

Differential Effect of Prior Knowledge of Manual Technical Drawing on Academic Achievement of South-East, Nigeria Colleges of Education (Technical) Students in AutoCAD

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Abstract: The study investigated the Differential Effect of Prior Knowledge of Manual Technical Drawing on Academic Achievement on Colleges of Education (Technical) Students in AutoCAD. The design of the study was a quasi-experimental research design. The study was carried out in South-East, Nigeria. The population for the study was 122 NCE students of technical education. Federal College of Education (Technical), Umunze in Anambra State and Enugu State College of Education (Technical) were used for the study. The population of the study was manageable; there was no sample and sampling technique. The instrument for data collection was AutoCAD achievement test (AAT). The AutoCAD achievement test has three versions: pre-test, post-test and retention test, which were the same except for the reshuffling and swapping of the questions and options of the 60 questions used for the study. The AutoCAD achievement test was subjected to face and content validation. The reliability using Kuder Richardson (K-R 20) was 0.79. The scores for the pre-test, post-test and retention test were analyzed using mean with standard deviation and ANCOVA. The major findings of the study were that prior knowledge of manual technical drawing increases the academic achievement and retention of colleges of education (technical) students in the study of AutoCAD. Based on the findings it was recommended that manual technical drawing should be a prerequisite course to AutoCAD in colleges of education (technical) in Nigeria.

Keywords: Manual Technical Drawing, Prior Knowledge, Academic Achievement, AutoCAD

1. Introduction

Manual technical drawing is an important discipline in technical education. It is the art and discipline of composing drawing that visually communicate how something functions or is to be constructed [13]. It is essential for communicating ideas among technical professionals in manufacturing and production industries [17]. In the effort to make manual technical drawing easier to understand, familiar symbols,

perspectives, units of measurement, notation systems, visual styles and page layout are used. Technical conventions constitute a visual language and help to ensure that the drawing is unambiguous and relatively easy to understand [21]. These drawing conventions are condensed into internationally accepted standards and specifications that transcend the barrier of language. According to Mott, technical drawing is a universal means of communicating complex technical concepts.

Manual technical drawing is a standard representation of

an object to be created. It is more than just a means of representation of an object. It is a fundamental concept of technical thought. It is a tool of individual creativity. Technical drawing is a means of expressing the 'mind's eye of technical people' [11]. Technical professional through technical drawing have determined the kind of world to live in. Pyramids, cathedrals and rockets exist because they were first picture in the mind of those who built them and they were able to sketch the drawing technically. In Colleges of Education (Technical), manual technical drawing is one of the core courses which students in school of technical education should study [29]. It is essential for communicating ideas among technical teachers and students in colleges of Education (Technical) [14]. It is 'technical teachers' universal medium of expression and communication [26]. Its prior knowledge is important [20].

Prior knowledge is what one already knows that may help the person to learn more. It is an important factor in learning [18]. Prior knowledge may make it easier for one to learn new things because of how human brain works [12]. When one learns, one connects new learning to what one already knows in one's brain, forming something like a bridge between the old and the new; that bridge or connection may makes learning easier [10]. Prior knowledge does not mean that one has known all about a topic or course in order not to learn more [30]. It may facilitate and make it easier to learn and absorb new information [8]. It may enhance retention. It may help what one has learnt to go into one's long term memory. When one remembers what one has learnt, one could be able to use it in settings outside the classrooms.

Prior knowledge is the knowledge available to the learner before new learning task begins. Interacting with the students in the classroom with prior knowledge before the commencement of a lesson may give the students direction on what the learning activities permit. It helps the students to study more effectively [2]. It reduces the time wasted in irrelevant materials [7]. Carefully designed and properly prepared introductory activities based on prior knowledge may contribute to bridge the gap between what had been learnt and what to be learnt subsequently [9]. It may make learning effective and promotes academic achievement [15].

Academic achievement is defined as measurable behavior in a standardized series of tests [5]. Achievement test is usually constructed and standardized to measure proficiency in school subject. It is the act of finishing an academic programme successfully [24]. It is the accomplishment and realization of academic goals [28]. Educational achievement is measured by standardized achievement test developed for school subject [23]. Academic achievement is measured in relation to what is attained at the end of a course since it is the accomplishment of medium or long term object of education. It is regarded as action of completing or attaining by exertion [1]. It is commonly measured by examinations or continuous assessment [25]. It helps to measure AutoCAD comprehension.

AutoCAD simply means Automated Computer Aided

Design. It is a drawing application intended at a command line [19]. It is software used to make drawing easy and reduces error. The two major tools in AutoCAD are the basic drawing tool and the basic modifying tool. AutoCAD is user friendly. It saves time. It has the advantages of ease of accuracy. Representation of drawing in AutoCAD is easy, rapid and reliable. It gives room for revision and modification. It is significantly faster than the traditional method of drafting.

1.1. Statement of the Problem

The issue of poor academic achievement in technical drawing courses like the use of AutoCAD in Colleges of Education (Technical) was glaring and worrisome [4]. It seems like lack of good foundation in manual technical drawing, contributes to the poor performance in Colleges of Education (Technical) students in AutoCAD [22]. The worry of the researchers was that students of Colleges of Education (Technical) in the South-East, Nigeria perform poorly in AutoCAD. They find it very hard to use AutoCAD to solve real drawing problems. It then became necessary to find out whether prior knowledge of manual technical drawing has any differential effect in the academic achievement and retention of students of Colleges of Education (Technical) in AutoCAD using AutoCAD Achievement Test (AAT). The problem of the study therefore, is what is the "Differential effect of prior knowledge of manual technical drawing on colleges of education (technical) students' academic achievement and retention in AutoCAD".

1.2. Purpose of the Study

The purpose of the study was to determine the differential effect of prior knowledge of manual technical drawing on academic achievement and retention of colleges of education (technical) students in AutoCAD in the South-East, Nigeria. Specifically, the study sought to determine:

- 1) the mean achievement scores of students of Colleges of Education (Technical) with prior knowledge and those without prior knowledge of manual technical drawing in AutoCAD.
- 2) the mean retention scores of students of Colleges of Education (Technical) with prior knowledge and those without prior knowledge of Manual technical drawing in AutoCAD.
- 3) the mean achievement scores of male and female students of Colleges of Education (Technical) with prior knowledge and those without prior knowledge of manual technical drawing in AutoCAD.

1.3. Research Questions

The following research questions guided the study.

What are the mean achievement scores of students of Colleges of Education (Technical) with prior knowledge and those without prior knowledge of manual technical drawing in AutoCAD?

What are the mean retention scores of students of Colleges

of Education (Technical) with prior knowledge and those without prior knowledge of manual technical drawing in AutoCAD?

What are the mean achievement scores of male and female students with Prior Knowledge and those without Prior Knowledge of manual Technical Drawing on their academic achievement in AutoCAD?

1.4. Null Hypotheses

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

Ho1: There is no significant difference between the mean achievement scores of students of Colleges of Education (Technical) with prior knowledge and those without prior knowledge of manual technical drawing in AutoCAD.

Ho2: There is no significant difference between the mean retention scores of students of College of Education (Technical) with prior knowledge and those without prior knowledge of manual technical drawing in AutoCAD.

Ho3: There is no significant difference between the mean achievement scores of male and female students with prior knowledge and those without prior of manual technical drawing on their academic achievement in AutoCAD.

2. Methodology

The design of the study was a quasi-experimental research design which involves the use of two comparable groups: experimental and non-experimental [16]. Quasi-experimental research design can be used to identify confidently the cause of any given effect [27]. The experimental design used non-equivalent control groups involving pre-test, post-test design and retention test.

2.1. Area of the Study

The study was conducted in the South-East, Nigeria. Federal College of Education (Technical) Umuze in Anambra State and Enugu State College of Education (Technical), Enugu were used for the study. Technology education has received a wider acceptance in their educational system [6].

2.2. Population for the Study

Population for the study was 122 students (112 males and 10 females) of NCE (T) year one. Eighty-seven of them (82 males and 5 females) studied manual technical drawing before entering College of Education and thirty-five (30 males and 5 females) did not study manual technical drawing. The population comprised 87 students (81 males and 6 females) from Federal College of Education (Technical) Umuze, Anambra State and 35 students (31 males and 4 females) from Enugu State College of Education (Technical), Enugu all in the South-East, Nigeria, (*Source: students data-bank from office of the Heads of Departments of Technical Education FCOE (T), Umuze and ESCET, Enugu*).

2.3. Sample and Sampling Techniques

The entire population of 122 students was used for the study. There was no sampling because the population was manageable.

2.4. Instruments for Data Collection

The instruments used by the researchers for data collection was AutoCAD Achievement Test (AAT) developed by the researchers. The AAT was administered as pre-test, post-test and retention in different forms. The post-test was different from pre-test by reshuffling and swapping. The retention test was different from pre-test and post-test also by reshuffling and swapping. The AAT was a 60-item instrument of multiple choice questions with four response option A –D. The multiple choice items were drawn using the table of specification covering the content areas used for the study.

2.5. Validation of the Instrument

The AutoCAD Achievement Test (AAT) was subjected to face and content validations. Three experts from University of Nigeria, Nsukka validated the instrument. The validators' comments, corrections and contributions formed the basis for modifying the items.

2.6. Reliability of the Instrument

The AutoCAD Achievement Test instrument was subjected to trial testing on students to ascertain the reliability of the instruments. The reliability study was at Federal College of Education (Technical) Asaba in Delta State, Nigeria. The internal reliability co-efficient of the instrument was computed using Kuder Richardson formula 20 (K-R 20). The reliability co-efficient of 0.78 was obtained. This showed that the instrument was reliable.

2.7. Experimental Procedure/Administration of Instrument

The following procedures were adopted in the administration of the instruments.

a) Pre-Test Session

Before the treatment a pre-AAT was administered on the students by the researchers.

b) Post-Test Session

After the treatment, the post-AAT was administered on the students.

c) The Retention Test

Two weeks after the post-AAT, the retention test was administered on the students.

2.8. Method of Data Collection

One hundred and twenty-two pre-AAT copies of the instrument were administered on students before the treatment which lasted for six weeks. At the end of the treatment, a post-AAT was administered. The scores for the experimental and control groups were recorded accordingly. The experimental group was the students who

studied manual technical drawing in the Technical College up to SS 3 before entering College of Education (Technical), while the control group was the students who did not study manual technical drawing before entering College of Education (Technical). The main treatment for the study was teaching of the selected topics. The test items in pre-test, post-test and retention test were score one mark each for correct answer and zero mark for a wrong answer. The maximum mark was 60 while the lowest mark was one.

2.9. Method of Data Analysis

Data collected for the study were analyzed using mean with standard deviation to answer all the two research questions. Analysis of covariance (ANCOVA) was used to test the two hypotheses at 0.05 level of significance.

Table 1. Mean Achievement Scores and Standard Deviation of Students with Prior Knowledge and Those without Prior Knowledge of Manual Technical Drawing in AutoCAD.

Group	N	Pre-Test		Post-Test		Mean Gain
		Mean	SD	Mean	SD	
Experimental	82	9.96	1.44	10.28	1.47	0.32
Control	40	6.40	0.58	9.65	0.91	0.25

The data present in Table 1 shows that the mean achievement scores of the experimental group in pre-test and post-test were 9.96 and 10.28 respectively with mean gain of 0.32. On the other hand, the mean achievement score of the control group in pre-test and post-test were 6.40 and 9.65 respectively with mean gain of 0.25. The experimental group achieved higher than the control group.

Table 2. ANCOVA for the test of Significant Difference between the Mean Achievement Scores of Students with Prior Knowledge and those without Prior Knowledge of Manual Technical Drawing in AutoCAD.

Source of variation	Sum of square	Df	Mean square	F	Sig.
Corrected Model	39.554	2	19.777	13.286	.000
Intercept	103.145	1	103.145	69.295	.000
Pre	28.970	1	28.970	19.462	.000
Group	2.857	1	2.857	1.919	.169
Error	177.131	119	1.488		
Total	12592.313	122			
Corrected Total	216.685	121			

The data present in Table 2 shows that the calculated F-value for the group with prior knowledge of manual technical drawing on academic achievement in AutoCAD was 1.919 with 0.169 level of significance thus, the null hypothesis of no difference between mean achievement score of students with prior knowledge of technical drawing and those without prior knowledge of manual technical drawing in AutoCAD was accepted. Therefore there is no significant difference between the mean achievement scores of students with prior

2.10. Decision Rule

If the calculated probability (significant) value is less than 0.05 significant level the null hypothesis was rejected, but if it is equal or greater than 0.05, the null hypothesis was accepted.

3. Results

Data for the study were presented and analyzed based on the research questions and the hypotheses that guided the study. The details are contained in tables 1-4.

3.1. Research Question One

What are the mean achievement scores of students with prior knowledge and those without prior knowledge of manual technical drawing in AutoCAD?

3.2. Null Hypotheses One

There is no significant difference between the mean achievement scores of students with prior knowledge and those without prior knowledge of manual technical drawing in AutoCAD.

knowledge and those without prior knowledge of manual technical drawing in AutoCAD.

3.3. Research Question Two

What are the mean retention scores of students with prior knowledge and those without prior knowledge of manual technical drawing in AutoCAD?

Table 3. Mean Retention Scores and Standard Deviation of Students with Prior Knowledge and Those without Prior Knowledge of manual Technical Drawing in AutoCAD.

Group	N	Post-test		Retention		Mean gain
		Mean	SD	Mean	SD	
Experimental	82	10.28	1.47	14.09	0.98	3.81
Control	40	6.65	0.91	9.43	0.66	2.75

The data present in Table 3 shows that the mean achievement score of the experimental group for retention was 14.09 with mean gain of 3.81, while the mean achievement score of the control group for retention was 9.43 with mean gain of 2.75, therefore the experimental group achieved more than the control group. The experimental group retained more than the control group.

Table 4. ANCOVA for the test for Significant Difference between the Mean Retention Scores of Students with Prior Knowledge and Those without Prior Knowledge of Manual Technical Drawing in AutoCAD.

Source of variation	Sum of square	Df	Mean square	F	Sig.
Corrected Model	25.314	2	12.657	13.286	.000
Intercept	66.013	1	66.013	69.295	.000
Pre	18.541	1	18.541	19.462	.000
Group	1.829	1	1.829	1.919	.169
Error	113.364	119	1.953		
Total	8059.080	122			
Corrected Total	138.678	121			

The data present in Table 4 shows that the calculated F-value for the students with prior knowledge of technical drawing on academic achievement in AutoCAD was 1.919 with 0.169 level of significance thus, the null hypothesis of no difference between mean retention scores of students with prior knowledge and those without prior knowledge of manual technical drawing in AutoCAD was accepted.

3.4. Null Hypotheses Two

There is no significant difference between the mean retention scores of students with prior knowledge and those without prior knowledge of manual technical drawing in AutoCAD.

3.5. Research Question Three

What are the mean achievement scores of male and female students with Prior Knowledge and those without Prior Knowledge of manual Technical Drawing on their academic achievement in AutoCAD?

Table 5. The Mean Achievement Scores and Standard Deviation of Male and Female Students with Prior Knowledge and Those without prior knowledge of manual technical drawing on their Academic Achievement in AutoCAD.

Group	Gender	N	Pre-Test		Post-Test		Mean Gain
			Mean	SD	Mean	SD	
Experimental	Male	76	8.12	1.06	10.37	1.08	2.25
	Female	6	6.03	0.60	8.33	0.31	2.30
Control	Male	36	5.76	0.48	7.82	0.70	2.06
	Female	4	5.80	0.23	6.85	0.10	1.05

The data present in Table 5 shows that the mean achievement score of the experimental group (male) for pre-test and post-test are 8.12 and 10.37 respectively with mean gain of 2.25 and experimental group (female) are 6.03 and 8.33 respectively with mean gain of 2.30. The mean achievement score of the control group (male) for pre-test and post-test are 5.76 and 7.82 respectively with mean gain of 2.06 and control group (female) are 5.80 and 6.85 respectively with mean gain of 1.05. The experimental group achieved more when compared to the control group.

Therefore those with prior knowledge of manual technical drawing achieved more that those without prior knowledge.

3.6. Null Hypotheses Three

There is no significant difference between the mean achievement scores of male and female students with prior knowledge and those without prior of manual technical drawing on their academic achievement in AutoCAD.

Table 6. ANCOVA for the test for Significant Difference between the Mean Achievement Scores of Male and Female Students with Prior Knowledge and Those without Prior Knowledge of Manual Technical Drawing on their Academic Achievement in AutoCAD.

Source of variation	Sum of square	Df	Mean square	F	Sig.
Corrected Model	842.325	2	421.167	17.118	.000
Intercept	908.728	1	908.728	36.935	.000
Pre	265.055	1	265.055	10.773	.000
Group	180.499	1	180.499	7.336	.169
Error	1943.687	79	24.608		
Total	141367.000	82			
Corrected Total	86.012.685	81			

The data present in Table 6 shows that the calculated F-value for the group with prior knowledge of manual technical

drawing on academic achievement in AutoCAD was 7.336 with 0.169 level of significance thus, the null hypothesis of

no difference between mean achievement score of students with prior knowledge of manual technical drawing and those without prior knowledge of manual technical drawing in AutoCAD was accepted. The null hypothesis was accepted.

The findings of the study were discussed according to the three research questions and three null hypotheses that guided the study. The findings on research question one showed that the experimental group who had prior knowledge of manual technical drawing had a higher mean achievement score than the control group. The pre-test and post-test mean achievement scores of the experimental group were higher than that of the control group. Also the mean gain of the experimental group was higher than the control group. The finding suggested that prior knowledge of manual technical drawing had a positive effect on student academic achievement in AutoCAD. The findings were in consonance with study conducted by Pinky who indicated that prior knowledge helped learners to understand and retain new concepts [27].

The result of hypothesis 1 indicated that there was no significant difference between the mean achievement scores of students with prior knowledge and those without prior knowledge. The result showed that the calculated F-value for the experimental group was 1.919 with 0.169 level of significance. The calculated probability was greater than 0.05. The null hypothesis was accepted. Therefore there is no significant difference between the mean achievement scores of students with prior knowledge and those without prior knowledge of manual technical drawing in AutoCAD academic achievement.

The result from research question two showed that the students in the experimental group had higher mean retention score than the students in control group. The experimental group had a mean retention score of 14.09 and mean gain of 3.81, while the control group had a retention score of 9.43 and mean gain of 2.75. The experimental group had better mean retention score than their counterpart - the control group. That meant that the experimental group retained more than the control group.

Hypothesis two tested indicated that there was no significant difference between the mean retention scores of students with prior knowledge and those without prior knowledge of manual technical drawing in AutoCAD academic achievement. The calculated probability was 0.169 which was greater than 0.05. The null hypothesis was accepted. Therefore there is no significant difference between the mean retention scores of students with prior knowledge and those without prior knowledge of technical drawing in AutoCAD academic achievement.

The findings on research question three showed that the experimental group who had prior knowledge of manual technical drawing had a higher mean achievement score than the control group. The pre-test and post-test mean achievement scores of the experimental group were higher than that of the control group. Also the mean gain of the experimental group was higher than the control group. The finding suggested that prior knowledge of manual technical drawing had a positive effect on male and female students'

academic achievement in AutoCAD.

The result of hypothesis 3 indicated that there was no significant difference between the mean achievement scores of male and female students with prior knowledge and those without prior knowledge. The result showed that the calculated F-value for the experimental group was 1.919 with 0.169 level of significance. The calculated probability was greater than 0.05. The null hypothesis was accepted. Therefore there is no significant difference between the mean achievement scores of male and female students with prior knowledge and those without prior knowledge of manual technical drawing in AutoCAD academic achievement.

4. Conclusion

The conclusion was made based on the findings of the study. The result of the study provided empirical evidence that prior knowledge of manual technical drawing enhanced students' academic achievement in AutoCAD. The study showed that students with prior knowledge had a better academic achievement in AutoCAD when compared with those without prior knowledge of manual technical drawing. Prior knowledge of manual technical drawing leads the students to a better understanding of AutoCAD. The findings of the study showed that prior knowledge of manual technical drawing is effective for a better retention and hence a better academic performance in AutoCAD. The findings also showed that there was no significant difference between the mean achievement and retention scores of students with prior knowledge and those without prior knowledge of manual technical drawing in AutoCAD.

5. Recommendations

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

- 1) Manual technical drawing should be a prerequisite course to AutoCAD in Nigerian colleges of education (technical).
- 2) The Ministries of Education at all levels should liaise with the government to provide the necessary infrastructures and equipment that can facilitate teaching and learning of manual technical drawing and AutoCAD.
- 3) Education administrators and professional bodies in technical and vocational courses should organize seminars and workshops regularly on the effect of prior knowledge to academic achievement.

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