Effect of Revit and AutoCAD Softwares on Students' 3D Skill Performance in Modelling Building Drawings in Technical Colleges in Akwa Ibom State

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Abstract.
The purpose of this study was to determine the effect of Revit and AutoCAD software on students'3D skill performance in modeling building drawings in Technical Colleges in Akwa-Ibom State. Three specific objectives, there research questions, three null hypothesis guided the study. The study adopted the quasi-experimental design of non-randomized pre-test, post-test control group. The population of the study was 320 students comprised all building construction students in senior technical three in the six technical colleges in Akwa Ibom State. The sample consists of 134 Senior Technical lll building and construction work students Purposive sampling technique was used to select the two schools from six technical colleges in the study. From the two schools, two intact classes were assigned to treatment and control groups. Data for the study were collected during the practical sessions of the instruction using the researcher developed instrument called 'Building Drawing Modeling Skilled Checklist'(BDMSC) The instrument developed was face and content validated by three experts in the faculty of education. The scores obtained from the trial-test were subjected to item analysis to determine the reliability index of the instrument. Reliability co-efficient of the instrument was determined using Cronbach Alpha method. The result showed reliability co-efficient of 0.87. The data collected were analyzed using mean, standard deviation to answer the research questions. Analysis of Covariance (ANCOVA) at 0.05 probability level was used to test hypothesis. The finding revealed that the use of Revit and AutoCAD has a significant effect on 3D skill performance in Modeling Building Drawings. The study shows that students taught modeling building drawing using Revit software performed better than students taught using AutoCAD.

Keywords: Revit, AutoCAD, Skill performance, Modelingdrawing, Students.

Introduction

In the field of design, ideas and plans are formed in the designer's mind, but to be transformed into reality, they have to be communicated to others. Although a designer may

have a great idea, it must be effectively communicated or it will remain just an idea and never move beyond conception. Building designers and other professionals in the building industry use drawings as the primary means of developing and communicating their ideas. Designers and architects do a lot of sketching and drawing. They develop their skills in freehand drawing by sketching existing objects and spaces in the environment. These same skills of observation and sketching are then used in visualizing design for new spaces and objects. According to David(2014), building drawing is important as it often easier to explain building details by drawings or sketches than by written description. Drawings, thus forms an effective mean of communication and drawings constitute an essential working basis for any building project. .Architectural drawings can be grouped into three basic drawing type: drawing as idea generation, drawing as a design and presentation medium and drawing as a guide for the construction process. There are distinct differences between each of these types, yet they all contain some common drawing tools, techniques, standards and graphic language.

Idea generation assists the designer in working through and visualizing the solution to a problem. Designers use many different types of drawings to generate and bring to reality their creative ideas. These drawings can be in the form of quick freehand sketches illustrating different kinds of views. Many times, these types of drawings are not shown to clients but are used solely to help designers shape their ideas. The drawings are not intended to be the final solution to a problem but rather to allow the designer to explore alternative or define an idea. They also help to record a designer's two- and three-dimensional thinking. These concept sketches and drawings are part of sequence of design steps referred to as the design process. Once a designer has developed an idea to a point that visual commination is needed to show it to the client or others, new drawings must be created for use as presentation media. These drawings depict the parameters of an idea in more detail, yet are not totally worked out to point that they serve as an accurate construction guide. Design drawings can range from pictorial renderings of an idea to rendered plan views of a building’s interiors. Drawings serve as prime means of communication for constructing buildings, interior spaces, cabinets, furniture, and other objects. Construction drawings are scaled, detailed, and accurate representations of how an object looks and how it is constructed, as well as the materials used. The drawings follow established architectural graphic conventions to indicate sizes, material and related information that are needed to bring the objects or spaces into reality. The builder needs clear concise drawings that are directly related to different views of an object such as plans, elevations and sections.

Drawings remain the primary means by which architects communicate their ideas to clients, craftsmen or within the design team. The way these drawings are created has evolved over time and is still evolving on a daily basis. The advent of computer-aided design commonly referred to as CAD has revolutionized the building design industry. CAD, or computer-aided design, refers to any software used by architects, engineers, or construction manager to create precision drawings or illustration of a new buildings as either two-dimensional drawing or three-dimensional models. CAD did not change the design process, but the tools and equipment

in the building design as well as the skills and techniques employed in the design. Drawing is an individual expression and digital media for more diversity of interpretation and allows designers to explore the 'drawing as artifact'.

Digital media processed by CAD now offers unprecedented opportunities for architectural drawing and has adapted to a modern construction industry that has on the whole moved away from traditional crafts. In so doing, drawings have necessarily become diamensionally more precise. David (2014) asserted that where once artisanal experience and craft tradition would underpin the translation of a land drawing into carefully crafted building elements, digital drawings now determine every detail of production, with little room for creative development during manufacture or construction. Input at full scale, digital drawings can describe a whole building in precise detail like never before. The new medium not only offers liberation to imagine new forms, but also the means to deliver complex forms on the site,by 'cascading' precise information to fabricators and constructors (David,2014). Each architectural design software is targeted at different needs, and choosing the best one for the designer depends on many factors such as cost, compatibility on the drawing process. However, thus study considers the REVIT and AUTOCAD software.

Revit is building design software for Building Information Modelling (BIM).Revit supports a multidiscipline building design process for collaborative design. Its powerful tools let designers use the intelligent model-based process to plan, design, construct and manage buildings and infrastructure. Architects and drafters can use Revit to an idea from conceptual design to construction documentation within a single software environment. It allows one to sketch freely, create 3D forms quickly and manipulate forms interactively. The software creates floor plans, elevations, sections, 3D views and more all based on specifications design. It helps to optimize building performance outcomes by analyzing materials, quantities, sun position, and solar effects. Revit generates stunning visualizations and walk-through to effectively communicate designs. Revit enables the user to create a dynamic database model which is tied to geometry, with constraints on connected features that adjust parametrically. With the advent of Revit, architectural firms could change elements once in a project and have that triple through all affected views of the model (Autodesk,2017). Revit supports a multi- discipline design process for collaborative design including features for architecture. MEP, structural engineering and construction. The powerful tools in Revit provide an intelligent model-based process to plan, design, visualize, construct and manage buildings and infrastructure. As a collaborative tool, Revit is used by each discipline with the unique perspective of completing that discipline's task. Revit revisions are assigned to clouds and numbered on sheets.(Applied Software,2020). Revit software produces consistent, coordinated and complete model-based building design and documentation. It automatically updates floor plans, elevations, sections and 3D views. It uses 3D visualizations to see a building before it is built. In using Revit to design, it model building components analyze and simulate systems and structures, and iterate designer generate documentation from Revit to model in terms of visualizing. Revit communicates design intent more effectively to project owners and team members by using

models to create high-impact 3D visuals. With respect to collaboration, multiple project contributors can access centrally shared models. This results in better coordination which helps reduce clashes and rework (Matt, 2019).

AutoCAD, on the other hand is a CAD-type software oriented to drawing and modeling in 2D. It allows the creation and modification of geometric models with an almost infinite capacity to develop all types of structures and objects. The ability to work in different fields has made AutoCAD transcend its traditional use in the world of architecture and building design. Currently, AutoCAD has a multitude of specialized auxiliary tools which cover every kind of industrial fields related to 2D design and modeling. AutoCAD is an interactive drafting software package developed for construction of objects on a graphics display screen. The use of this software for construction is important in terms of neatness, fitness and accuracy unlike the traditional teaching method Ituses primitive entities such as lines, polylines, circles, arcs and text as the foundation for more complex object.(Wikipedia, 2007).

AutoCAD is one of the most powerful and widely used CAD software which can perform nearly any graphics task. AutoCAD and Revit are widely used by architects and drafters when designing buildings. Both software packages can be used to create construction plans, but there are also important differences. The main difference between these programs is that AutoCAD is a tool used to draw 2D line data for the purposes of a 2D product such as a paper set of Permit Drawings. Revit produces the same as the afford mentioned and add so much more. Revit has the capabilities of 3D modeling/massing. Collaboration (allowing multiple users to work on the same file), Live scheduling of any item in the project (Doors, Windows, Light Fixtures).Revision Management, Clash detection, SSEnergy Analysis, Structural Analysis, Heat Loss/Heat Gain Calculations. Sun/Shadow studies and much more. Revit was designed as a tool for the full design construction workflow. Revit's automations also let users create a library of objects that can be accessed for any design or project rather than working with simple lines. Revit allows users to build models using components like walls, roofs, beams, windows and doors. All changes to a model are automatically updated in all views, including plans and elevations (kurko,2021). Both AutoCAD and Revit can be used for modeling building designs.

Modeling involves making a representation of something. Modeling is anything that represents something else usually on a smaller scale. An architectural model is a type of scale model -a physical representation of a structure, build to study aspects of an architectural design or to communicate design ideas 3D modeling or CAD(Computer Aided Design)allows engineers and designers to build realistic computer models of parts and assemblies of buildings. CAD brings building design ideas to life in the digital world.CAD models represent a physical body using a collection of points in virtual space (Computer system), connected by various geometric entities such as triangles, lines, curved surface among others (Sikos,2016). This means that all parts of a building drawing can be modeled using software such as AutoCAD

and Revit. Some key areas to consider in modeling buildings are elevations, doors, windows, floor plans, columns, slabs, staircase and roofs.

Statement of the Problem

Most technical drawing and building design concepts are difficult to impart to students in traditional teaching method but only need certain feature of technology to bring the lesson closely to the learners. This has facilitated the integration of Computer Aided Design(CAD) software in building design. The current concept of architectural design education is a blend of the traditional method of drafting on paper and the modern method of using CAD in the design process. The most widely used tool for building drawing in most technical schools is AutoCAD. The use of AutoCAD has proven to help students develop digital building design skills, however the drawback of AutoCAD is that it produces designs mostly in 2D and the demand for 3D designs has grown exponentially Revit on the other hand produces designs in 3D while also having features that allow for flexibility sleek and better designs. The inappropriate use of digital tools and the heavy reliance on AutoCAD, the lack of integration among different digital tools and more importantly, the absence of effective coordination between theoretical courses and design projects has resulted in a relatively poorer overall architectural design product. Continued reliance on AutoCAD as the main design software will lead to students possessing obsolete building kills.

Purpose of the Study.

The main purpose of the study is to determine the effect of Revit and AutoCAD software on students' skill performance in modeling building drawings in technical colleges in Akwa Ibom State. Specifically, the study seeks to

1. Determine the effects of Revit and AutoCAD software on students' skill performance in modeling elevation in technical colleges in Akwa Ibom State.
2. Determine the effects of Revit and AutoCAD software on students' skill performance in modelling doors in technical colleges in Akwa Ibom State.
3. Determine the effects of Revit and AutoCAD software on students' skill performance in modelling windows in technical colleges in Akwa Ibom State.

Research Questions. The following research questions are stated for the study.

1. What are the effects of Revit and AutoCAD software on students' skill performance in modeling elevations in technical colleges in Akwa Ibom State?
2. What are the effects of Revit and AutoCAD software on students' skill performance in modeling doors in technical colleges in Akwa Ibom State?

3. What are the effects of Revit and AutoCAD software on students' skill performance in modeling windows in technical colleges in Akwa Ibom State?

Research Hypotheses. The following null hypotheses were stated to guide the study.

Ho1. There is no significant difference in the skill performance of students taught elevation modeling using Revit and AutoCAD.

Ho2. There is no significant difference in the skill performance of students taught doors modeling using Revit and AutoCAD.

Ho3. There is no significant difference in the skill performance of students taught windows modeling using Revit and AutoCAD.

Methodology

Quasi-experimental design using the pre-test, post-test control group method was employed for the study. This design was deemed appropriate since the study involved students in Senior Technical Three (ST III) using intact classes in building drawing and in two independent groups. The population is 320 students. The population of the study comprised all Building Construction Students in Senior Technical Three(ST III) students in the six public Technical Colleges in Akwa Ibom State. The sample consists of 90 Senior Technical III building and construction work students in four intact classes drawn from two selected Technical Colleges in Akwa Ibom State. Random Sampling Technique was used to select the two schools from six Technical colleges in the study area. The instruments for the group's treatment were Building Drawing Revit/AutoCAD modeling skills lesson plans were developed by the researcher. The instructional packages (lesson plans) were based on the same objectives for teaching Revit and AutoCAD respectively. Data for the study was collected using the researcher developed instrument called 'Building Drawing Modeling Skills Checklist' (BDMSC). The instrument was made up of 98 items and was used to access the skills of the students in using Revit and AutoCAD.The checklist items attempted to measure the rate of skills acquisition with respect to elevations, doors, windows, columns, slabs, staircase and roofs.

The instrument developed by the researcher was face and content validated by three experts in the Faculty of Education. One expert in the area of Test and Measurement and two experts in the Department of Industrial Technology Education, University of Uyo were involved in the validation process. The instrument (instructional Packages and rating scale) were trial-tested on 30 ST III construction work students in one of the schools in the study area that met the criteria but did not participate in the main study. The scores obtained from trial-test were subjected to item analysis to determine the reliability index of the instrument. The reliability coefficient of the instrument was determined using Cronbach Alpha method. The

result showed reliability co-efficient of o.87. On the basis of the high reliability index, the instrument was deemed suitable to be used in conducting the study.

`Data for the study was collected during the practical sessions of the instruction using the researcher developed instrument called "Building Drawing Modeling Skills Checklist"(BDMSC). A criterion was developed for assessing the students' skill acquisition. Each item in the instrument had sub-items that represent processes and product .Each item in the instrument was further broken down and evaluated based on the process or product. Each step or process had a score and the total score obtained from the steps or sub-items gave the score for that particular item (skill) in the instrument. The data generated was analyzed using mean, standard deviation and analysis of covariance (ANCOVA). The mean was used to answer all the research questions and ANCOVA was used in testing the research hypotheses. The ANCOVA was adopted for data analysis to ensure comparability and equality of groups before treatment. It ensured that the groups were statistically equated on the basis of some critical (secondary dependent) variables. (Onwioduokit,2000).

Research Question 1. What are the effects of Revit and AutoCAD software on students' skill performance in modeling elevation in technical colleges in Akwa Ibom State?

Table 1. Summary of the Mean and Standard Deviation Scores of Students' skills Performance in Modeling Elevation Using Revit and AutoCAD

Group		Pre-test	Post-test	Mean Gain (Postest-Pretest)
Revit	Mean	9.06	44.34	35.28
	N	68	68	
	Std. Deviation	4.99	14.23	
AutoCAD	Mean	8.85	38.61	29.76
	N	66	66	
	Std. Deviation	3.04450	13.30573	

Table 1 shows the summary of the performance of students in modeling elevation using REVIT and AutoCAD. The table gives the pretest and posttest scores of students in treatment and control group. The result shows that the mean gain for students in Revit is 35.28 as against 29.76 for AutoCAD.This shows that students taught modeling elevation using Revit performed better than students taught using AutoCAD.

Research Question 2. What are the effects of Revit and AutoCAD software on students' skill performance in modeling doors in technical colleges in Akwa Ibom State?

Table 2. Summary of the Mean and Standard Deviation Scores of Students Performance in Modeling Doors Using Revit and AutoCAD

Group		Pretest	Postest	Mean Gain (Postest-Pretest)
Revit	Mean	13.99	45.07	31.08
	N	68	68	
	Std. Deviation	6.00	16.89	
AutoCAD	Mean	12.00	42.09	30.09
	N	66	66	
	Std. Deviation	5.35	12.06	

Table 2 shows the summary of the performance of students in modeling doors using Revit and AutoCAD.The result shows that mean gain for students in Revit is 31.08 while the mean gain for students in AutoCAD is 30.09. This shows that students taught modeling doors using Revit performed better than students taught using AutoCAD.

Research Question 3. What are the effects of Revit and AutoCAD software on students' skill performance in modeling windows in technical colleges in Akwa Ibom State?

Table 3. Summary of the Mean and Standard Deviation Scores of Students Performance in modeling Windows Using Revit and AutoCAD.

Group		Pretest	Posttest	Mean Gain (Postest-Pretest)
Revit	Mean	13.57	45.71	32.14
	N	68	68	
	Std. Deviation	6.018	15.96	
AutoCAD	Mean	12.42	44.65	32.23
	N	66	66	
	Std. Deviation	5.71	16.82	

Table 3 shows the summary of the performance of students in modeling windows using Revit and AutoCAD. The result shows that mean gain for students in Revit is 32.14 while the mean gain for students in AutoCAD is 32.23. This shows that students taught modeling windows using AutoCAD performed better than students taught using Revit. The following hypotheses were tested at .05 level of significance.

Research Hypothesis 1. There is no significant difference in the skill performance of students taught elevation modelling using Revit and AutoCAD.

Table 4. Summary of Analysis of Covariance (ANCOVA) Test for Significant Difference in the skill Performance of Students taught Elevation Modeling Using Revit and AutoCAD.

Source	Type II Sum of Squares	df	Mean Square	Fcal	Sig.	Decision
Model	275.671[a]	35	7.876	13.843	.000	
Pretest	244.444	1	244.444	429.618	.000	
Effect	31.227	34	.918	1.614	.036	**
Error	56.329	99	.569			
Total	332.000	134				

Table 4 gives the summary of the ANCOVA test. The result shows that the calculated F value is 1.614. The probability of F (Sig) is .036. Since the P value is less than the significance level of .05 (P<.05), the result is statistically significant. Thus, the null hypothesis is rejected. Hence, there is a significant difference in the skill performance of students taught elevation modeling using Revit and AutoCAD.

Research Hypothesis 2. There is no significant difference in the skill performance of students taught door modeling using Revit and AutoCAD.

Table 5: Summary of ANCOVA Test for significant difference in the skill performance of student Taught Door Modeling Using Revit and AutoCAD

Source	Type II Sum of Squares	df	Mean Square	Fcal	Sig.	Decision
Model	266.930[a]	37	7.214	10.754	.000	
Pretest	237.314	1	237.314	353.765	.000	
Effect	29.616	36	.823	1.226	.215	*
Error	65.070	97	.671			
Total	332.000	134				

*Not Significant at p<.05.036.

Table 5 gives the summary of the ANCOVA test. The result shows that the calculated F value is 1.226.The probability of F(sig) is .215. Since the P value is greater than the significance level of .05 (p<.05), the result is statistically not significant. Thus, the null hypothesis is retained. Hence there is no significant difference in the skill performance of students taught door modeling using Revit and AutCAD.

Research Hypothesis 3. There is no significant difference in the skill performance of students taught windows modeling using Revit and AutoCAD.

Table 6: Summary of ANCOVA test for Significant difference in skill performance of students taught window modeling using Revit and AutoCAD

Source	Type II Sum of Squares	df	Mean Square	Fcal	Sig.	Decision
Model	268.283[a]	36	7.452	11.462	.000	
Pretest	240.948	1	240.948	370.593	.000	
Effect	27.335	35	.781	1.201	.239	*
Error	63.717	98	.650			
Total	332.000	134				

*Not Significant at p<.05.239 .

Table 6 gives the summary of the ANCOVA test. The result shows that the calculated F value is 1.201. The probability of F (sig) is .239. Since the p value is greater than the significance level of .05. (p<.05), the result is statistically not significant. Thus, the null hypothesis is retained. Hence, there is no significant difference in the skill performance of students taught window modeling using Revit and AutoCAD.

Discussion of Findings

The findings of the study are hereby discussed under relevant subheadings

Skills Performance of Students in Elevation Modelling Using Revit and AutoCAD

The result shows that the mean gain for students in Revit is 35.28 as against 29.76 for AutoCAD. This shows that students taught modelling elevation using Revit performed better than students taught using AutoCAD. The related hypothesis test confirms that there is a significant difference in the academic performance of students taught elevation modelling using Revit and AutoCAD. This finding is in line with Christenson (2006) who investigated the capabilities and limitations of Autodesk Revit in a construction technology course. Findings of the study showed that student performance in the course was generally good, and student responses to the Revit assignments indicate the success of the strategy of "introduction" rather than "instruction toward mastery. This finding is in supported by Moses (2010) who found a significant mean differences between the pretest-posttest mean score of students in control group taught technical drawing with conventional teaching method and the experimental group taught technical drawing with computer assisted instruction which is an indication that the effect of computer assisted instruction (CAI) on students' academic performance is higher than the effect of the conventional teaching method.

Skills Performance of Students in Door Modelling Using Revit and AutoCAD

The result shows that the mean gain for students in Revit is 31.08, while the mean gain for students in AutoCAD is 30.09. This shows that students taught modelling doors using Revit performed better than students taught using AutoCAD. The hypothesis test indicates that there is no significant difference in the academic performance of students taught door

modelling using Revit and AutoCAD. This finding is supported by Ferrandiz, et al (2017) who evaluated the benefits of introducing ‘‘BIM’’ based on Revit in construction courses. Findings showed that BIM based on Revit reduces student performance time while increasing student motivation and satisfaction.

The findings of the study is supported by Ogbuanya and Aniedi (2013) who examined effects of Automated technical drawing computer assisted drafting technique on students’ academic achievement. The findings shows that there is significant difference in academic achievement and interest of students’ taught with AUTOTEDRACAD techniques. This difference was in favor of the final test points of students in experimental group. That is to say, the computer assisted education is more successful than teacher centered education method to increase the academic achievements related to technology education.

Skills Performance of Students in Window Modelling Using Revit and AutoCAD

The result shows that the mean gain for students in Revit is 32.14, while the mean gain for students in AutoCAD is 32.23. This shows that students taught modelling window using AutoCAD performed better than students taught using Revit. The related hypothesis test shows that there is no significant difference in the academic performance of students taught window modelling using Revit and AutoCAD. This finding is corroborated by Christenson (2006) who found that Revit possesses an apparent advantage over AutoCAD relative to the act of preparing standardized construction documentation: *the automation of context*. The production of a detail drawing using AutoCAD generally requires the detailer to provide context through the use of external references, and consequently, a detailer’s attention is constantly refocusing between large and small. For example, if during the production of a detail drawing, a design change should occur to the large-scale floor plan or building section, the detailer must proactively bring this context forward to test its influence on the detail; neglecting to do so runs the risk of miscoordination. Revit directly impacts this process because it automates the presence of large-scale context on the production of small-scale work. This finding is supported by Oruabena, *et al* (2016) which focused on the use of ArchiCAD software program and its effects on students’ academic performance in building drawing in Government Technical college, Ahoada, Rivers State. From the result obtained it revealed that students taught building drawing with ArchiCAD performed better than those taught with the conventional method. The final result revealed that students taught building drawing using ArchiCAD performed better than those taught with conventional method.

Conclusion

Based on the findings of the study, it is concluded that the use of Revit and AutoCAD has a significant effect on skills performance in modeling building drawing. The outcome of the study shows that students taught modeling building drawing using Revit software performed better than student taught using AutoCAD. However, the result also shows that this is not significant. Hence, students can be taught building design modeling using Revit or

AutoCAD. The difference is that those taught using Revit can design in 3D and are more likely to develop better design skills.

Recommendation. Based on the findings of the study, the following recommendation are made

1. School authorities should partner with technological institutes to train teachers on the application of Revit for building modeling.
2. Building teachers should use Revit when teaching students elevation modeling?
3. When teaching students how to draw using CAD teachers should introduce both AutoCAD and Revit for drawing design and modeling.

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