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# EFFECT OF AUTOCAD SOFTWARE PACKAGE ON CREATIVE ABILITY AND ACADEMIC ACHIEVEMENT OF TECHNICAL DRAWING STUDENTS TECHNICAL COLLEGES IN DELTA STATE

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## Abstract

Continuous increase in poor creative ability and academic achievement of technical drawing students in technical colleges in Delta State especially in an external examination such as National Business and Technical Examination Board calls for an urgent solution. In view of this, it becomes necessary for the researcher to determine whether the use of AutoCAD software package to teach technical drawing students in technical college in Delta State could improve their mean creative ability and academic achievement. The study adopted quasi-experimental design. It was guided by two research questions and one null hypothesis tested at 0.05 level of significance.The population of the study was 356 National Technical Certificate (NTC 11) of Technical drawing Studentsin state owned technical colleges. Purposive sampling technique was used to sample 160 technical drawing studentsdrawn from two schools out of the six technical colleges in the State. Instrumentfor data collection was Technical Drawing Achievement Test (TWAT) which was validated bythree experts. The instrument was tested for reliability using test–retest method to obtain coefficient value of 0.89. The arithmetic mean was used to answer the research questions while Analysis of Covariance (ANCOVA) was used to test the null hypotheses at 0. 5 level of significance. The study revealed that students in the experimental group obtained higher mean scores than those in the control group. It was concludedthat the use of AutoCAD could improve the creative ability and academic achievement of technical drawing students'in technical colleges. In view of the positive effect of AutoCAD software package, it was therefore recommended amongothers, that the AutoCAD software package should be adopted for teaching technical drawing to promote students' creative ability and overall academic achievement.

**Keywords:** AutoCAD, Technical Drawing, Creative Ability, Academic Achievement and Technical Colleges.

## Introduction

The main objective of every vocational institution is to equip its recipient with the appropriate skills required for national development. It is in line with this that technical colleges were established to train individual as artisans, craftsmen and technicians. The training qualifies the recipient for self-reliant and self-employed in their area of interest and specialization(Deebom, Dokubo and Obed, 2018). Technical colleges in Nigeria are established to produce craftsmen at the craft level and master craftsmen at the advanced craft level (Okuntade, 2014). On completion of the three years programme in technical college, the students are awarded National Technical Certificate (NTC), while Advanced National Technical Certificate (ANTC) could be obtained with the additional enrollment of ANTC examination at the end of three years NTC programme. The ultimate objectives of establishing technical colleges are; to provide trained manpower in the applied sciences, technology and business craft at an advanced craft and technician levels, to enhance technical knowledge and vocational skills necessary for agricultural, commercial and economic development; and to give training and impart the necessary skill to individual who shall be self-reliant economically (FRN, 2016). In technical colleges, students are exposed to different trades through the various trade subjects like Technical Drawing

Technical drawing is one of the trade subjects offered at technical college level to enhance technical knowledge and vocational skills necessary for national development. NERDC (2013) stated that, technical drawing is one of the core subjects which aimed at giving complete, accurate, clear and quick description of objects by means of graphic representations made according to an accepted plan or scheme. It is used to develop idea by transferring mental pictures into accurate proportion and arrangement on paper. When the general form of a product or structure has been planned, the shape and details of manufacture for each part or element are described with drawing. Technical drawingdescribes all details of construction and process in manufacture, they are often more valuable for purpose of reproduction.

Eze and Emili, (2013) asserted that use of technical drawing could be advantageous as it brings about clarity to drawing by enabling holistic view of sold shapes, sizes and angles on one sheet. It could enhance and accelerates creativity in style and expression in drawings, produces a depth and weight that could easily demonstrate its technicality. Furthermore, it allows efficient communication among engineers and could be kept as a record of the planning process. Since a picture is worth a thousand words, technical drawing is a much more effective tool for engineers than a written plan. It is used do the actual work of producing, constructing, installing or assembling. The ultimate aims of studying technical drawing are; to develop the ability to produce simple manufacturing drawing and sketches based on current practice, to develop the skills to read manufacturing and construction drawings used in present industries, to develop a working knowledge of the layout of plans and equipment, to develop skills in abstracting information from calculation sheets and schematic diagrams, to produce working drawings for manufacturers, installers and fabricators as well as to become proficient in the art of making and interpreting drawings.

In order to become proficient in the art of making and interpreting drawings, the students must first of all understand thoroughly the underlying principles of orthographic projection. He must then become familiar with the accepted methods of applying these principles to different types of drawings. Skills in technical drawing are indicated not only by the ability to write, but by the ability to read this language. It can be read only by forming a metal picture of the subject that is

represented. The training that this interpretation gives in visualizing clearly in space and in reading description from lines has a value not understood by those unfamiliar with it.

Therefore, teacher softechnical drawing especially in technical colleges should be able to develop and employ various instructional methods which could encourage students to actively participate in the learning process (Eze and Emili, 2013). It is therefore hoped that when this is achieved by technical drawings teachers in technical colleges, it would encourage students' interest to learn, improve their cognitive and psychomotor skills and accelerated their creative skill and ability.
Creative ability is the spatial ability or intellectual capacity used to function and operate in 2-dimensional or 3- dimensional spaces. It is a cognitive function that makes it possible for human to deal effectively with spatial relations, visual-spatial tasks and orientation of objects in space. It is the ability to think in picture, to create mental images and to transform visual or spatial ideas into imaginative and expressive creation (Jimoh, 2010). In the same vein, creative ability is spatial reasoning which enables an individual to use concept of shapes, features and relationships in both concrete and abstract ways, to make and use things in the world, to navigate, visualize and to communicate. Thus, when spatial skill or aptitude is correctly applied in teaching and learning in technical drawing digital classroom could promote students' academic achievement

Academic achievement refers to knowledge and skills attained by a student in a school subject designated by a score obtained in an achievement test. According to Eze, Obidile and Okotubu (2020). Academic achievement represents the outcome that indicates the extent to which a person has accomplished specific goals that were the focus of activities in instructionalenvironments, specifically in schools. They could be seen as the outcome of students' effort in examinations. Eze, Obidile and Okotubu (2020) posited that academic achievementis used to measure student's success in educational institutions or how well studentsmeet standard set out by examining bodies or the institution. In teaching and learning situations, academicachievement is synonymous with academic performance. Academic achievement is appropriate in determining the efficiency of instruction, useful in testing of information retention of knowledge in learning as well as the effectiveness of instructional method.

Over the years, graduates of technical colleges have serious difficulty in learning with conventional method such as lecture /demonstration teaching methods (Eze and Onwusa, 2020).Accordingly Eze and Onwusa, students perhaps would not work at their own speed. The fact that conventional method is teacher-centred, it could not provide students with experiential learning environment that could facilitate better understanding of spatial properties and relationship of objects and space. Supporting the above assertion, Oluwale, Jegede and Olamade (2013) noted that with the manual tools, it could be very difficult to solve complex drawing problem easily. Kumazhege (2015) revealed that manual tools may lack accuracy and consistency both in appearance and in performance. The abstract nature of presentation of technical drawing could not encourage the class to progress without a great deal of the teacher's intervention.

However, as a result of increasing industrialization and advancement of automation in work environment in modern times, the method of imparting and acquiring relevant knowledge and skills in learning environment has increasingly brought changes in learning processes (Wilfred, 2016). The aspiration to inculcate innovative knowledge and creative skills necessitated a change to improve the preparation of technical college students for functioning in a continually changing and highly demanding conducive learning environment. Therefore, education systems all over the world are under increasing pressure to appropriately utilize the digital tools to teach students in the 21st century (UNESCO, 2009). In addition, the emergency of a new understanding of

knowledge construction and the reciprocal relationship between the teacher and learner are absolutely essential in education especially in technology education. Hence, many application software packages have been developed for Computer-Aided Design, including the Automated Computer Aided design called the AutoCAD.

The AutoCAD is an interactive drafting software package developed for construction of objects on a graphic display screen. The concept of AutoCAD evolved in the 1980's, when engineers and architects were seeking to harness the power of newly introduced personal computers to reduce the drafting time. People began experimenting with internal graphic controllers which allowed them to draw engineering /architectural drawings at the front end which were efficiently replicated at the back end of the computer. Onwusa et. al (2023) defined AutoCAD as a means of using computer systems to assist in the creation, modification, analysis, or optimization of a design. AutoCAD was officially launched in December 1982 by Autodesk, a leader in 3D design, engineering and entertainment software. Autodesk, the company behind AutoCAD, has developed custom versions that could be used by design engineers, civil engineers, electrical and electronics engineers and mechanical engineers. Most essentially, CAD software could be used to increase the productivity of the designer, improve the quality of design, improve communications through documentation, and create a database for manufacturing.

AutoCAD which is one of the most powerful CAD software used in the industry offers two different techniques (2-D and 3-D) of graphics task (Taylor and Parsons, 2011). These two-techniques used in AutoCAD technology and software are the two-dimensional and three-dimensional Cartesian coordinate systems. Whereas, the AutoCAD two-dimensional Cartesian coordinate system is a two-dimensional Computer-Aided Design, used for graphics construction in AutoCAD environment through the specification of coordinate with the X and Y Cartesian coordinate system only. The AutoCAD three-dimensional use three-dimensional Cartesian coordinates system in AutoCAD environment (Jimoh, 2010). Two-dimensional drawing is related to rectangle, square, triangle, polygon, etc. While three-dimensional drawing is related to cylinder, cube, sphere, pyramid, prism and more.

Digitemie and Emeli, (2016) stated that in contemporary times the use of three-dimensional technology has become a crucial tool and therefore stated that,making drawing accurate, enhancing speed in the drawing process, enabling students to draw legibly, improving clarity in drawing, making students consistent and thus promoting uniformity in drawings are the advantages of the software package in teaching and learning drawings. It could as well boost students' interest and motivate them to engage in learning activities. Additionally, it could make the drawing more creative and purposeful as well as to develop problem solving abilities of the students. In the same way, it could improve design documentation with less transcription errors, create manufacturing database as well as provide easier modifications and alterations in drawings. More importantly it might increase productivity of the designer, simulation and virtualization (Usikpedo, 2022).

**Statement of problem**

There is a growing concern about the low creative ability andpersistent pooracademic achievement of technical college students in technical drawing subjects. Studies have attributed this low creative ability andpooracademic achievement to negative attitude towards the use of manual drawing instruments such as drawing board, T-square, protractor, set squares, drawing sheet, drawing pencils, compass, pair of divider and drawing pins/clips which has become a major issue of concern as many students learning this subject, approach it with phobia. According to Eze and Emili, (2014), the use of the manual tools in teaching technical drawing has led to difficulties in teaching the subject because many of the students find it difficult to manipulate these instruments, thus

making them to learn with low level of engagement which could lead to high failure rate in the subject.

In view of this, it has become necessary for the researcher to determine whether the use of AutoCAD software package to teach technical drawing students' in technical college in Delta State could improve their mean creative ability and academic achievement.

**Purpose of the Study**

The general purpose of this study therefore was to determine the effect of AutoCAD software package on technical drawing students' creative ability and academic achievement in technical drawing in technical colleges in Delta State. Specifically, the study seeks to determine the:

6. Mean creative ability scores of students taught technical drawing with AutoCAD and those taught with demonstration teaching method
7. Mean academic achievement scores of students taught technical drawing with AutoCAD and those taught with demonstration teaching method

**Research Questions**

The following two research questions guided the study:

3. What are the mean creative ability scores of students taught technical drawing using AutoCAD software package with those taught using demonstration teaching method?
4. What are the mean academic achievement scores of students taught technical drawing using AutoCAD software package with those taught using demonstration teaching method?

**Hypotheses**

The null hypotheses were tested at 0.05 level of significance was used for the study.

12. There is no significant difference between the mean academic achievement scores of technical colleges students taught technical drawing with AutoCAD software package and those taught using demonstration teaching method.

**Methods and Materials**

Quasi-experimental design was adopted for the study. Specifically, the pretest, posttest non-randomized control group design was adopted for the study. The design was adopted because it was not possible for the researchers to randomly sample the subject and assign them to groups without disrupting the academic programme. The timetable of the technical colleges was used for the study. The study was conducted at technical colleges in Delta State which is located in the south-south zone of Nigeria. The population of the study was 356 National Technical Certificate (NTC 11) technical drawing students in the six technical colleges in Delta State. The sample of the study was 160 NTC II technical drawing students purposively sampled from four out of the six technical colleges in Delta State. The purposive sampling technique was based on availability of professionally qualified staff in AutoCAD, technical colleges offering technical drawing, manageable population for the study, technical colleges with computer facilities/ laboratory for teaching and learning and schools with regular electricity supply. Also, willingness of the classroom teachers to participate as research assistants in these schools was also considered.

One intact class was used as the experimental group and another intact class used as control group respectively. The instrument for data collection was Technical Drawing Achievement Test

(TDAT) adapted by the researchers from the NABTEB past examination questions between 2021, 2022 and 2023. TDAT contained 40 multiple choice test items with four options (A-D) and 10 theory questions to test creative ability. TDAT lesson plan were validated by three

experts in Technology Education Department. Based on the comments, corrections and advise of the experts, the original package was edited by the researchers for the final draft.

The package was used for the study. The copies of the research instrument were administered to the technical college students drawn from the Government Science and Technical College Benin, Edo State who were not part of the population studied. The instruments were tested for reliability using
test–retest method and was calculated using Pearson Product Moment Correlation and the overall correlation coefficient value of 0.89 was obtained.

**Experimental Procedure**

The researchers sought and obtained permission from the authorities concerned for the involvement and participation of their students and teachers in the study. In the first week, the researchers visited the schools for orientation for the participating research assistants. The technical drawing teachers were trained on how to conduct the experiment treatment and were given prepared lesson plans and notes. Teachers of the control group were instructed to use demonstration teaching method, while the teachers of the experimental groups used AutoCAD software package for teaching. Likewise, students of experimental groups were given training on how to maneuver computer and AutoCAD software package. To reduce experimental bias, the regular technical drawing classroom teachers in the participating schools taught their own students. Hence, the researchers were not directly involved in administering the research instruments and the treatments.

The pretest was administered with the help of research assistants (the class teachers) to determine the initial abilities of the students prior to the experiment. In the second week, the teaching commenced and ended on the fifth week. The primary focus of the teaching process was concentrated on drawing in AutoCAD environment. Each lesson lasted for 80 minutes and the treatment lasted for five weeks. The teaching was conducted during the normal school period using the school time table. The exercise provided a post-test data for each of the dependent variables. The experimental group wrote the examination using the AutoCAD software and students saved their drawings in CDROM and was printed before submission to the classroom teachers. The control group wrote the examination with manual drawing instruments and the research assistants supervised the examination, marked the scripts, recorded the marks and made the scores available to the researchers.

Data collected for the study were analyzed using mean scores and standard deviation to answer the research questions while Analysis of Covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance. In the test of null hypotheses using ANCOVA, when the p-value was less or equal to the level of significance (0.05), the null hypothesis was rejected. Also, when the p-value was greater than the level of significance (0.05), the null hypothesis was not rejected. The pre-test and post-test scores were used for data analyses using Statistical Package for the Social Sciences (SPSS) version 25.

**Data Presentation**

**Research Question 1**

What are the mean creative ability scores of students taught technical drawing using AutoCAD software package with those taught using demonstration teaching method?

**Table 1:** Mean of Pretest and Posttest Scores of Treatment Groups taught Technical Drawing using AutoCAD software technique with those taught using demonstration teaching method Creative Ability

| Groups | No | Pre-test Mean | SD. | Post-test Mean | SD. | Mean Gain |
|---|---|---|---|---|---|---|
| **Experimental Group (AutoCA)** | 89 | 22.833 | 8.790 | 29.451 | 3.996 | 6.818 |
| **Control Group (DTM)** | 71 | 22.940 | 3.143 | 28.818 | 2.930 | 5.874 |

The data in table 1 shows that the experimental group had a mean of 22.833 and a standard deviation of 8.790 in the pretest, a mean score of 29.451 and a standard deviation of 3.996 in the post-test gain of 6.818. The control group had a mean score of 22.940 and a standard deviation of 3.143 in the pretest and a mean score of 28.818 and a standard deviation of 2.930. The posttest and mean gain of 6.818. The result showed that the experimental group creative ability was higher than the control groups. With these results, the use of AutoCAD techniques was really effective and efficient in improving students' creative ability in technical drawing.

## Research Question 2

What are the mean academic achievement scores of students taught technical drawing using AutoCAD software package with those taught using demonstration teaching method?

**Table 2:** Mean Scores and Standard Deviation for Pre-test and Post-test Academic Achievement of Students Taught AutoCAD software and those taught with demonstration teaching method Academic Achievement

| Groups | No | Pre-test Mean | SD. | Post test Mean | SD. | Mean Gain |
|---|---|---|---|---|---|---|
| **ExperimentalGroup (AutoCAD)** | 89 | 29.451 | 3.989 | 38.512 | 3.326 | 9.361 |
| **Control Group (DTM)** | 71 | 24.540 | 2.851 | 30.895 | 3.052 | 6.36 |

The data in table 1 shows that the experimental group had a mean of 29.451 and a standard deviation of 3.989 in the pretest, and a mean score of 38.512 and a standard deviation of 3.326 in the post test making a pretest – posttest gain of 5.33. The control group had a mean score of

24.540 and a standard deviation of 2.851 in the pretest and a mean score of 22.87 and a standard deviation of 3.326 .in the posttest and mean gain of 6.361. The result showed that the experimental group performed better than the control group with the pretest-posttest gain of 9.361 and 6.361 respectively.

## Hypothesis 1

There is no significant difference between the mean academic achievement scores of technical colleges students taught technical drawing with AutoCAD software package with those taught using demonstration teaching method.

**Table 3:** Summary of Analysis of Covariance (ANCOVA) for Differences in Academic Achievement of Students

| Source | Type III Sum of Squares | Df | Mean Square | F-cal | Sig. |
|---|---|---|---|---|---|
| Corrected Model | 591.605a | 2 | 295.802 | 9.5610 | .000 |
| Intercept | 3649.742 | 1 | 3649.742 | 117.9630 | .000 |
| Pretest | 743.232 | 1 | 74.232 | 2.3990 | 126 |
| Group | 539.381 | 1 | 539.381 | 17.4330 | .000 |
| Error2134.840 | 159 | | 309160 | | |
| Total 45164.00 | | 158 | | | |
| Corrected Total 2726.44 | | 160 | | | |

Significance at sig of F less 0.05

Table 3 shows that there is significant main effect of treatment in the post test achievement of students in the experimental and control group F-cal = 17.4330, $p< 0.05$. This means that there was significant difference in the mean achievement scores of students in the experimental group and the control group. The hypothesis that there is no significant mean difference in the achievement of students taught with the use of Auto CAD software package and DTM is therefore rejected. This means that the F-cal was statistically significantly at $p<0.05$ level. Thus, indicating that AutoCAD technique was significantly more effective than the demonstration teaching method in the teaching of technical drawing in the technical colleges in Delta State, Nigeria.

**Discussion of Findings**

The data presented in table 1 provided answer to research question one. The findings revealed that AutoCAD technique was effective and efficient in improving students' creative ability in technical drawing. Eze and Emili, (2013) pointed out that providing diverse learning activities could be a major source of enhancing spatial visualization ability amongst learners especially in CAD. In addition to drawing geometry with AutoCAD technique, the participants assigned to AutoCAD software package were able to solve spatial tasks by interactions with animation and virtual objects through twisting, rotating, and rolling of the virtual objects providing multi-point viewing relative to coordinate system and with the use of view point rotation that involved changing viewers angle to objects in AutoCAD space without changing the object's coordinate system, thus facilitating the visual perception and processing of objects in space. The use of coordinate system and the high degree of interaction with virtual objects and animation in the AutoCAD environment had benefited the treatment groups assigned to AutoCAD software since these features are absent in the TD. Usoro, (2010) noted that AutoCAD provided space learning environment that facilitates better understanding of spatial properties and relationships of objects and space. He explained that AutoCAD environment allows real time interactions by means of one or more control devices and involving one or more sensorial perception. In the AutoCAD environment, learners could view objects from close up or from a distance when examining specific and holistic feature of the artefacts thus concurring with Eze and Emili, (2013) studied that suggested alternating between interaction and observation was the best way to learn spatial visualization.

The data presented in table 2 provided answer to research question two, findings revealed that AutoCAD software package was effective in improving students' academic achievement in technical drawing.

The finding indicated that experimental group had higher mean scores than the control group in posttest. Although the slight superiority of the control group over the experimental group in the pretests could be attributed to the initial differences between the subjects in the groups. These findings that AutoCAD technique hold positive effect on students' academic achievement is in consonance with the works of Eze and Emili, (2013) who noted that impact of multi-media computer-based instruction on students' comprehension of drafting principles was significantly more effective than the traditional format in academic achievement.

Table 3 revealed that the calculated F-value (17.4330), Significance of F (.000) and confidence level of 0.05 there was a statistically significant difference between the effect of treatments (AutoCAD and DTM methods) on student's achievement in technical drawing. Confirming that, the difference between the effect of AutoCADand demonstration teaching method was statistically significant.

The implication of this finding is that the AutoCAD technique is more effective than demonstration teaching method in enhancing students' achievement in technical drawing. This finding compared favourablywiththe finding of Digitemie and Emeli (2016). Findings showed that the AutoCAD technique was more effective than the demonstration teaching method. Similarly, Eze and Emili, (2013).) noted that drawing in AutoCAD environment have significant communication advantages by representing form and space more realistically. AutoCAD techniques providing different perspective views to make available the user a sense of an objects' orientation in space. Thus, this result could be attributed to the fact that three physical dimensions of space-height, width and length could improve deeper understanding in geometric construction in the treatment.

**Conclusion**

Based on the findings of the study, it was concluded that AutoCAD software package was an innovative, effective and efficient method of improving students' creative ability and academic achievement in technical drawing in technical colleges. This implies that students learnt better when they are exposed to computers, videogames, digital music players, video cams, cell phones, and all the other modern technological toys and tools. Therefore, the use of AutoCAD package should be integrated into teaching and learning of technical drawing in technical colleges because CAD drawings are faster, better and more accurate than manually drafted counterparts using drawing instruments.

**Recommendations**

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

i. AutoCAD should be incorporated by curriculum planners into the teaching of technical drawing to enhance students' creative ability and good academic achievement in the subject.

(18) Technical drawing teachers should embrace the innovative approach offered by AutoCAD software package by embarking on self-updating, so as to make them relevant in this present technology era.

(19) The Ministry of Education should make provisions to train and re-train technical drawing teachers on ICT training programme on regular basis, so as to equip them in latest technology software in the teaching of technical drawing. When the teachers are motivated by way of training to meet the latest trend in the graphics technology, they will be able to impact same to the learners.

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