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Effects Of Autodesk Revits And Autocad Onachievement Of Higher National Diploma Students In Principle Of Architectural Design And Drawing In South-West Nigeria

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Abstract: ***This study examined the effects of Autodesk Revits and AutoCAD on Achievement of Higher National Diploma students in Principle of Architectural Design and Drawing in South-West Nigeria. The study adopted 2×2 factorial design which involved students in their intact classes assigned to treatment groups. The instruments used in this study were Principles of Architectural Design and Drawing Achievement Test (PADDAT). The pre-test and post-test were analyzed using mean and standard deviation to answer the research questions. The results showed that Autodesk Revit was more effective than AutoCAD in improving students' achievement, however, the effectiveness of Autodesk Revit on students' achievement in Principle of Architectural Design and Drawing does not depend on level of gender. Hence, there was no significant interaction effect of treatment and gender on students' achievement in Principle of Architectural Design and Drawing. It was recommended that Autodesk Revit should be adopted to teach Principle of Architectural Design and Drawing.***

Keywords: Autodesk Revit, Architectural Design, Students, Effectiveness, Autocard, Achievement Test.

I. INTRODUCTION

The world today has significantly shifted from the traditional method of operation to a more technologically advancement position. This has generally altered the mode of operation in all facets of life. The impact of the advancement in technology has changed the mode of drawings in the building industry from using drawing instruments and drafting board to the use of Computer Aided Design (CAD) packages. Hutchinson (2002) explained that some of the reasons for the use of CAD packages in the building industry for Architectural Design and Drawing include: visualization, automatic generation of two-dimensional (2-D) views from three-dimensional (3-D) drawing, rapid prototyping, increased revision speed, and data sharing. Computer-aided design (CAD) can be said to mean the use of a wide range of computer-based tools to assist engineers, architects and other design professionals in their design activities.

According to Bryan (1997) Computer-Aided Design (CAD) involves the use of computer programs and systems to design detailed two-dimensional or three-dimensional models of physical objects, such as mechanical parts and buildings. Principle of Architectural Design and Drawing which is one of the major courses for Higher National Diploma (HND)

students in Building Technology is a branch of building technology which always gives impression of what a building should look like from inception and it involves a lot of activities. It involves the construction of front elevation, right side elevation, left side elevation, plan, section views, sanitary plan, site plan in 2-D, doors schedule, windows schedule and different perspectives of the building plan in 3-D (National Board for Technical Education, 2003). Two major types of CAD packages are developed mainly for Principle of Architectural Design and Drawing by Autodesk Company namely Autodesk Revit and AutoCAD.

According to Wikipedia, (2009), "Autodesk Revit is a building information modelling software for Microsoft Windows, developed by Autodesk and allows the user to design with parametric modelling and drafting elements". It has a platform for building information modelling in architectural design and documentation system. It supports the principle of architectural design and drawing schedules required for a building project. AutoCAD on the other hand is vector graphic software developed by Autodesk for Two-Dimensional and Three-Dimensional design and drafting (Bui, 2006). It uses primitive entities such as lines, polylines, circles, arcs and text as the foundation for more complex objects (Wikipedia, 2007). UNESCO (2002) noted that "with the emerging technologies in the building industry, which have occasioned ample use of computer technologies to improve productivity, educational systems around the world are under increasing pressure to use the new information and communication technologies (ICTs) to teach students the knowledge and skills they need in the 21st century". According to Strong and Smith (2007), human and computer interface have direct relationship to stress on the students cognitive ability which in turn enhances students' active engagement and interaction with the learning environment and help to improve students' achievement in learning.

Gender however plays vital roles in achievement ability of individuals. Gender, refers to a psychological term, which describes behaviours and attributes expected of individual on the basis of being a male or a female (Uwameiye and Osunde, 2005). Evidences however abound that trainings designed with specific focus on the ability and potential will improving students' achievement in graphics related subjects, engineering, mathematics and sciences.

Students' achievement connotes performance in school subject as symbolized by a score on an achievement test. However, achievement depends upon a number of factors some of which are instructional methods used, the environment upon which the learning takes place and the learner himself/herself. The teacher's method of teaching matters a lot if students will achieve in any subject. Among other things, teachers should use various motivational techniques, maintaining rules and regulations and good control of the class in order to stimulate learners' achievement (Moore, 2008).Therefore, the need arises that Higher National Diploma (HND)students are involved in all aspects of learning processes to ensure their achievement in Principle of Architectural Design and Drawing. In the opinion of Rojewskin (2007), there is need for shifting from teacher–centred instruction to student-centred instruction, so that students will be able to function well in the 21st century. The shift seems to be easier with the use of Computer Aided Design.

Autodesk Revits and AutoCAD packages offer different environment and activities for improving students' achievement however, one source of concern to educators has been, which of these CAD packages will be better to teach Principle of Architectural Design and Drawing to the Higher National Diploma students in Building technology? Hence, this study.

A. STATEMENT OF THE PROBLEM

Demonstration method remains the popular method of teaching and learning of Principle of Architectural Design and Drawing to Higher National Diploma students in Nigerian Polytechnics. This method when compared with the vogue in computer is limited by being teacher-centred. The trend in the world of work is however the use of computer packages. Popular among specially designed CAD packages for Architectural Design and Drawing are Autodesk Revit and AutoCAD. The need therefore arises that the gap between the school and the world of work must be bridged in the teaching and learning of Principle of Architectural Design and Drawing. The use of CAD packages like Autodesk Revit and AutoCAD will go a long way in filling the gap and also enhance students' achievement.

These two CAD packages have some similarities and differences in their applications, this study therefore wishes to identify which of them will be best at enhancing students' achievement. Hence this study will find the effects of Autodesk Revit and AutoCAD on achievement of Higher National Diploma students in Principle of Architectural Design and Drawing.

B. OBJECTIVES OF THE STUDY

The aim of this study was to determine the effects of Autodesk Revit and AutoCAD on Higher National Diploma students' achievement in Principle of Architectural Design and Drawing. The specific objectives of the study were to determine the effects of:

- ✓ Autodesk Revit and AutoCAD on students' achievement in Principle of Architectural Design and Drawing and
- ✓ Interaction of gender on the achievement of students when taught Principle of Architectural Design and Drawing with AutoCAD and Autodesk Revit;

C. SIGNIFICANCE OF THE STUDY

This study will be advantageous at enlightening the teachers of Principle of Architectural Design and Drawing in the Higher National Diploma level in the Polytechnics, especially in selecting the appropriate CAD package that will improve students' achievement in Principle of Architectural Design and Drawing. The findings of the study will equip the teachers on their instructional delivery by adopting appropriate CAD package (Autodesk Revit or AutoCAD) that will be most relevant to the work place.

This study will also be beneficial to the students because, using CAD package as a learning tool will make the learning

environment to be students–centred and active students' participation in the classroom activities will be recorded as against the demonstration method that is teacher–centred. Therefore, the students' attention in learning Principle of Architectural Design and Drawing will be sustained. The students will also gain immensely if the appropriate instructional method is applied to teach them. In addition, being versatile in the use of CAD package (Autodesk Revit or AutoCAD) will increase their employability in the industries.

The curriculum planners are currently under the pressure of preparing curriculum that will be good enough to meet the yearnings of the world of work. The vogue now in the world of work is of computer application. The trend is not different in the building industry. Therefore, the curriculum for teaching students in order to acquire necessary knowledge and skills must also be computably inclined. It has now become a challenge to the curriculum planners to plan for a curriculum that will enable the students of Higher National Diploma in Principle of Architectural Design and Drawing to become versatile in using CAD package (Autodesk Revit Architecture or AutoCAD). This study will therefore be of great value to the curriculum planners at understanding the best CAD package (Autodesk Revit Architecture or AutoCAD) that can be good for training spatial ability of Higher National Diploma Students in Architectural Design and Design.

Obviously, the graduating students of Higher National Diploma programmes are technologists who should be able to work with the current trends in their place of work. Industries will only like to employ technologists who will be able to move with time, especially technologically. Adoption of a CAD package (Autodesk Revit or AutoCAD) as a learning tool for Higher National Diploma Students in Principle of Architectural Design and Drawing in replacement of the present demonstration method will afford the industries opportunities of getting right caliber of technicians needed in the building industry.

D. SCOPE OF THE STUDY

The scope of this study covers the Autodesk Revit and AutoCAD as instruments for enhancing achievement of students in architectural design and drawing. The study involved all Higher National Diploma students of Building Technology in their year one in the state and Federal Polytechnics in the South-West Geo-Political Zone of Nigeria. Gender was introduced into the study to identify if any of the CAD packages is gender bias.

II. RESEARCH QUESTIONS

The following are the research questions for the study:

- ✓ What is the effect of using Autodesk Revit and AutoCAD on students' achievement in Principle of Architectural Design and Drawing?
- ✓ What is the significant difference between the main effect of gender on students' achievement in Principle of Architectural Design and Drawing?
- ✓ What is the interaction effect of gender on the achievement of students when taught Principle of Architectural Design and Drawing with AutoCAD and Autodesk Revit?

III. HYPOTHESES

The following null hypotheses were tested at 0.05 level of significance:

HO_1: There will be no significant difference between the main effects of treatments

(Autodesk Revit and AutoCAD) on students' achievement in Principle of Architectural Design and Drawing.

HO_2: There will be no significant difference between the main effect of gender on students' achievement in Principle of Architectural Design and Drawing.

HO_3: There will be no interaction effect of treatments given to students by their gender with respect to their mean scores on Principle of Architectural Design and Drawing Achievement Test.

IV. METHODOLOGY

The study adopted 2×2 factorial design which involved students in their intact classes assigned to treatment groups. This design was considered suitable in conducting this study because the researcher was primarily interested in the effects of Autodesk Revit and AutoCAD as independent variables but took into consideration gender as a moderator variable which may influence the dependent variables. With this design the researcher was able to assess the effects of the main independent variables (Autodesk Revit and AutoCAD) at each of the two levels of moderator variable. In this design, 45 male students received Autodesk Revit treatment (Cell 1) and 35 male students received AutoCAD treatment (Cell 3). 16 female students received Autodesk Revit treatment (Cell 2) and 18 female students received AutoCAD treatment (cell 4). The scores in the four cells represented the mean scores of the four treatment groups on the dependent variables. In addition to the four cells, there were four marginal mean scores: two for the columns and two for the rows. The marginal column means are for the main effects of the two treatments of Autodesk Revit and AutoCAD while the marginal row means are for the main effect of the Gender.

The population for the study comprised 317 HND I Building Technology students in all the ten Polytechnics offering Building Technology in South-West geo-political zone of Nigeria in 2017/2018 academic session. The sample size for this study consisted of 114 HND I Building Technology students which included 80 male and 34 female students. A multi-stage stratified sampling technique was used to select the sample for the study. In the first stage of the sampling, purposeful stratified random sampling technique was used to select two Federal Polytechnics and two State Polytechnics from the list of Polytechnics offering Building Technology in the South-Western geo-political zone of Nigeria. Thereafter, simple random sampling technique through balloting without replacement was used to randomly assign one intact class of HND 1 Building Technology students from the two Federal Polytechnics sampled to the two

treatments. One intact class was assigned to Autodesk Revit and the other was assigned to AutoCAD. Other intact classes of HND1 Building Technology students in the two State polytechnics sampled were also randomly assigned to the two treatments. One intact class assigned to Autodesk Revit and the other assigned to AutoCAD. In essence, two intact classes, (One from Federal polytechnic and One from State Polytechnic) received Autodesk Revit treatment. Also another two intact classes, (One from Federal polytechnic and One from State Polytechnic) received AutoCAD treatment. Each intact class comprised male and female students. Hence, 45 male and 16 female students constituted treatment groups assigned to Autodesk Revit, while 35 male and 18 female students also constituted another treatment groups assigned to AutoCAD.

The instruments used in this study is Principle of Architectural Design and Drawing Achievement Test (PADDAT) which was developed by the researcher through the preparation of the Table of specification, taking into consideration the topics covered by the practical content of Principle of Architectural Design and Drawing. The Autodesk Revit and AutoCAD Lesson Plans which were used to teach the treatment groups were developed by the researcher.

To ensure content validity of the Principle of Architectural Design and Drawing Achievement Test (PADDAT), a Table of specification was built for the test giving due consideration to the objective and major topics in the practical content of the Principle of Architectural Design and Drawing syllabus for HND I. In order to ensure that the items did not deviate from the specifications of the test blueprint, test of goodness of fit was carried out. The result of the goodness of fit computed showed that the question items distribution did not deviate from the table of specification. Based on the table of specification, a total number of seventy three multiple choice items were drawn. The PADDAT, the Autodesk Revit lesson plan and AutoCAD lesson plan for the Principle of Architectural Design and Drawing were subjected to face validation by five experts three of which are Principle of Architectural Design and Drawing lecturers and two measurement experts. In the face validation exercise, each of the validators was presented with a copy of each of the instruments for validation. Based on the experts' corrections and suggestions, a final copy of PADDAT, Autodesk Revit lesson plan and AutoCAD lesson plan were prepared by the researcher.

A trial test was conducted on the PADDAT for the purpose of determining the psychometric indices of the test. In the trial test, the PADDAT was administered on a sample of 27 students drawn from HND1 building technology students in a Polytechnic in the North Central region of Nigeria. The answer sheets were marked and used for computing the difficulty index, discrimination index and distractor index of the test items. A total of 47 items of the PADDAT had good difficulty, discrimination and distractor indices.

However, to ensure that difference in cultural and social background will not affect the reliability, a trial test was carried out on the PVRT so as to determine its reliability coefficient. The PVRT was administered on sample of 27 HND1 Building Technology students in a Polytechnic in the North Central Region of Nigeria. Kuder Richardson 20 and Split Half reliabilities using Guttman split-half coefficient were computed and found to be 0.74 and 0.88 respectively for a sample of 27 in each.

The trial test to determine the coefficient of reliability of the Principle of Architectural Design and Drawing Achievement test (PADDAT) was carried out using test-re-test reliability technique. The objectives answer sheets were marked by the researcher and the scores obtained were kept. After two weeks, the PADDAT was re-administered to the same sample in the same Polytechnics. The objectives answer sheets were also marked by the researcher and the scores obtained in the first and second administration of the tests were correlated. The reliability coefficient of the PADDAT administered on sample of 27 was found to be 0.82 using Pearson Product Moment correlation coefficient.

The regular teachers of Principle of Architectural Design and Drawing in the participating Polytechnics taught their own students. In order to take care of the difference in the teachers' quality, two different classes were used for each treatment. The researcher was not directly involved in administering the research instruments and the treatments. The reason for this is to reduce the experimental bias which may occur as a result of the student's awareness of being observed. In order to ensure uniformity in the standard of teaching, the researcher developed the lesson plans used for the study. This went a long way in controlling invalidity that might be caused by teacher variability in the development of their individual lesson plans and to ensure uniformity of standard in the conduct of the research. There were two different types of lesson plan developed by the researcher; one was for Autodesk Revit teachers and the second one was for AutoCAD teachers.

The experiment commenced with a pre-test administered to the Autodesk Revit group and AutoCAD group using Principle of Architectural Design and Drawing Achievement Test (PADDAT). These were achieved through the assistance of the lecturers handling Principle of Architectural Design and Drawing in their respective schools. The essence of the pre-test was to obtain a base line data on the dependent variables (Achievement). After the pre-test, the group assigned to Autodesk Revit and the group assigned to AutoCAD had practical content of Principle of Architectural Design and Drawing lesson for six weeks using Autodesk Revit and AutoCAD. Immediately after the treatments, a post-test of Principle of Architectural Design and Drawing Achievement Test (PADDAT) was administered to all groups to obtain post treatment data for the dependent variable (Achievement).

The lecturers of Principle of Architectural Design and Drawing and their assistants administered both pre-test and post-test to the treatment groups in their respective schools. Objective answer sheets were provided for the students to fill-in the answers to the Principle of Architectural Design and Drawing Achievement Test (PADDAT). The researcher marked the answer sheets to obtain the students' scores on cognitive achievement in Principle of Architectural Design and Drawing before and after the treatment. The exercise provided both base line and post treatment data on the dependent variables (Achievement).

Mean and standard deviation were used to answer the research questions. The mean and standard deviation of the pre-test and the post-test of each group were compared to

determine the effects of the two CAD packages (Autodesk Revit and AutoCAD) on cognitive achievement in Principle of Architectural Design and Drawing. The differences between the pre-test and post-test mean scores otherwise known as mean gain of the treatment groups (AutoCAD and Autodesk Revit) were compared to take decision on which group performed better in the achievement.

The hypotheses formulated for the study were tested at 0.05 level of significance using Analysis of Covariance (ANCOVA). ANCOVA is a statistical technique which removes the initial differences between groups, so that the selected groups or pre-tested groups can be correctly considered as equated or equivalent, by removing score difference in the pre-test performance across groups and reducing the between-group source variation (Ali, 1996). Since students in their intact classes participated in this experiment, ANCOVA was considered appropriate for analyzing the differences between the main effects of the treatments on the dependent variables. Where significance of F is less or equal to 0.05 ($\rho < .05$), F-value was considered significant and the null hypothesis was rejected. Meanwhile, where sig. of F is greater than 0.05 ($\rho > .05$), F-value was considered not significant then the null hypothesis was accepted.

This section presents the results of the data analyses for the study. The presentation of data is organized according to the research questions and null hypotheses that guided the study.

RESEARCH QUESTION 1: What is the effect of AutoCAD and Autodesk Revit on students' achievement in Principle of Architectural Design and Drawing?

Treatment Groups	n	Pretest $\overline{X}$	SD	Posttest $\overline{X}$	SD
AutoCAD	53	12.96	1.78	32.13	3.05
Autodesk Revit	61	12.78	1.78	40.36	2.22

Source: Researchers' Computation, 2016

Table 1: Mean and Standard Deviation of Pretest and Posttest Scores of Treatment Groups taught Principle of Architectural Design and Drawing with AutoCAD and Autodesk Revit in the Achievement Test

The data presented in Table 1 above shows that the treatment group taught Principle of Architectural Design and Drawing with AutoCAD had a mean score of 12.96 and a standard deviation of 1.78 in the pre-test with a mean score of 32.13 and a standard deviation of 3.05 in the post-test. The difference between the pre-test and post-test mean scores was 19.17. The deviation of the post-test scores from the mean was however higher than the deviation of the pre-test scores from the mean. The treatment group taught Principle of Architectural Design and Drawing with Autodesk Revit had a mean score of 12.78 and standard deviation of 1.78 in the pre-test while the post-test mean score was 40.36 with standard deviation of 2.22. The difference between the pre-test and post-test mean scores was 27.58 while the deviation of the post-test scores from the mean was higher than the deviation of the pre-test scores from the mean. With these results, the effect of Autodesk Revit was higher than the effect of AutoCAD on students' achievement in Principle of Architectural Design and Drawing.

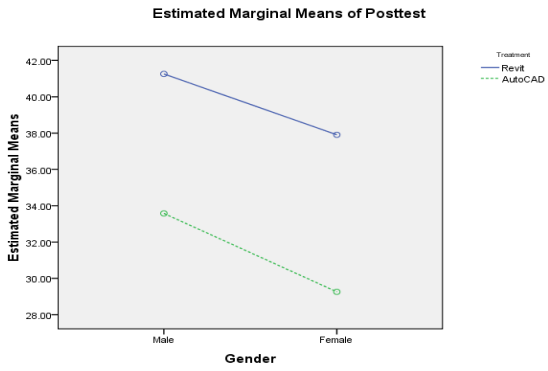
RESEARCH QUESTION 3: What is the interaction effect of Gender on the achievement of students when taught Principle of Architectural Design and Drawing with AutoCAD and Autodesk Revit?

	AutoCAD			Revit		
Gender	n	Pretest	Posttest	n	Pretest	Posttest
Male	35	12.97	33.60	45	12.91	41.26
Female	18	12.94	29.27	16	12.43	37.81

Source: Researchers' Computation, 2018

Table 3: The interaction effect of gender on the achievement of students when taught Principle of Architectural Design and Drawing with AutoCAD and Autodesk Revit

The data presented in Table 3 shows that male students taught Principle of Architectural Design and Drawing with AutoCAD had a pre-test mean score of 12.97 and post-test mean score of 33.60. The difference between the mean scores was 20.63. The male students taught with Autodesk Revit had a pretest mean score of 12.91 and a post-test mean of 41.26. The difference between the mean scores was 28.35. Meanwhile, female students taught Principle of Architectural Design and Drawing with AutoCAD had a pre-test mean score of 12.94 and a post-test means core of 29.27. The difference between the mean scores was 16.33. However, the female students taught with Autodesk Revit had a pre-test mean score of 12.43 and a post-test mean score of 37.81. The difference between the mean scores was 25.38. With these results, male students taught Principle of Architectural Design and Drawing had higher mean scores than female students in the achievement test. Which shows that there was an effect attributable to gender on the achievement of students taught Principle of Architectural Design and Drawing with AutoCAD and Autodesk Revit in favour of male students. However, there was no combination of gender and methods to produce greater achievement gains. This implies that the effectiveness of Autodesk Revit on students' achievement in Principle of Architectural Design and Drawing does not depend on level of gender. Thus, there is no interaction effect of treatments given to students and their gender with respect to their mean achievement score in Principle of Architectural Design and Drawing. Furthermore, Figure 14 illustrates the trend analysis of achievement scores by treatment conditions and gender. The slopes show that male students performed higher than female students in both CAD packages.



Source: Researchers' Computation, 2018

Figure 2: The trend analysis of students' achievement scores by treatment conditions and gender

TESTING OF HYPOTHESIS: The hypotheses formulated for the study were tested at 0.05 level of significance using Analysis of Covariance (ANCOVA).

HO_1: There will be no significant difference between the main effect of treatment (AutoCAD and Autodesk Revit) on students' achievement in Principle of Architectural Design and Drawing.

HO_2: There will be no significant difference between the main effect of gender (male and female) on students' achievement in Principle of Architectural Design and Drawing.

HO_3: There will be no significant interaction effect of treatment and gender on students' achievement in Principle of Architectural Design and Drawing.

Source	Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	2300.338[a]	4	575.085	156.702	.000
Intercept	2258.190	1	2258.190	615.323	.000
Pretest	17.227	1	17.227	4.694	.032
Treatment	1570.191	1	1570.191	427.854*	.000
Gender	346.618	1	346.618	94.448*	.000
Treatment * Gender	5.513	1	5.513	1.502	.223
Error	400.022	109	3.670		
Total	154869.000	114			
Corrected Total	2700.360	113			

**Significant at sig of F< .05*

Source: Researchers' Computation, 2018

Table 5: Summary of Analysis of Covariance (ANCOVA) for Test of Significance of Three Effects: Treatments, Gender and Interaction of Treatment and Gender on Students' Achievement in Principle of Architectural Design and Drawing

The data presented in Table 5 shows F-calculated values for three effects: treatment, gender and interaction effect of treatments and gender on students' achievement in Principle of Architectural Design and Drawing. The data show that there was a significant effect of treatment on students achievement in Principle of Architectural Design and Drawing (F = 427.854, significance of F=.000 i.e $\rho < .05$). This simply means that the difference between the mean achievement scores of the treatment groups taught Principle of Architectural Design and Drawing with AutoCAD and Autodesk Revit was statistically significant. Hence, HO_1 was rejected at .05 level of significance. Table 6 also shows that there was a significant effect of gender on students achievement in Principle of Architectural Design and Drawing favouring male (F = 94.448, significance of F=.000 i.e $\rho < .05$). Therefore, HO_2 was rejected at 0.05 level of significance. However, there was no significant interaction effect of treatment and gender on students achievement in Principle of Architectural Design and Drawing when taught with AutoCAD and Autodesk Revit (F = 1.502, significance of F=.223 i.e $\rho > .05$). Implicitly, there was no differential effect of treatment over level of gender on students' achievement in Principle of Architectural Design and Drawing. Hence, HO_3 was accepted at .05 level of significance.

V. FINDINGS AND DISCUSSIONS

A. FINDINGS

The findings of the study are hereby summarized as follow:

- ✓ The effect of Autodesk Revit on students' achievement in Principle of Architectural Design and Drawing was higher than the effect of AutoCAD.
- ✓ There was an effect attributable to gender on the achievement of students taught Principle of Architectural Design and Drawing with AutoCAD and Autodesk Revit.
- ✓ There was a significant effect of treatment on students' achievement in Principle of Architectural Design and Drawing when taught with AutoCAD and Autodesk Revit.
- ✓ There was a significant effect of gender on students' achievement in Principle of Architectural Design and Drawing favouring male.
- ✓ There was no significant interaction effect of treatment and gender on students' achievement in Principle of Architectural Design and Drawing when taught with AutoCAD and Autodesk Revit.

B. DISCUSSIONS

The results of findings as provided in Table 1 revealed that the effect of Autodesk Revit on students' achievement in Principle of Architectural Design and Drawing was higher than the effect of AutoCAD. Table 5 shows the analysis of covariance which was used to test the first hypothesis at the calculated F-value (427.854) significance of F (.000) and confidence level of .05. The results showed that there was a statistically significant difference between the main effect of treatments (Autodesk Revit and AutoCAD) on students' achievement in Principle of Architectural Design and Drawing which confirms that the difference between the main effect of Autodesk Revit and AutoCAD was statistically significant.

The implication of this finding is that Autodesk Revit is more effective than AutoCAD in enhancing students' achievement in Principle of Architectural Design and Drawing. This confirms the result of the survey earlier conducted on the benefits of modelling CAD over vector CAD which revealed that modeling CAD was more effective than the vector CAD (Scribner and Anderson, 2005). This is because modelling CAD provides change engine which enables immediate modification on any part of a design.

Modelling CAD is advantageous in the sense that the entire system, including parts, assemblies and drawings, can be changed simply by changing one parameter of a complex design. We can also quickly explore and evaluate different design variations and alternatives to determine the best design while existing design data can be reused to create new designs (Randy 2006). According to Botoye (2009) drawing with modeling CAD has significant advantages in the area of communicating appropriately and in understanding manner different components of design. The fact that modeling CAD can provide different orientations of a building design in both 2D and 3D gives better advantage. According to Mohler (2006) modeling technique provides different perspective

views to provide the user a sense of an objects' orientation in space. Therefore, the outcome of this study is attributed to the fact that modeling CAD gives better understanding of the concept of design and drawing.

Analysis of covariance was employed to test the third hypothesis as can be seen in Table 5 with the calculated F-value (1.502), significance of F (.223) and confidence interval of 0.05. This implies that there was no interaction effect of treatments given to students taught with AutoCAD and their gender with respect to their mean scores on Principle of Architectural Design and Drawing achievement test. This result showed that the effectiveness of CAD on students' achievement in Principle of Architectural Design and Drawing does not depend on the level of gender. Hence, there were no differential effects of treatments over levels of gender (male and female), which implies that Autodesk Revit is more effective in improving students' achievement in Principle of Architectural Design and Drawing regardless of gender levels.

Hypothesis two was however tested using analysis of covariance as can be seen in Table 5. At the calculated F-value (94.448), significance of F (.000) and confidence level of .05, there was a significant difference between the main effect of gender on students' achievement in Principle of Architectural Design and Drawing. This simply shows that spatial ability is importantly related to achievement in architectural and building drawing because of its direct relationship to the graphical communication associated with design (Koch, 2006). Therefore, spatial ability has correlation with achievement in architecture. According to Scribner and Anderson (2005) well developed spatial skills have been proven to be critical to a technical person's ability to develop creative design solution to engineering problems. Interestingly, where non-spatial strategies are required to solve problems, it still influences the degree to which a problem solver is able to develop and evaluate strategies (Alias, Black & Gray, 2002). This might not be unconnected with its influence at making inferences since a mental model must first be created before a problem could be solved. The effect of gender on spatial ability in Principle of Architectural Design and Drawing was however responsible for the gender difference on students' achievement in Principle of Architectural Design and Drawing resulting in better males achievement than their female counterpart.

VI. SUMMARY, CONCLUSION AND RECOMMENDATIONS

The trend in the world of work presently requires training institutes to be proactive in the methods of training their products so as to make them relevant in the world of work. The use of Computer-Aided Design (CAD) is however dominating the design and drawing activities in the building industry today.

The results emanated from the study on the basis of the data collected and analyzed were:

- ✓ It was found out that Autodesk Revit is more effective than AutoCAD in enhancing students' achievement in Principle of Architectural Design and Drawing.
- ✓ There was a significant difference between the main effect of Gender (male and female) on students' achievement in Principle of Architectural Design and Drawing
- ✓ There was no interaction effect of treatments given to students taught with AutoCAD and their gender with respect to their mean scores on Principle of Architectural Design and Drawing Achievement Test.

The current technological advancement occasioned by the use of Computer Aided-Design (CAD) packages for design and drawing in the building industry demands the need to find the best CAD that will assist Higher National Diploma students in building technology to improve their achievement in design and drawing. The result emanated from this study therefore showed that Autodesk Revit is more effective in improving students' achievement in Principle of Architectural Design and Drawing than AutoCAD. Also the study revealed that, there was an effect attributable to gender on students' achievement in Principle of Architectural Design and Drawing. However, the study did not find any interaction effects of CAD packages (Autodesk Revit and AutoCAD) and gender on achievement of Higher National Diploma students in Principle of Architectural Design and Drawing. What this connotes is that the effectiveness of Autodesk Revit and AutoCAD on students' achievement in Principle of Architectural Design and Drawing does not depend on the levels of gender. Hence, irrespective of nature of sex, learners will record improved performance in their spatial ability and achievement in Principle of Architectural Design and Drawing when Autodesk Revit is employed for teaching Principle of Architectural Design and Drawing. These results therefore showed that Autodesk Revit is a viable teaching tool for Principle of Architectural Design and Drawing since it affords the teachers opportunity to engage students in real world of design and drawing while it enables students to develop valuable thinking skills in design and drawing.

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

- ✓ Teachers of Principle of Architectural Design and Drawing should adopt the use of Autodesk Revit to teach Principle of Architectural Design and Drawing.
- ✓ National Board for Technical Education (NBTE) should place emphasis on the use of Autodesk Revit as a training tool for Higher National Diploma students in Principle of Architectural Design and Drawing
- ✓ There should be regular Workshops, seminars and conferences organized for teachers who teach Principle of Architectural Design and Drawing to improve their knowledge and skills on the use of Autodesk Revit for improving students' achievement.

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