



## **EFFECTS OF CAD TECHNOLOGY ON BUILDING TECHNOLOGY STUDENTS' INTERESTS IN BUILDING DRAWING**

Amos Aderemi Ayoola, Wole Idowu Akinlabi and Ibukun Francis Adeagbo

Department of Technical Education, Emmanuel Alayande University of Education, Oyo State.

### **Abstract**

This study examined the effects of CAD packages on improving Building Technology students' interest in Building Drawing. Three research questions and three hypotheses guided the study. A factorial design with students in their intact classes was employed, involving 152 NCE III Building students from all Federal and State Colleges of Education in Southwest Nigeria. The sample consisted of 28 male and 11 female students. The Building Drawing Interest Inventory (BDII), developed by the researcher, was utilized. Pre-tests and post-tests of the instrument were conducted, and an Analysis of Covariance (ANCOVA) was employed to test the hypotheses. The results revealed that there was no significant difference between the effects of Autodesk Revit and AutoCAD on students' interest in Building Drawing. Additionally, there was no significant difference between the effects of gender on students' interest in Building Drawing, nor was there a significant interaction effect of treatment and gender on the students' interests. It was recommended that the curriculum for Building Drawing in Colleges of Education be revised to incorporate appropriate CAD technology as a training tool for Building Drawing.

**Keywords:** CAD Technology, Building Technology, Students' Interest in Building Drawing

### **Introduction**

There are rapid changes in all facets of life, occasioned by rapid technological development. These changes have also greatly impacted the world of work, to the extent that almost all aspects are now technologically driven, and any employee who refuses to adapt quickly becomes irrelevant. In today's building industry, nearly all functions are technologically driven, including the production of Building Drawings, which are now predominantly created using Computer-Aided Design (CAD) technology. Hutchinson (2009) outlined some reasons for using CAD in modern-day Building Drawing, such as better visualization with the ability to generate 3D views from 2D drawings.

Additionally, CAD offers capabilities such as prototyping, efficient revision speed, and easy data sharing. Computer-aided design (CAD) is a versatile tool for engineers, architects, and other professionals in the design industries, aiding them in carrying out their design activities (Richard, 2021).

Building Drawing is an essential aspect of Building Technology in Colleges of Education, involving the creation of elevations, plans, sectional views, and site plans in 2D, as well as the preparation of schedules of doors and windows and 3D perspective views of building plans (NBTE, 2019). Two CAD packages developed by Autodesk, namely Autodesk

Revit and AutoCAD, are commonly used for training students in Building Drawing. Autodesk Revit is a building information modelling software tool for architects, structural engineers, and others (Wikipedia, 2022). It is a Computer-Aided Design (CAD) paradigm that allows for intelligent, parametric object-based design in 2D and 3D, providing full bi-directional associativity that enables changes to be propagated instantly. AutoCAD, on the other hand, is a software application enabling computer-based design and drafting (Adoga, 2019). It allows users to create electronic drawings, plans, and designs, with comprehensive capabilities for both 2D and 3D drawings. AutoCAD is versatile, and capable of performing nearly any drawing task (Bui, 2006).

Teaching Building Drawing with CAD packages like Autodesk Revit and AutoCAD has become common in schools due to their shared potential to provide a human-computer interface. The interaction between computers and humans has implications for stress management and cognitive abilities, enhancing students' engagement and interaction with the learning environment (Strong & Smith, 2007). The teacher's instructional method plays a significant role in generating students' interest in any subject. The content of a subject often determines the appropriate instructional method. Teachers are responsible for stimulating students' interest in their lessons, which requires applying various motivational techniques, maintaining rules and regulations, and effectively managing the classroom to stimulate learners' interest (Moore, 2008). Interest is a feeling of curiosity or concern about something that captures attention. Moore defines interest as a social construction developed within the dynamic relationship between the individual and the situation. Students' interest is more sustained when they are actively engaged in the class, emphasizing the importance of enlisting the interest of Nigerian Certificate in Education (NCE) students in Building Technology to ensure their success in Building Drawing.

A College of Education is a post-secondary institution where the Nigerian Certificate in Education (NCE) is awarded. The NCE (Technical) in Building Technology aims to produce technical teachers who are intellectually and professionally prepared to teach subjects of a technical nature, enabling them to adapt to changing situations in the world of technological development (NCCE, 2012). It is a co-educational institution capable of imparting basic functions in Building Technology practice to both male and female students in the private and public sectors.

### **The Role of Gender in the Discuss**

Gender plays diverse roles in various classroom activities. Gender refers to a psychological term that describes behaviours and attributes expected of individuals based on being male or female (Uwameiye and Osunde, 2005). Studies conducted by Nemeth and Hoffmann (2006) and Medina, Gerson, and Sorby (2000) revealed measurable gender differences in the abilities of boys and girls, with boys often found to have better abilities in classroom activities. However, Branoff (1998) observed that females can benefit equally from classroom training programs as their male counterparts. The rapid technological changes and increased demand for sophisticated manpower in the world of work, combined with globalization trends, pose a significant challenge to the training of trainees. UNESCO and ILO (2002) recommended lifelong learning for Vocational and Technical Education. This implies that various institutions of learning must rise to the challenge to remain relevant, ensuring their products meet the requirements of the world of work. Hence, this study aims to observe how the interest of Building Technology students at Colleges of Education can be promoted in Building Drawing through the use of CAD technology.

Numerous CAD software options exist in today's technological landscape; however, Autodesk Revit and AutoCAD stand out as particularly user-friendly for Building Drawing in Colleges of Education. These two CAD packages possess fundamental skills in

creativity, problem-solving, collaboration, and higher-order thinking (Finkelstein, 2009). Nevertheless, they engage students' interests differently. Therefore, it is crucial to use the appropriate CAD package to stimulate students' interest in Building Drawing at Nigerian Colleges of Education, bridging the gap between academia and industry. Educational outcomes significantly improve when instructional methods align with programs (Gall, Gall, and Borg, 2007).

This study will benefit teachers of Building Drawing in Colleges of Education by aiding them in selecting the most suitable CAD package to stimulate students' interest in Building Drawing and enhancing their instructional delivery. This, in turn, will help bridge the gap between male and female students' interest in Building Drawing. Students will greatly benefit from the application of appropriate instructional methods, leading to increased employability in industries. Additionally, curriculum planners will find value in this study as it assists in deciding which CAD package, whether Autodesk Revit or AutoCAD, will effectively stimulate the interest of Nigerian College of Education students in Building Drawing. Thus, the current study determined:

- i. The effects of the treatments (Autodesk Revit and AutoCAD) on students' interest in Building Drawing
- ii. The effects of gender on Building Technology students' interest in Building Drawing.
- iii. The interaction effects of treatments given to the Building Technology students and their gender

Also, the study posed the following null hypotheses:

- i. There is no significant difference between the effects of treatments (Autodesk Revit and AutoCAD) on students' interest in Building Drawing.

- ii. There is no significant difference between the effects of gender on students' interest in Building
- iii. There is no interaction effect of treatments given to students and their gender concerning their mean scores on the Building Drawing Interest Inventory.

### Methods

The study utilized a factorial design, where students were allocated to treatment groups within their intact classes. The primary aim was to enhance students' interest in Building Drawing through the use of CAD technology. Therefore, the treatments (Autodesk Revit and AutoCAD) served as independent variables. Gender (male and female) was incorporated as a moderator variable due to its potential influence on the dependent variables. This design allowed the researcher to examine the effects of the independent variables (Autodesk Revit and AutoCAD) at different levels of the moderator variable (Gender). In this design, male students were divided into two groups: one receiving Autodesk Revit treatment (Cell 1) and the other receiving AutoCAD treatment (Cell 3). Similarly, female students were split into two groups: one receiving Autodesk Revit treatment (Cell 2) and the other receiving AutoCAD treatment (Cell 4). The scores within each of the four cells represent the mean scores of the treatment groups on the dependent variables. Additionally, there were four marginal mean scores: two for the columns representing the main effects of the two treatments, and two for the rows representing the main effect of Gender.

The study was conducted across all National Commission for Colleges of Education (NCCE) accredited Colleges of Education offering Technical Education (Building Technology) in Southwest Nigeria. The target population comprised 152 NCE III Technical Education students from both Federal and State Colleges of Education in the region. Data were collected during the 2021/2022 academic session from the respective Head of Department's (HOD's) offices in each College of Education. A sample

of 31 NCE III students was selected for the study using a multi-stage sampling technique. This sample included 18 male and 13 female students. Initially, a simple random sampling technique was employed to select two out of the seven Colleges of Education offering Technical Education in the Southwestern zone of Nigeria. Subsequently, one intact class from each selected college was randomly assigned to either Autodesk Revit or AutoCAD treatment groups. Each intact class comprised both male and female building students.

For data collection, the Building Drawing Interest Inventory (BDII), developed by the researcher, was utilized. The inventory items were structured on a five-point Likert scale, ranging from Strongly Agreed (SA) to Strongly Disagree (SD). Positively worded items were scored as 5, 4, 3, 2, 1, while negatively worded items were reverse-coded as 1, 2, 3, 4, 5. Additionally, the researchers developed Lesson Plans for both Autodesk Revit and AutoCAD, which were utilized to teach the treatment groups. The Building Drawing Interest Inventory (BDII) and the lesson plans for Autodesk Revit and AutoCAD underwent validation by experts in Building Drawing and test and measurement. Each validator was provided with the instruments to conduct face validation. Based on their feedback and suggestions, revisions were made to the instruments. Subsequently, the Building Drawing Interest Inventory underwent construct validation by administering it to an equivalent sample of NCE III Building Technology students at a College of Education in the North Central region of Nigeria.

Factor analysis technique was employed to assess the items in the interest inventory. Items that met the factor-loading standard of 0.35 were retained, while those failing to meet this criterion or loading on multiple factors were discarded due to factor impurity. Additionally, factors with fewer than four items were excluded as they could not be adequately explained or classified as valid constructs. Ultimately, 29 out of the 40 items were deemed factorially pure and selected for use in the study

following the construct validation process. To determine the internal consistency of the interest inventory, the Building Drawing Interest Inventory (BDII) was administered to an equivalent sample of NCE III Building Technology students in a College of Education in the North Central of Nigeria and Cronbach Alpha was used to compute the reliability coefficient which was found to be 0.89 for a sample of 27.

### **Experimental Procedure**

The Building Drawing Interest Inventory (BDII) (see Appendix A and B) was initially administered to the students participating in the study as a pre-test. Following this, the treatment group assigned to Autodesk Revit received Building Drawing lessons for eight weeks using Autodesk Revit, while the treatment groups assigned to AutoCAD similarly underwent Building Drawing lessons for eight weeks using AutoCAD. Subsequently, the Building Drawing Interest Inventory (BDII) was administered to all treatment groups to gather post-treatment data on the dependent variable (interest of each treatment group). The pre-test of the BDII was conducted by the Building Drawing lecturers in their respective schools and subsequently scored by the researchers to establish baseline data on the dependent variable before treatment. During the post-test phase, the Building Drawing Interest Inventory (BDII) was administered to the treatment groups by the lecturers in the respective schools. Students' responses regarding their level of agreement or disagreement with the items of the BDII were scored to determine their interest levels following the treatment. This process yielded post-treatment data for the dependent variable.

Analysis of Covariance (ANCOVA) was used to test the hypotheses generated for the study. According to Ary et al. (2000), ANCOVA is a method for analysing differences between experimental groups on the dependent variable, after considering any initial differences between the groups, on pre-test measures or any other measures of relevant independent variables. This is because ANCOVA is a

statistical technique which removes the initial differences between groups so that the selected or pre-tested groups can be correctly considered as equated or equivalent by removing score

differences in the pre-test performance across groups and reducing the between-group source variation.

**Table 1:** Analysis of Covariance (ANCOVA) of the Building Drawing Interest Inventory on the effects of treatments (AutoCAD and Autodesk Revit) and Gender with Interaction effect of treatments applied to the Students.

Source of Variation	Some of Squares	DF	Mean Square	F	Sig of F
Covariate	7.452	1	7.452	.777	.361
Pre-test	7.452	1	7.452	.777	.361
Main Effects	33.587	2	16.794	2.111	.121
Treatment	5.342	1	5.342	.616	.465
Gender	28.126	1	28.126	4.682	.067
2-way Interactions	6.411	1	6.411	.699	.387
Treatment*Gender	6.411	1	6.411	.699	.387
Explained	89.254	4	22.314	3.163	.019
Residual	1733.000	232	7.470		
TOTAL	1822.254	236	7.721		

**\*Significant at sig of F < .05**

Table 1 is the summary of the analysis of the F-calculated on the effects of treatment, gender and interaction effects on students' interest in Building Drawing. The F-calculated for treatment which is 0.616 with a significance of F at 0.465 is higher than 0.05. The implication is that the null hypothesis is Accepted at 0.05 level of significance. Also, the F-calculated for gender is 4.682 at a significance level F of 0.067 which is greater than 0.05 which implies that the null hypothesis which states that there is no significant difference between the effects of gender on students' interest in Building Drawing will be accepted at 0.05 level of significance. The null hypothesis for the effects of the interaction of treatment on gender is accepted because the F-calculated is 0.699 at a significance level of 0.387 which is higher than 0.05 therefore, there is no interaction effect of treatments and their gender concerning Building Drawing Interest Inventory.

### Discussion

The findings derived from the data collected and hypotheses tested indicated a confirmation of the null hypothesis, suggesting that there was no significant difference in the effect of treatments, specifically Autodesk Revit and

AutoCAD, on students' interest in Building Drawing. Additionally, the study revealed a confirmation of the null hypothesis, signifying that there was no significant difference in the effects of gender on students' interest in Building Drawing. Lastly, it was observed that there was no interaction effect between the treatments administered to students taught with Autodesk Revit and AutoCAD concerning the Building Drawing Interest Inventory. As shown in Table 1, the difference between Autodesk Revit and AutoCAD in stimulating students' interest in Building Drawing was insignificant. This implies that regardless of the CAD technology employed in teaching the students, their interest will be enhanced, corroborating previous studies (Jimoh, 2010; Mohamed & Mohamed, 2023; Siminialayi & Fomsi, 2018) where CAD was found to enhance unity school students' interest in Technical Drawing. The study also indicated that Autodesk Revit and AutoCAD are effective instruments for stimulating students' interest in Building Drawing, aligning with Jimoh's (2019) findings that learners, irrespective of gender, experience improved interest in engineering graphics when CAD is used. Additionally, Asiloku (2016) and Sunday and Louis (2020) concluded that

Computer-Aided Instruction (CAI) provides students with a deeper understanding and better stimulation of interest in geometric construction. Finally, the effectiveness of CAD packages on students' interest in Building Drawing does not depend on gender. Students' interest will be stimulated equally well when CAD is used, regardless of whether the student is male or female.

A 2×2 factorial quasi-experiment was conducted, treating subjects with Autodesk Revit and AutoCAD, with interest as an independent variable and gender as a moderator variable, to assess the impact on the interest of students in Building Drawing at Colleges of Education. The study had three purposes and formulated three hypotheses. The population consisted of 152 NCE III students enrolled in Building Drawing programs across Colleges of Education in the South-west region of Nigeria. From this population, 31 students were sampled and assigned to treatment groups (Autodesk Revit and AutoCAD). The Autodesk Revit group comprised 10 males and 5 females, while the AutoCAD group had a similar composition. The instrument used for data collection was the Building Drawing Interest Inventory (BDII), developed by the researcher. The BDII, along with the Autodesk Revit and AutoCAD lesson plans, underwent face validation by five experts. Additionally, the BDII underwent construct validation using factor analysis, resulting in the selection of 29 out of 40 items for the interest inventory. The internal consistency of the BDII was assessed using Cronbach Alpha, yielding a reliability coefficient of 0.89. Surprisingly, there was no significant interaction effect observed, suggesting that the impact of Autodesk Revit and AutoCAD on students' interest in Building Drawing did not vary significantly based on gender. This finding underscores the inclusive nature of technology-enhanced learning environments, which can benefit all students regardless of gender.

Overall, the study contributes to the growing body of literature on the role of CAD technology in education, particularly in

technical subjects like Building Drawing. It provides valuable insights for educators and curriculum developers in designing effective instructional strategies to foster students' interest and engagement in technical disciplines.

### **Conclusion and Recommendations**

The findings of this study underscore the importance of leveraging modern technology, particularly Computer-Aided Design (CAD) packages, to enhance students' interest in Building Drawing within the contemporary building industry. The results demonstrate that both Autodesk Revit and AutoCAD are equally effective in stimulating students' interest in this field, indicating that regardless of the CAD software utilized, students' interest can be enhanced. Echoing the recommendations of UNESCO (2002), educational institutions must embrace appropriate computer technology to transform traditional classroom environments into interactive, student-centred learning spaces. Active involvement in the learning process, facilitated by computer technology, sustains students' interest and enhances their achievement (Ogwo & Oranu, 2006). Consequently, it is imperative to stimulate students' interest in learning, as it is foundational to academic success. Moreover, the study revealed no significant interaction effects between Autodesk Revit or AutoCAD and gender on students' interest in Building Drawing. This suggests that the effectiveness of CAD technology in enhancing students' interest transcends gender differences, aligning with Hart's (2002) findings that both males and females can benefit equally from training programs. Therefore, regardless of gender, students exhibit improved interest in Building Drawing when Autodesk Revit or AutoCAD is employed as a training tool.

Based on these findings, it is recommended that the curriculum for Building Drawing in Colleges of Education be revised to incorporate the use of Autodesk Revit or AutoCAD technology as training tools. Gender should not be a determining factor in the selection of CAD

software, as both are effective in enhancing students' interest. Additionally, teachers of Building Drawing should enhance their knowledge and skills in utilizing CAD technologies to ensure optimal engagement and interest among students. Furthermore, drawing studios in Technical Education Departments within Nigerian Colleges of Education should be equipped with modern facilities relevant to CAD technology. This will not only improve students' interest in Building Drawing but also ensure that they are adequately prepared for the demands of the contemporary building industry. Ultimately, by leveraging CAD technology and enhancing teaching practices, educators can foster a conducive learning environment that promotes students' interest and facilitates their academic success.

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## Appendix A

**BUILDING DRAWING INTEREST INVENTORY**

**Institution**.....

**Registration Number**.....

**Sex:**            Male                        Female           

**Instruction:** Below is a list of statements to ascertain your disposition towards Building Drawing. Please, check (√) to indicate the degree to which you agree or disagree with the statements.

Note: Strongly Agree (SA); Agree (A); Undecided (UD); Disagree (D); Strongly Disagree (SD)

S/N	Items	SA	A	UD	D	SD
1	I like being taught Building Drawing					
2	I like to be involved in design activities					
3	I always think about how Building components are constructed					
4	I do not like reading books that contain illustrations made with diagrams					
5	I like to picture the way things look in my head					
6	I always imagine from the beginning what a building looks like when completed					
7	I do not like studying in the technical drawing room					
8	I found the construction of objects very fascinating					
9	I like fiddling with drawing instruments					
10	I always encourage others to attend classes involving the construction of objects					
11	I do not like taking part in discussions based on the properties of points and lines					
12	I believe that there are prospects in being a building designer					
13	I like to visualize objects from different perspectives					
14	I don't like learning the properties of objects that have height, length and width					
15	I do not like answering questions in classes involving the construction of buildings					
16	I do not like solving problems involving the conversion of objects that have height, length and width to plane figures that have only length and width					
17	I do not like staying with building designers whenever they are drawing					
18	If I were an Architectural design and drawing teacher, I would not like to teach a class involving the development of roof geometry					
19	I am always confused about the development of building elevations					
20	I do not like to involve myself in construction activities					
21	Whenever I hear the word Building Drawing, I have a feeling of dislike					
22	I compete with other students for high scores in Building Drawing exercises and tests					
23	I don't feel at ease in a Building Drawing class					

24	Drawing and designing of building wastes time					
25	I am always late to drawing classes					
26	I used to be afraid whenever I was called upon to answer questions during the construction of objects that have height, length and width					
27	I am excited whenever a teacher is teaching the construction of objects					
28	Discussion of properties of lines, points and planes on the projection planes is very interesting					
29	I always understand how building components work when illustrations are made					
30	I am excited whenever I solve problems involving the construction of buildings correctly					
31	I am always carried away when I see people drawing with computer					
32	I usually hate Building Drawing lecturers					
33	I will not study any course involving drawing after OND					
34	I spend my leisure time visiting architectural studios					
35	There is no gain in studying building and design					
36	I always devote much time to studying building drawing and design					
37	I always love an excursion to building drawing firms					
38	Architectural Design and Drawing usually widen one's horizon					
39	Architectural Design and Drawing generally present interesting technological skill					
40	I love watching films of Architects and draughtsmen working in the drawing studio					

**Revit Lesson Plan for Treatment Group Assigned to Revit Technique  
Lesson Plan 1**

Subject: Architectural Design and Drawing  
 Topic: The Design of a simple floor plan  
 Class: ND I Building Technology  
 Duration: 2 hours  
 Specific Objectives: At the end of the lesson, students should be able to:  
     1. Effectively launch into the Revit environment  
     2. Should be able to set the Revit parameters  
     2. Design a simple floor plan  
 Entry Behaviour: students had been taught the use of graphical reproduction equipment.  
 Instructional Materials: Projector and Computer Systems.  
 Instructional Procedure

Step	Content	Teacher's Activities	Students' Activities	AutoCAD Command
1		The teacher displays the objectives of the lesson on the Projector screen and explains the objectives to the students	Students read the objectives on the projector screen	
2	Lunching into Revit	The teacher asks the students to launch into Revit on their individual	Each of the Students lunches into Revit by double clicking	Revit Lunches into the drawing area.

		computer set as the teacher launches into Revit on his computer system	the Revit icon on their Computer Desktop	
3	Creating a Project	The teacher asks students to click on new in the drawing area under the project	The students click on new in the drawing area under the project	Revit provides a New Project dialog box
4		The teacher asks the students to move the cursor downward to select Project under Create New then click OK	The students move the cursor downward to select Project under Create New and then click OK	Revit default displays the Autodesk Revit screen with pull-down menus along the top edge, a status bar along the bottom edge and a variety of toolbars at the top edge of the screen. The centre of the Autodesk Revit screen is divided into three i.e. the Design Bar, the Project Browser and the Workspace.
4	Setting the Basic parameters	The teacher asks students to click on the Basics tool in the design Bar	Students click on the Basics tool in the Design Bar.	Revit displays the Basic tools.
5		The teacher asks students to double-click on views (all) under the project tool	The students double-click on views (all) under the project tool	Revit displays the floor plan and drops down to level 0, level 1 and the site
		The teacher asks the students to double-click on Level 1	The students double-click on level 1	Revit displays drawing area in level 1 i.e ground floor level
6	Setting the Parameters for the wall	The teacher asks the student to click on the wall tool	The students click on the wall tool	Revit displays the wall parameters
7		The teacher asks the students to set the parameters as directed e.g unconnected height, wall line, chain line, offset etc	The students set the parameter as directed by the teacher	Revit internalize the set parameter
8	Draw the Floor Plan	The teacher asks the students to click to indicate the wall starting point	The students click on their individual computers the starting point	Revit displays the starting point with 0,0
9		The teacher specifies the endpoint horizontally (length) as 6000 and presses the enter key	The students input 6000 to move a distance specified horizontally (length) and press the enter key	Revit draws the wall
10		The teacher specifies 4800 vertically (breadth) from the end 6000 and press enter key	The student inputs 4800 moves vertically (breadth) from the end of 6000 and presses the enter key	Revit draws the wall
11		The teacher specifies 6000 horizontally (length) but in the opposite direction from the end of 4800 and presses enter key	The student inputs 6000 but in the opposite direction move horizontally (length) from the end of 4800 and presses enter key	Revit draws the wall
12		The teacher specifies 4800 vertically (breadth) from the end 6000 to	The student inputs 4800 (breadth) move vertically upward from the end of 6000 to	Revit draws the floor plan

		the starting point and presses the enter key	the starting point and presses the enter key	
14	Evaluation	The teacher asks the following questions from the students: 1. In Creating a Project what does a person do? 2. If you want to Set the Basic parameters what do you do? 3. What do you do to indicate the starting point in drawing a wall with Revit?	The students answer	
15	Summary and Assignment	Teacher revises the lesson again and asks the students to draw simple ground floor plan using length 12000 and breadth 8000		

<b>Lesson Plan 2</b>	
Subject:	Architectural Design and Drawing
Topic:	The Design of the Kitchen, Toilet, and Living room as a unit
Class:	ND I Building Technology
Duration:	2 hours
Specific Objectives:	At the end of the lesson, students should be able to design a simple unit of building with Kitchen, Toilet and Living room
Entry Behaviour:	students had been taught the use of Revit to produce a simple ground floor plan of a building.
Instructional Materials:	Projector and Computer Systems.

**Instructional Procedure**

Step	Content	Teacher's Activities	Students' Activities	AutoCAD Command
1		The teacher displays the objectives of the lesson on the Projector screen and explains the objectives to the students	Students read the objectives on the projector screen	
2	Lunching into Revit	The teacher asks the students to launch into Revit on their individual computer set as the teacher launches into Revit on his computer system	Each of the Students lunches into Revit by double clicking the Revit icon on their Computer Desktop	Revit Lunches into the drawing area.
3	Creating a Project	The teacher asks students to click on new in the drawing area under the project	The students click on new in the drawing area under the project	Revit provides a New Project dialog box
4		The teacher asks the students to move the cursor downward to select Project under Create New then click OK	The students move the cursor downward to select Project under Create New and then click OK	Revit default displays the Autodesk Revit screen with pull-down menus along the top edge, a status bar along the bottom edge and a variety of toolbars at the top edge of the screen. The centre of the

				Autodesk Revit screen is divided into three i.e. the Design Bar, the Project Browser and the Workspace.
4	Setting the Basic parameters	The teacher asks students to click on the Basics tool in the design Bar	Students click on the Basics tool in the Design Bar.	Revit displays the Basic tools.
5		The teacher asks students to double-click on views (all) under the project tool	The students double-click on views (all) under the project tool	Revit displays the floor plan and drops down to level 0, level 1 and the site
		The teacher asks the students to double-click on Level 1	The students double-click on level 1	Revit displays drawing area in level 1 i.e ground floor level
6	Setting the Parameters for the wall	The teacher asks the student to click on the wall tool	The students click on the wall tool	Revit displays the wall parameters
7		The teacher asks the students to set the parameters as directed e.g unconnected height, wall line, chain line, offset etc	The students set the parameter as directed by the teacher	Revit internalize the set parameter
8	Draw a unit building with a kitchen, toilet, and living room	The teacher asks the students to click to indicate the wall starting point	The students click on their individual computers the starting point	Revit displays the starting point with 0,0
9		The teacher specifies the endpoint horizontally (length) as 8850 and presses enter key	The students input 8850 to move a distance specified horizontally (length) and press the enter key	Revit draws the wall
10		The teacher specifies the length of the living room as 4800 and uses the wall tool to draw the demarcation wall	The student input 4800 and also drew the demarcation wall using the wall tool	Revit draws the wall
11		The teacher specifies the length of the toilet, store, and kitchen as 3300 and draws the demarcation wall.	The students input 3300 as the length of the toilet, store, and kitchen and also draw the demarcation wall	Revit draws the wall
12		The teacher specifies the breadth of the living room as 8100 and draws the external wall	The students input 8100 as the breadth of the living room and draw the external wall.	Revit draws the wall
13		The teacher specifies the breadth of the kitchen as 3000 and draws the demarcation wall	The students input the breadth of the kitchen as 3000 and draw the demarcation wall	Revit draws the wall
		The teacher specifies the breadth of the store as 1800 and draws the demarcation wall	The students input the breadth of the kitchen as 1800 and draw the demarcation wall	Revit draws the wall
14	Evaluation	The teacher asks the following questions from the students: 1. What should be considered in locating the kitchen? 2. What should be done to demarcate spaces with Revit?	The students answer	

15	Summary and Assignment	The teacher revises the lesson again and asks the students to design a simple ground floor plan with a kitchen, toilet, and living room		
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<b>Lesson Plan 3</b>	
Subject:	Architectural Design and Drawing
Topic:	The Design of a 2-bedroom flat
Class:	ND I Building Technology
Duration:	2 hours
Specific Objectives:	At the end of the lesson, students should be able to design a simple 2-bedroom flat
Entry Behaviour:	students had been taught the use of Revit to design a simple unit of building with Kitchen, Toilet and Living room
Instructional Materials:	Projector and Computer Systems.

Instructional Procedure

Step	Content	Teacher's Activities	Students' Activities	AutoCAD Command
1		The teacher displays the objectives of the lesson on the Projector screen and explains the objectives to the students	Students read the objectives on the projector screen	
2	Lunching into Revit	The teacher asks the students to launch into Revit on their individual computer set as the teacher launches into Revit on his computer system	Each of the Students lunches into Revit by double clicking the Revit icon on their Computer Desktop	Revit Lunches into the drawing area.
3	Creating a Project	The teacher asks students to click on new in the drawing area under the project	The students click on new in the drawing area under the project	Revit provides a New Project dialog box
4		The teacher asks the students to move the cursor downward to select Project under Create New then click OK	The students move the cursor downward to select Project under Create New and then click OK	Revit default displays the Autodesk Revit screen with pull-down menus along the top edge, a status bar along the bottom edge and a variety of toolbars at the top edge of the screen. The centre of the Autodesk Revit screen is divided into three i.e. the Design Bar, the Project Browser and the Workspace.
4	Setting the Basic parameters	The teacher asks students to click on the Basics tool in the design Bar	Students click on the Basics tool in the Design Bar.	Revit displays the Basic tools.
5		The teacher asks students to double-click on views (all) under the project tool	The students double-click on views (all) under the project tool	Revit displays the floor plan and drops down to level 0, level 1 and the site

		The teacher asks the students to double-click on Level 1	The students double-click on level 1	Revit displays drawing area in level 1 i.e ground floor level
6	Setting the Parameters for the wall	The teacher asks the student to click on the wall tool	The students click on the wall tool	Revit displays the wall parameters
7		The teacher asks the students to set the parameters as directed e.g un-connected height, wall line, chain line, offset etc	The students set the parameter as directed by the teacher	Revit internalize the set parameter
8	Draw a 2-Bedroom flat	The teacher asks the students to click to indicate the wall starting point	The students click on their individual computers the starting point	Revit displays the starting point with 0,0
9		The teacher specifies the endpoint horizontally (length of the building) as 9075 and presses the enter key	The students input 9075 to move a distance specified as the length of the building and press enter key	Revit draws the wall
10		The teacher specifies the breadth of the building as 9900 and uses the wall tool to draw the perimeter wall of the building	The students input 9900 as the breadth of the building and then draw the perimeter wall of the building using the wall tool	Revit draws the wall
11		The teacher specifies the dimension of the living room as 4800 along the length of the building on the left side and draws the demarcation wall of 225.	The students input 4800 as the dimension of the living room along the length of the building on the left side and draw the demarcation wall of 225	Revit draws the wall
12		The teacher specifies the dimension of bedroom 1 as 3600 along the length of the building on the left side and draws the demarcation wall of 225	The students input 3600 as the dimension of bedroom 1 along the length of the building on the left side and draw the demarcation wall of 225.	Revit draws the wall
13		The teacher specifies the dimension of bedroom 1 along the breadth of the building as 3600 on the rear side and draws the demarcation wall of 225	The students input the dimension of bedroom 1 along the breadth of the building as 3600 on the rear side and draw the demarcation wall of 255.	Revit draws the wall
14		The teacher specifies the dimension of the toilet as 1800 along the breadth of the building on the rear side and draws the demarcation wall of 225	The students input the dimension of the kitchen as 1800 along the breadth of the building on the rear side and draw the demarcation wall of 225	Revit draws the wall
15		The teacher explains to the students that the space between the toilet and the perimeter wall along the breadth of the building on the rear side represents the breadth of the second room.	The students listen and locate the said space	
16		The teacher specifies the dimension of room 2 along the length of the building as 3600 on the right side of	The students input 3600 as the dimension of room 2 along the length of the building on	Revit draws the wall

		the building and draws the demarcation wall of 225.	the right side and draw the demarcation wall of 225.	
17		The teacher specifies the dimensions of the kitchen along the right side of the building as 3000 and draws the demarcation wall of 225.	The students input 3000 as the dimension of the kitchen along the length of the building on the right side and drew the demarcation wall of 225.	Revit draws the wall
18		The teacher specifies 1575 as the dimension of the verandah along the right side of the building	The students input 1575 as the dimension of the verandah along the right side of the building	Revit draws the wall
19	Evaluation	The teacher asks the following questions from the students: 1. why do we prefer using 225 as an external wall of a building? 2. what should be considered in locating the toilet in a flat?	The students answer	
20	Summary and Assignment	The teacher revises the lesson again and asks the students to design a 2-bedroom flat other than the one done in the class		

<b>Lesson Plan 4</b>	
Subject:	Architectural Design and Drawing
Topic:	Fixing of Windows and Doors
Class:	ND I Building Technology
Duration:	2 hours
Specific Objectives:	At the end of the lesson, students should be able to 1. fix Windows using the Revit tools 2. Fix doors using the Revit tools
Entry Behaviour:	students had been taught the use of Revit to design a 2-bedroom flat
Instructional Materials:	Projector and Computer Systems.

Instructional Procedure

Step	Content	Teacher's Activities	Students' Activities	AutoCAD Command
1		The teacher displays the objectives of the lesson on the Projector screen and explains the objectives to the students	Students read the objectives on the projector screen	
2	Lunching into Revit	The teacher asks the students to launch into Revit on their individual computer set as the teacher launches into Revit on his computer system	Each of the Students lunches into Revit by double clicking the Revit icon on their Computer Desktop	Revit Lunches into the drawing area.
3	Opening of a saved file	The teacher asks students to click on browse in the drawing area under the project	The students click on browse in the drawing area under the project	Revit provides a list of saved Projects in the dialog box



4		The teacher asks the students to click on the 2-bedroom flat earlier designed and save in the class.	The students click on the 2-bedroom flat earlier designed and saved in the class.	Revit displays the Autodesk Revit screen with the saved 2-bedroom flat
5	Fixing of Windows	The teacher asks students to click on the Basics tool in the design Bar	Students click on the Basics tool in the Design Bar.	Revit displays the Basic tools.
6		The teacher asks students to click on the window tool	The students click on the window tool	Revit highlights element properties
7		The teacher asks the students to click on element properties	The students click on element properties	Revit displays the element properties dialogue box
8		The teacher asks the student to click on load in the element properties dialogue box.	The students click on load in the element properties dialogue box	Revit displays all available elements
9		The teacher asks the students to double-click on the window	The students double-click on the window	Revit displays all available windows
10		The teacher asks the students to click on the interested window and click on open to load the selected widow	The students click on the interested window and click on open to load the selected widow	Revit displays the element properties dialogue box again
11		The teacher asks the students to click OK	The students click OK	Revit loads the windows
12		The teacher asks the students to click on any portion of the wall where they want windows to be located	The students click on any portion of the wall where they want windows to be located	Revit fixes windows in identified locations
13	Fixing of Doors	The teacher asks students to click on the Basics tool in the design Bar	Students click on the Basics tool in the Design Bar.	Revit displays the Basic tools.
14		The teacher asks students to click on the door tool	The students click on the door tool	Revit highlights element properties
15		The teacher asks the students to click on element properties	The students click on element properties	Revit displays the element properties dialogue box
16		The teacher asks the student to click on load in the element properties dialogue box.	The students click on load in the element properties dialogue box	Revit displays all available elements
17		The teacher asks the students to double-click on the door	The students double-click on the door	Revit displays all available doors
18		The teacher asks the students to click on the interested door and click on open to load the selected door	The students click on the interested door and click on open to load the selected door	Revit displays the element properties dialogue box again
19		The teacher asks the students to click OK	The students click OK	Revit loads the doors
20		The teacher asks the students to click on any portion of the wall where they want doors to be located	The students click on any portion of the wall where they want doors to be located	Revit fixes doors in identified locations
21	Evaluation	The teacher asks the following questions from the students: 1. What is the first step in fixing a widow using Revit What are the functions of element properties in door fixing in Revit	The students answer	

22	Summary and Assignment	Teacher revises the lesson again and asks the students to fix windows and doors to other class work earlier.		
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<b>Lesson Plan 5</b>	
Subject:	Architectural Design and Drawing
Topic:	Roofing
Class:	ND I Building Technology
Duration:	2 hours
Specific Objectives:	At the end of the lesson, students should be able to Design roof using Revit
Entry Behaviour:	students had been taught the use of Revit to design a 2-bedroom flat
Instructional Materials:	Projector and Computer Systems.

#### Instructional Procedure

Step	Content	Teacher's Activities	Students' Activities	AutoCAD Command
1		The teacher displays the objectives of the lesson on the Projector screen and explains the objectives to the students	Students read the objectives on the projector screen	
2	Lunching into Revit	The teacher asks the students to launch into Revit on their individual computer set as the teacher launches into Revit on his computer system	Each of the Students lunches into Revit by double clicking the Revit icon on their Computer Desktop	Revit Lunches into the drawing area.
3	Opening of a saved file	The teacher asks students to click on browse in the drawing area under the project	The students click on browse in the drawing area under the project	Revit provides a list of saved Projects in the dialog box
4		The teacher asks the students to click on the 2-bedroom flat earlier designed and save in the class.	The students click on the 2-bedroom flat earlier designed and saved in the class.	Revit displays the Autodesk Revit screen with the saved 2-bedroom flat
5	The design of the roof	The teacher asks students to click on the Basics tool in the design Bar	Students click on the Basics tool in the Design Bar.	Revit displays the Basic tools.
6		The teacher asks students to click on the roof tool	The students click on the roof tool	Revit displays a roof dialogue box
7		The teacher asks the students to click on the roof by footprint in the dialogue box	The students click on a roof by footprint in the dialogue box	Revit displays the parameter dialogue box and highlights the drawing
8		The teacher asks the student to suitably adjust the parameters in the parameter dialogue box.	The students suitably adjust the parameters in the parameter dialogue box	Revit internalizes the adjusted parameters
9		The teacher asks the students to move the cursor to the drawing and click on the walls	The students move the cursor to the drawing and click on the walls	Revit highlights the specified overhang distance around the drawing
10		The teacher explains that the slope may be defined depending on whether the roof is gable or hip.	The students listen	
11		The teacher asks the students to click finish in the sketch dialogue box	The students click finish in the sketch dialogue box	Revit roofs the building

21	Evaluation	The teacher asks the following questions from the students: 1. What happens when you click on the roof dialogue box 2. If you want to make the roof a gable what do you do	The students answer	
22	Summary and Assignment	The teacher revises the lesson again and asks the students to design the roof to other class work earlier.		

<b>Lesson Plan 6</b>	
Subject:	Architectural Design and Drawing
Topic:	Project the elevations
Class:	ND I Building Technology
Duration:	2 hours
Specific Objectives:	At the end of the lesson, students should be able to use Revit to project 1. Front elevation of a 2-bedroom flat 2. Right elevation of a 2-bedroom flat 3. Left elevation of a 2-bedroom flat 4. Rear elevation of a 2-bedroom flat
Entry Behaviour:	students had been taught the use of Revit to design the ground floor plan of a 2-bedroom flat
Instructional Materials:	Projector and Computer Systems.
Instructional Procedure	

Step	Content	Teacher's Activities	Students' Activities	AutoCAD Command
1		The teacher displays the objectives of the lesson on the Projector screen and explains the objectives to the students	Students read the objectives on the projector screen	
2	Lunching into Revit	The teacher asks the students to launch into Revit on their individual computer set as the teacher launches into Revit on his computer system	Each of the Students lunches into Revit by double clicking the Revit icon on their Computer Desktop	Revit Lunches into the drawing area.
3	Opening of a saved file	The teacher asks students to click on browse in the drawing area under the project	The students click on browse in the drawing area under the project	Revit provides a list of saved Projects in the dialogue box
4		The teacher asks the students to click on the 2-bedroom flat earlier designed and save in the class.	The students click on the 2-bedroom flat earlier designed and saved in the class.	Revit displays the Auto-desk Revit screen with the saved 2-bedroom flat
4	Projecting the front elevation	The teacher asks students to click on elevation under the project tool	Students click on the elevation under the project tool.	Revit displays the elevations i.e. East, North, South and West elevations.
5		The teacher explains to the students that East elevation is Front Elevation, North elevation is left side elevation, South elevation is right elevation West elevation is rear elevation	The students listen and take note	

6		The teacher asks the student to click on the East elevation	The students click on the East elevation	Revit displays East Elevation
7		The teacher asks the student to click on the North elevation	The students click on the North elevation	Revit displays North Elevation
8		The teacher asks the student to click on the South elevation	The students click on the South elevation	Revit displays South Elevation
9		The teacher asks the student to click on the West elevation	The students click on the West elevation	Revit displays West Elevation
10	Evaluation	The teacher asks the students to state the procedure for making elevations in Revit	The students answer	
	Summary and Assignment	The teacher revises the lesson again and asks the students to make elevations of any other design made by them		

### Appendix B

**BUILDING DRAWING INTEREST INVENTORY**

**Institution**.....

**Registration Number**.....

**Sex:**                      Male                                            Female                     

**Instruction:** Below is a list of statements to ascertain your disposition towards Building Drawing. Please, check (√) to indicate the degree to which you agree or disagree with the statements.

Note: Strongly Agree (SA); Agree (A); Undecided (UD); Disagree (D); Strongly Disagree (SD)

S/N	Items	SA	A	UD	D	SD
1	I like being taught Building Drawing					
2	I like to be involved in design activities					
3	I always think about how Building components are constructed					
4	I do not like reading books that contain illustrations made with diagrams					
5	I like to picture the way things look in my head					
6	I always imagine from the beginning what a building looks like when completed					
7	I do not like studying in the technical drawing room					
8	I found construction of objects very fascinating					
9	I like fiddling with drawing instruments					
10	I always encourage others to attend classes involving construction of objects					
11	I do not like taking part in discussion based on properties of points and lines					
12	I believe that there are prospects in being a building designer					
13	I like to visualize objects from different perspectives					
14	I don't like learning the properties of objects that has height, length and width					
15	I do not like answering questions in classes involving construction of buildings					

16	I do not like solving problems involving conversion of objects that has height, length and width to plane figures that has only length and width					
17	I do not like staying with building designers whenever they are drawing					
18	If I were an Architectural design and drawing teacher, I will not like to teach a class involving the development of roof geometry					
19	I am always confused in the development of building elevations					
20	I do not like to involve myself in construction activities					
21	Whenever I hear the word Building Drawing, I have a feeling of dislike					
22	I compete with other students for high scores in Building Drawing exercises and tests					
23	I don't feel at ease in an Building Drawing class					
24	Drawing and designing of building wastes time					
25	I am always late to drawing classes					
26	I used to be afraid whenever I am called upon to answer questions during construction of objects that has height, length and width					
27	I am excited whenever teacher is teaching construction of objects					
28	Discussion of properties of lines, points and planes on the projection planes is very interesting					
29	I always understand how building components work when illustrations are made					
30	I am excited whenever I solve problems involving construction of buildings correctly					
31	I am always carried away when I see people drawing with computer					
32	I usually hate Building Drawing lecturers					
33	I will not study any course involving drawing after OND					
34	I spend my leisure time to visit architectural studios					
35	There is no gain studying building and design					
36	I always devote much time to studying building drawing and design					
37	I always love excursion to building drawing firms					
38	Architectural Design and Drawing usually widens ones horizon					
39	Architectural Design and Drawing generally presents interesting technological skill					
40	I love watching films of Architects and draughtsmen working in the drawing studio					

**FACTORIALLY PURE BUILDING DRAWING INTEREST INVENTORY**

**Institution**.....

**Registration Number**.....

**Sex:** Male  Female

**Instruction:** Below is a list of statements to ascertain your disposition towards Architectural Design and Drawing. Please, check (✓) to indicate the degree to which you agree or disagree with the statements.

Note: Strongly Agree (SA); Agree (A); Undecided (UD); Disagree (D); Strongly Disagree (SD)

S/N	Items	SA	A	UD	D	SD
1	I like being taught Architectural Drawing					
2	I always think about how Building components are constructed					
3	I like to be involved in design activities					
4	I always imagine from the beginning what a building looks like when completed					
5	I found the construction of objects very fascinating					
6	I like fiddling with drawing instruments					
7	I do not like taking part in discussions based on the properties of points and lines					
8	I believe that there are prospects in being a building designer					
9	I like to visualize objects from different perspectives					
10	I don't like learning the properties of objects that have height, length and width					
11	I do not like solving problems involving the conversion of objects that have height, length and width to plane figures that have only length and width					
12	I do not like staying with building designers whenever they are drawing					
13	If I were an Architectural design and drawing teacher, I would not like to teach a class involving the development of roof geometry					
14	I am always confused about the development of building elevations					
15	I don't feel at ease in an Architectural Design and Drawing class					
16	I compete with other students for high scores in Architectural Design and Drawing exercises and tests					
17	I am always late to drawing classes					
18	I am always afraid whenever I am called upon to answer questions during the construction of objects that have height, length and width					
19	I always love an excursion to building drawing firms					

20	I always understand how building components work when illustrations are made					
21	I am always carried away when I see people drawing with computer					
22	I usually hate Architectural Design and Drawing lecturers					
23	I will not study any course involving drawing after OND					
24	I spend my leisure time visiting architectural studios					
25	There is no gain in studying architectural and design					
26	I always devote much time to studying architectural drawing and design					
27	Architectural Design and Drawing usually widen ones horizon					
28	I like to picture the way things look in my head					
29	I love watching films of Architects and draughtsmen working in the drawing studio					