



IMPACT OF COMPUTER-AIDED DESIGN AND DRAFTING ON STUDENTS' ATTITUDE AND PERFORMANCE IN TECHNICAL DRAWING IN UNITY COLLEGES IN PORT HARCOURT

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ABSTRACT

The study investigated the impact of Computer-Aided Design and Drafting (CADD) on students' attitude and performance in Technical drawing in Unity Colleges in Port Harcourt using quasi-experimental and descriptive survey designs. Samples of eighty (80) Technical drawing students from the two unity colleges in Port Harcourt were drawn from a population of 228 students. Two research questions were answered and two hypotheses tested at 0.05 level of significance. Instruments used for data collection were Technical Drawing Achievement Test (TDAT) to determine students' performance and Technical Drawing Structured Questionnaire (TDSQ) used to measure students' attitude towards Computer-Aided Design and Drafting usage. Data collected were analyzed using SPSS (Mean and Standard Deviation to answer research questions, while ANCOVA and Independent t-test were used to test the hypotheses). The findings revealed among others; that CADD had significant impact on students' performance in Technical drawing, and also positively influenced the attitude of the students. Recommendations include among others; that the Nigerian Educational Research & Development Council (NERDC) should design a curriculum that will enforced the incorporation of modern technology software such as the CADD in the teaching and learning process in Secondary Schools in every subject areas as this will help to promote the learning outcome and thus bringing about positive change towards students' attitude in the different subject areas.

KEYWORDS: Computer-aided Design, Drafting, Attitude, Technical Drawing, Performance

INTRODUCTION

Technical Drawing (TD) is a graphic subject that makes use of lines, symbols and signs to convey information. It is a core subject offered by all technology/technical students in senior secondary schools in Nigeria, with the primary objectives of equipping students with basic and fundamental skills needed in the pursuit of engineering courses in tertiary institutions. Technical drawing is a foundation to which other technical/engineering courses are laid, and a pre-requisite subject for studying engineering and related technical courses in tertiary institutions, and it is often referred to as the 'language of the engineers'. In the primitive or 'stone age', the only way the draughtsman could illustrate or express his ideas was by drawing on the walls and stones, then that was replaced by drawing on paper, and today the use of Computer Aided Design software is gradually replacing the manual drafting. Technical drawing is used by engineers, architects, artist, and by technicians and craftsmen. Technical drawing finds its applications in so many works of life which include:

construction and manufacturing industries, government parastatals, Schools, hospitals, et cetera.

The Federal Government in recognition of the prominent role technology plays in production and nation building, advocated for provision of adequate technological tools in all educational system for efficient instruction and learning process (FRN,2013), all in effort to promote learning outcome. The learning outcome and attitude of students in any subject is very crucial in the teaching and learning process. For an effective teaching and learning to take place, there is need to put into consideration the way and manner learners learn. In this technology era, where learners are exposed to different technological tools ranging from smart phones, personal computers, to tablets, and uses them to communicate and access information. It becomes imperative that the teacher understands and adapts to the available technology instructional materials in order to enhance students' academic performance or learning outcome, as the use of right and appropriate materials in the teaching and learning process is very crucial to the performance



of the students and goes a long way to determine the quality of learning outcome Obanya, (2014).

Technical Drawing as a graphic subject can be taught using Computer-Aided Design and Drafting (CADD) software and other graphic designs software such as; AutoCAD, Corel Draw, Smart Draw, Sketch-up etcetera. CADD has powerful features in its environment that can help shift teaching and learning from teacher-centered classroom to student-centered classroom, and it is able to create interactive and engaging learning environment for teachers and learners. It also provides tools such as; the drawing tools, modifying and editing tools, et cetera in its environment that makes drawing faster, consistent, neater and accurate.

However, the consistent weak/poor performance and negative attitude of students over the years in Technical drawing Diraso, et al (2013); Siminialayi, (2018) should be of great concern. These authors pointed out that apart from the poor performance, there is also low enrollment of students in engineering and related courses in tertiary institutions, which they attributed to the negative attitude of students in Technical drawing at the secondary school levels, The Technical drawing students at this level are the ones who eventually enroll for engineering courses at the tertiary institutions. So this study intends to determine whether the application of Computer-Aided Design and Drafting in the teaching and learning of Technical drawing will have positive impact on students' performance and attitude towards

Technical drawing in unity Colleges in Port Harcourt in Rivers State.

LITERATURE REVIEW

Computer-aided design and drafting (CADD) is the process of drafting Technical drawing with the use of computer software. It is the technology for design and technical documentation which replaces the manual way of drafting with an automated process (STANDS4Network, 2021). The CADD output conveys information such as: the process involved; the dimension of the product; and the tolerances depending on the application of a specific convention. CADD software is used to a make drawing and editing of 2D (2-dimensional) and 3D (3-dimensional) designs easier and faster. It makes use of visual and symbols, and it is a powerful tool for the engineers, architects, artists and draughts men for making of designs (Charter, 2020). It is used for manufacturing of component parts and for drafting and design of different types of buildings (Encyclopedia, 2020).

Computer-aided design was first released by Autodesk as a commercial software application in 1992, but before then it has been existing as a desktop application since 1982 and as a mobile, web and cloud-based app since 2010 (Nunns, 2016). The CADD application depends on the profession of the user and the type of software.

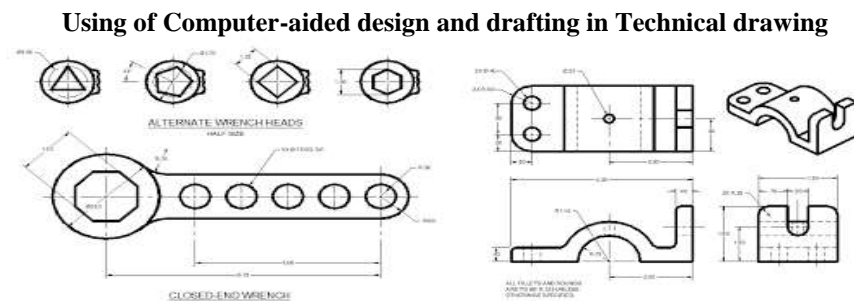


Figure 1: Use of Computer-aided design and drafting in Technical Drawing.

Source: <https://summaryplanet.com>



Table 1: Advantages of Computer-Aided Design and Drafting over the Manual drafting in Technical drawing (Rajesh, A. et al (2020))

Entity	Computer Aided Drawing (CADD)	Manual drawing
Line thickness	Line thickness is available from 0.0000mm to 5000mm	Depends on the type of pencil used by the draughtsman
Storage space	Does not occupy much space	The space is dependent on the skills developed by the draughtsman
Prototype	With CADD, making of prototype of any product is possible	It is not possible making a prototype of product with the manual drawing
Editing	It is very easy to edit drawing with CADD	Editing with the manual drawing is not always very easy.
Scaling factor	Scaling with the software can be done by just one command.	Scaling using the manual instrument could be time consuming.
Conversion of 2D to 3D	With CAD it is possible converting 2-dimensional objects to 3-dimensional objects.	Conversion is not possible with the manual drafting.
Virtual manufacturing	It is possible to do virtual drawing.	It is not possible.
Animating process	Animation is very easy and possible with the CADD software.	Not possible with the manual method.

Apart from the above advantages of CADD over manual drafting, others advantages include: accuracy, consistency, enhancing speed, neatness and legibility (Siminialayi and Fomsi, 2018).

The research is anchored on Constructivism theory. Constructivism is a learning theory based on the idea that new knowledge is constructed on the learners' prior knowledge (www.cwcmavista.org 2017). The theory views learning as a process in which individual construct meaning as a result of previous knowledge along with experience. The theory does not see learners as "empty vessels" that needed to be filled, but rather believes that every learner has previous knowledge inside them. This theory is of opinion that students' prior knowledge serves as important foundation for new learning. This means that student's prior knowledge of the course contents plays significant role in students understanding of the new method or techniques. That is to say, Technical drawing students' previous knowledge of the manual drawing method can enhance their learning of the new technology approach.

Constructivism, according to (David and Alan, 2005) is the theory whereby people create their individual understanding as well as knowledge of the content, by experience and reflecting on it. When learners encounter new thing, they resolve it using prior knowledge and their previous experience. The constructivist believes the opinions and ideas of learners are of top most importance in the teaching-learning process. The theory is also of the view that students should apply prior knowledge and experiences to create innovative related and or adaptive concept of learning. This therefore implies that the application of Computer-Aided Design and Drafting as a tool for instruction can enable students construct knowledge of

Technical drawing overtime with their previous knowledge. This learning theory believes that the teachers should act as facilitators in providing guide lines, plans, or organizes and provides directions to the learners who are accountable for their learning. The major proponents of this theory are; Piaget (1896), Brumer (1915); Vygotsky (1896), and Dewey (1859) as cited in Rintaningrum, (2008).

The theory is connected to this study: "Impact of Computer Aided Design and Drafting on students' Attitude and Performance in Technical drawing in unity colleges, because the students' previous knowledge of the concept and fundamental principles of Technical drawing is needed for learners to effectively apply the technological approach. This can help to change their attitude and thereby improve the learning outcome. Technical drawing is also a subject that is concerned with students' ability to construct their individual knowledge, ideas and problem solving and so the theory is also related to the study in this aspect.

Siminialayi (2018), on a study to investigate the effect of AutoCAD on students' performance in Technical Drawing in Unity schools in Rivers State'. The study adopted quasi-experimental designs. Total population used for the study was 492 Technical Drawing students from the three Unity Colleges in Rivers State. Sample size of 92 Senior Secondary School 11 Technical Drawing students were drawn from the population using purposive sampling technique. The instrument used for data collection was Technical Drawing Achievement Test (TDAT). Result from findings revealed that students taught with AutoCAD performed better than their counterpart who were taught using the conventional method.



Similarly, Zira and Wilfred (2019) carried out an investigation on the impact of AutoCAD application instruction on students' Academic Performance in Building Engineering Drawing in Technical Colleges in Adamawa State. The study was guided by two research questions and two hypotheses. The sample size comprised of 86 Year 11 Building Engineering Drawing students from the Technical Colleges. The instrument used for the study was standard questions adapted from National Technical and Business Examination Board (NABTEB) past questions. Mean and standard deviation were used to answer research questions, while ANCOVA and t-test were used to test the null hypotheses at 0.05 level of significance. Findings of study revealed among others that teaching and learning of Building Engineering Drawing using AutoCAD motivated learners and thus increased academic performance significantly. In the same vein, Santayo & Galiano, (2019) investigated a study on the attitude of students towards Design Discipline in the use of Computer-Aided Design (CAD) in Higher Education in Mexico City. Sample size for the study comprised of 141 students from seven different Universities in Mexico. The instrument used for data collection was Sociological-type closed survey instrument. Result from the study revealed that there was no significant difference in the quality of design when CAD or no test at all was used. The finding from recent study, (Hu,2021) on the 'Realization of Intelligent Computer Aided Design System also showed that students taught using conventional method had negative attitude while those taught using CAD had positive attitude in physical education, which they attributed to the students' high enthusiasm in the use of technological tools.

STATEMENT OF THE PROBLEM

With the information and technology age where learners communicate and access information using various technological tools, it has become pertinent to inculcate these digital tools into every subject area including Technical drawing as this might help to promote better performance and attitude towards in Technical drawing.

The enrollment of students in National Examination Council (NECO) and West African Examination Council (WAEC) in Technical drawing over the years has been on the decrease, this is evidence in the total number of students that enroll for Technical drawing in external exams such as NECO. For instance, the overall percentage of students who enroll for Technical drawing in NECO examination between the periods of 2012 to 2016 was just 9.7 percent of the total students in SS3 in three selected schools for the study in Rivers State (Siminialayi, 2018). This of course calls for serious concern and worry, knowing the vital role of engineering and technology in National development of any county (Enu and Eus, 2011).

This low number of students offering Technical drawing, and the persistent low level of performance at the secondary school level, may continue to have adverse impact on the number of engineering graduates in the country, leading to insufficient

manpower in the construction /manufacturing industries, and thus affecting National development. The researcher therefore, wonders whether enforcing the incorporation of Computer-Aided Designs software into the teaching and learning process can help to enhance students' performance and attitude towards Technical Drawing in Unity Colleges in Port Harcourt.

AIM AND OBJECTIVES OF THE STUDY

The aim of this study is to find out whether the application of Computer-Aided Drawing and Drafting software can help to improve students' performance and change their attitude towards Technical drawing in Unity Colleges in Port Harcourt.

The study sought to:

- i). determine the impact of Computer-Aided Design and Drafting (CADD) on students' performance in Technical drawing.
- ii). find out the attitude of Technical drawing students' in the use of Computer-Aided Design and Drafting.

RESEARCH QUESTIONS

The following research questions were answered during the study.

- i. What effect does the use of CADD have on students' performance in Technical Drawing?
- ii. How will the use of CADD affect the attitude of students towards Technical Drawing?

HYPOTHESES

For the purpose of the study, a null hypothesis was formulated and tested at 0.05 level of significance.

1. There is no significant difference in the performance of students taught with CADD and those taught without CADD in Technical Drawing.
2. There is no significant difference in the attitude of students taught with CADD and those taught without CADD towards Technical Drawing.

METHODOLOGY

Technical drawing Achievement Test (TDAT) was administered as a pre-test to the control and experimental groups prior to the introduction of the conventional (traditional) and technology approaches. A lesson plan was prepared using both traditional and technology methods by the researcher, the control group was taught by the subject teacher, while the experimental group was taught by the researcher with the help of the ICT teachers in the school. The lesson lasted for two weeks after which a post test was administered using the same question as the pretest, but varying the questions (i.e. re-arranging the numbers). The students' scripts were marked and recorded which constituted the data for students' performance.

Technical Drawing Structured Questionnaire (TDSQ) was also used to determine students' attitude in the use of Computer-



Aided Design and Drafting in Technical drawing (table 2). The researcher personally administered the questionnaire to the 80 students.

RESULTS

Research question 1: What effect does the use of CADD have on students' performance in Technical Drawing?

The scores from the Technical Drawing Achievement Test were used to answer this research question. The result of the findings was reported on table 2;

Table 2: Mean and standard deviation analysis showing the effect of CADD on students' performance in Technical Drawing.

Groups	N	Mean	S/D
Experimental Group	40	35.375	13.511
Control Group	40	27.875	17.055

Experimental group mean (35.375) higher than control group mean (27.875).

Hypothesis 1: There is no significant difference in the performance of students taught with CADD and those taught without CADD in Technical drawing.

Table 3: ANCOVA analysis showing the no significant difference in the effect of CADD on students' performance in Technical Drawing.

Source	Df	F	Sig.
Corrected Model	2	15.807	.000
Intercept	1	85.982	.000
Pretest	1	8.723	.000
Group	1	25.377	.004
Error	77		

$F(77) = 25.377, p < 0.05$

The result from table 2 shows that the experimental group taught with CADD has a mean score of 35.375 and a standard deviation of 13.511 while the control group which was taught without CADD had a mean of 27.875 and a standard deviation of 17.055. The table therefore reveals that the mean score 35.375 of the experimental group is higher than the mean score of 27.875 of the control group showing that the experimental group had higher achievement scores than the control group. This shows that the Computer-Aided Design Drafting has positive effect on the performance of students in Technical Drawing.

Similarly, table 3 indicates that the computed F of 25.377 is statistically significant at the chosen alpha level of 0.05.

Therefore, with the effect of pretest which contains extraneous variables partialled out or removed, there is a significant difference in the effect of CADD on students' performance in Technical drawing as $F(77) = 25.377, p < 0.05$. The null hypothesis of no significant difference in the effect of CADD on students' performance in Technical drawing is rejected and the alternate accepted.

Research question 2: How will the use of CADD affect the attitude of students towards Technical Drawing as measured by their mean scores?

**Table 4: Mean analysis showing the attitude of students in the use of CADD**

S/N	Statement	N	Mean	SD	Decision
1.	I enjoy the traditional method of teaching Technical Drawing (TD)	40	2.29	1.066	Disagree
2.	The traditional method of teaching TD can be very boring.	40	2.12	.969	Disagree
3.	I am comfortable with the time frame in the teaching and learning TD in the traditional classroom	40	2.45	1.041	Disagree
4.	The time of teaching and learning TD in the traditional classroom is not always enough	40	1.81	.994	Agree
5.	There is no need to introduce new technology in the teaching and learning of TD	40	3.62	.661	SD
6.	I prefer the new technology to the traditional method	40	1.69	.680	Agree
7.	I get distracted when using the new technology	40	2.81	.740	Disagree
8.	I am satisfied with learning with the new technology	40	1.62	.731	Agree
9.	I am able to draw very well with the traditional method.	40	2.05	.697	Disagree
10.	I don't see any need of the new technology approach.	40	3.60	.544	SD
11.	Drawing with the manual instrument is fun and interesting	40	1.86	.683	Agree
12.	Drawing using the Computer aided software is fun and interesting	40	1.55	.633	Agree
13.	I get anxious whenever I don't have my complete drawing tools for drawing	40	1.36	.759	Agree
14.	I am not bothered even when my drawing tools are not complete	40	3.76	.692	SD
15.	irrespective of the method used, I am able to draw very well	40	2.00	.855	Disagree
16.	drawing very well in TD has a lot to do with the method used	40	1.50	.834	Agree

Note: 1= Strongly Agree, 2 = Agree, 3 = Disagree and 4 = Strongly Disagree.

Hypothesis 2: There is no significant difference in the attitude of those taught with CADD and those taught without CADD and towards Technical Drawing.

Table 5: Independent samples t-test analysis showing difference in the attitude of students towards Technical Drawing of those taught with CADD and those taught without CADD.

t-test for equality of means				
t	df	@	Sig (2-tailed)	Decision
12.238	90	.05	.000	Rejected H ₀₁

$t(90) = 12.238$ $p < 0.05$, i.e. $p = .000$ is less than 0.05

On table 4, the mean scores of 4.00 – 2.00 means negative attitude, while the mean scores of 1.99 – 0.99 means positive attitude. So items with mean scores of 4.00 – 3.00 indicates strongly disagree; 2.99 – 2.00 implies disagree; 1.99 – 1.00 indicates Agree and 0.99 and below implies strongly agree.

In the same vein, table 5 shows that $t(90) = 12.238p < 0.05$, i.e. $p = .000$ is less than 0.05 therefore, the null hypothesis of no significant difference in the attitude of students taught with CADD and those taught without CADD towards Technical drawing is rejected and the alternate accepted. This means that the attitude of students taught with CADD and those taught without the software is significantly different.

DISCUSSION OF FINDINGS

Use of CADD and Students' Performance in Technical Drawing.

The result obtained from research question 1 as reflected on table 2 shows that the experimental group (i.e. those students taught with CADD) has a mean score of 35.375, as against the control group (those taught without CADD) with a mean score of 27.875. This means that students taught with CADD performed better than those taught without CADD as measured by their mean scores. Statistical analysis also shows that there is a significant difference between the performance of students taught with CADD and those taught without CADD. More so, the result obtained from the hypothesis as reflected on table 3 shows that the computed 25.377 is statistically significant at the



chosen alpha level of 0.05, and therefore the null hypothesis was rejected.

The finding means that students taught with the computer-aided design and drafting were able to achieve better performance in Technical drawing than their counterpart who were taught without CADD. However, this result is expected, because the CADD environment provides drawing and modifying tools which makes drawing to accuracy possible (Rajesh, et al 2020). The high performance of students taught with CADD could be attributed to the enabling environment created by the software thus making the drawing faster and easier (Charter, 2020). Likewise, the reason why those taught without the CADD did not perform very well could also be attributed to insufficient time, as the use of manual drawing instrument requires a lot of time and 'technical-know-how'. This finding is in agreement with some past research findings; (Siminailay, 2018; Zira and Wilfred 2019). Findings from each of the study revealed positive impact of computer-aided design on students' performance.

However, the study of Santayo and Galiano (2019) revealed findings which is dissimilar to the present study, their results revealed that there was no significant difference between students taught with the computer software and those taught without the software. This could probably be to the lack of adequate or appropriate technology software application tools or as a result of the teachers' inability to make use of modern technological instructional tools.

Attitude of Technical Drawing students towards Computer-Aided Design and Drafting usage.

The data on table 4 were used to provide the answer to research question 2. The results of the analysis indicated that the majority of the students showed negative attitude towards the use of traditional method in the teaching and learning of Technical drawing as seen in the mean (item 1). This response is not surprising as drawing using the manual instrument could be tedious and tasking. Apart from this, the students indicated negative attitude regarding the time frame in the traditional method (item 3), meaning that the traditional method of drawing is time consuming, unlike the technological method that saves time of theoretical explanations. However, the majority of the students showed positive attitude in the incorporation of computer- aided design into the teaching and learning Technical drawing (item 5-8 and item 10). This again is not surprising as the 21st century learners will always show positive attitude whenever computer is being used for instruction (Hu, 2021). The students were also in agreement that drawing very well has to do with the method use (item 15 and 16). However, some students also agree that drawing with the manual method could be fun and interesting.

Similarly, result from table 5 shows that $t(90) = 12.238$, $p < 0.05$, i.e. $p = .000$ is less than 0.05 therefore; the null hypothesis of no significant difference in the attitude of students towards

CADD usage in Technical drawing is rejected. This implies that the attitude of students taught with the computer aided design and drafting and those taught without the software towards Technical drawing is significantly different.

CONCLUSION

From the findings, it can be concluded that the use of Computer-Aided Design and Drafting (CADD) in the teaching and learning of Technical drawing had a positive impact on students' performance and attitude. The significant difference between the performance of students taught with CADD and those taught using the traditional method was in the favour of those taught with CADD. This could be as a result of the enabling environment created by the computer-aided design software.

The implication of this is that the use of computer-aided design and drafting software will help to improve students' performance and attitude towards Technical drawing and hence encouraging more students to show interest in studying engineering and technology related courses in tertiary institutions which will in turn led to increase in manpower and thereby promoting National Development.

RECOMMENDATIONS

Based on the findings, discussion and conclusion the following recommendations were made:

- i. The Federal Ministry of Education should make provisions to train and re-trained Technical drawing teachers/instructors on Information and Communication Technology training programs on regular basis, so as to equip them with the current technology trends that will foster better academic performance and positive attitude of students towards Technical drawing.
- ii. Technical drawing teachers should avail themselves of the opportunity provided by CAD software package by embarking on self-updating, so as to remain relevant in the information age.
- iii. The Nigerian Educational Research & Development Council (NERDC) should design a curriculum that will enforced the incorporation of CAD software in the teaching and learning of Technical drawing at the senior secondary school as this will help to foster learning outcome.
- iv. The various education bodies should initiate plans and proposals on ICT initiative and school projects to ensure full implementation of computer technology instructions.

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