CATD?

Table 4: Mean of TD Instructors and Administrators on Assessment Methods used in Assessing Students in CATD

S/N	Assessment Methods	M_1	M_2	M_t	Remarks
1	Practical test	2.54	2.89	2.72	Used
2	Structured short answer questions	2.87	3.00	2.94	Used
3	Multiple-choice test	3.95	3.86	3.91	Used
4	Observation of trainees	1.57	1.45	1.51	Not Used
5	Oral test	1.08	2.00	1.34	Not Used
6	Essay test	3.85	3.00	3.43	Used

Key: M_1= Mean of TD instructors, M_2= Mean of administrators, M_t= Average mean

Result of data presented in Table 4 shows that the assessment methods used in assessing students in TD are practical test (2.72), structured short answer questions (2.94), multiple-choice test (3.91) and essay test (3.43). However, assessment methods such as observation of trainees (1.51) and oral test (1.34) are not used in assessing students in CATD.

Research Hypothesis One

There is no significant difference between the mean response of TD instructors and administrators on the instructional methods used in teaching CATD.

Table 5: Independent Sample t-test of TD Instructors and Administrators on the Instructional Methods used for Teaching CATD

Group	*N*	*M*	*SD*	*t*	*df*	*p-value*	*Remarks*
TD Instructors	48	2.14	4.50	0.45	398	0.61	NS
SSSS	352	1.92	4.70				

NS = *Not Significant,* ***p >*** *0.05,* ***df****= 398*

Result of data presented in Table 5 shows that the mean score of TD instructors and administrators on the instructional methods used for teaching CATD do not significantly differ*, t(398) = 0.45, p = 0.61.*This therefore, suggests that the null hypothesis is upheld.

Research Hypothesis Two

There is no significant difference between the mean response of TD instructors and administrators on the assessment methods used for assessing students learning outcomes in CATD.

Table 6: Independent Sample t-test of TD Instructors and Administrators on the Assessment Methods used for Assessing Students in CATD

Group	*N*	*M*	*SD*	*t*	*df*	*p-value*	*Remarks*
TD Instructors	48	2.64	4.50	0.52	398	0.75	NS
SSSS	353	2.70	4.70				

NS = *Not Significant,* ***p >*** *0.05,* ***df****= 398*

Result of data presented in Table 6 shows that the mean score of TD instructors and administrators on the assessment methods used for assessing students learning in CATD do not significantly differ*, t(398) = 0.52, p = 0.75.* This therefore, suggests that the null hypothesis is upheld.

Discussion of Findings

Result of data presented in Table 1 with regards to the qualification/experience of TD instructors shows that a vast majority of TD instructors within the study area are NCE (Tech) holders representing 66.67%. Furthermore, TD instructors with HND/First Degree and master's degree were found to represent 27.08% and 6.25% respectively. However, none of the TD instructors were found to have possessed a doctorate degree qualification. Although, a reasonable number (i.e 35.42%) of the instructors have 10years experience and above, 29.17% have 2-5years experience, 18.75% have 5-10years experience and 16.66% have 1-2years experience in teaching TD at the secondary school level. Even though NCE is the minimum qualification for teaching at junior secondary school level, it is not a sufficient qualification for teaching TD at senior secondary school level since the subject (TD) is not a junior secondary school subject. Akuezuilo (2006) corroborated

that the successful implementation of any secondary school subject requires well experience and certified teachers with not less than 5years experience and holders of a minimum qualification of First degree. TD instructors ought not to limit themselves to first or master's degree alone. Instructors can also aspire to acquire doctorate degree in relevant fields for enhance knowledge and performance in the subject in which they teach.

Result of data presented in Table 2 shows that ofall the facilities needed for the effective and efficient implementation of CATD, only computer laboratory and drawing sheets were found to be available in the sampled schools. Essential facilities such as public electricity, electricity generator, 2D & 3D CAD software, multi-media projectors and internet services are not available among many others. This finding is in line with that of Labe and Upwa (2017) which revealed that most of the requisite facilities such as mentioned above that are required for the effective and efficient teaching/learning of CATD are not adequate in science and technical colleges. According to NERDC (2007), facilities such as public electricity, electricity generator, CAD software, multi-media projects, internet service and many others must be readily available for the successful implementation of CATD. CATD is a technical education subject that requires psychomotor activities during implementation. It is worthy of note that psychomotor activities requires the manipulation and use of some facilities and equipment. The implication of this scenario is that secondary school students are not acquiring the needed knowledge in CATD due to lack or unavailability of the needed facilities.

Result of data presented in Table 3 revealed that the most common instructional methods deployed by TD instructors for the teaching and learning of CATD are demonstration with practice and discussion methods.However, suitable methods such as design studio visits, competency-based teaching and activity oriented teaching are not used by TD instructors in delivering CATD to students.This finding is consistence with that of Asebiomo and Sanusi (2011) and Adadu*et al* (2018) which revealed that technical teachers or teachers in general do not select appropriate instructional strategies according to the nature of topics and subjects which they teach. CATD is a specialized component of the technical drawing curriculum that requires the selection and mix of suitable instructional methodologies such as design studio visits; competency-based instruction and activity oriented instruction in order to enable secondary school students acquire appropriate knowledge, skills and attitudes in CATD. This assertion is further buttressed by NERDC (2007) which stated that to successfully implement the CATD of the TD curriculum at the secondary schools; instructors must be able to select a mix of most suitable instructional strategies such as design studio visits, activity oriented and competency-based instructions.

Result of data presented in Table 4 shows that the assessment methods used in assessing students in TD are practical test, structured short answer questions, multiple-choice test and essay test. However, assessment methods such as observation of trainees, and oral test are not used in assessing students in CATD. This finding is in line with the recommendation by NERDC (2007) which listed assessment methods such as practical test, structured short answer questions and multiple-choice as the most appropriate for assessing students learning in CATD. The only means of establishing whether students have learned is when they are been assessed and evaluated with the valid assessment and evaluation methods. If the assessment methods are valid; the inference, conclusion and judgement can be said to be reliable.

Conclusion

With regards to the findings of the study, the paper concludes that the teachers teaching CATD are not qualified, though they have adequate experience in the teaching of TD at the secondary school level. Also, the facilities required for the effective and efficient implementation of CATD are not readily available for both teachers and students use. Furthermore, TD instructors are not applying appropriate instructional method for the teaching of CATD at the secondary schools. However, suitable assessment methods for assessing students learning in TD as recommended by NERDC are being deployed by TD instructors for the purpose of assessing students learning in TD in secondary schools.

Recommendations

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

1. Government through Education Trust Fund (ETF) should embark on sponsoring secondary school Technical Drawing instructors for further training on the use of competency-based instruction for teaching CATD at the secondary school level.
2. Government, school heads and administrators should partner with appropriate private organization to assist in procuring the needed facilities for the successful implementation of the CATD component of the TD curriculum at the secondary school level.
3. Technical Drawing instructors should sponsored by government and school heads to acquire appropriate knowledge and skills in the use of suitable assessment tools, methods and procedures for assessing and evaluating students learning in CATD.

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