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Effect of Cognitive Apprenticeship Instructional Method on Students' Skill Achievement, Problem-Solving and Retention in Metalwork Technology in Technical Colleges

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Abstract—**The poor performance of students in technical colleges in Nigeria has been a major concern to researchers. It is believed that the use of effective instructional method in technical colleges will enhance students' achievement. This demands that teachers in technical colleges would adopt instructional methods that would improve the academic performance of students in metalwork technology in technical colleges. The study investigated the effect of cognitive apprenticeship instructional method on students' skill achievement, problem-solving and retention in metalwork technology in technical colleges in Delta State. Three research questions guided the study and three null hypotheses were tested at 0.05 level of significance. The study adopted the quasi-experimental research design. Specifically, the pre-test post-test non-equivalent control group experimental design was used. Population of the study was 246 vocational II metalwork students in the six technical colleges in Delta State. A sample of 113 was used for the study. Instrument for data collection was Metalwork Achievement Practical Test (MAPT). The instruments was validated by three experts (two from the Department of Technology and Vocational Education and one from Measurement and Evaluation Unit of the Department of Educational Foundation all in Nnamdi Azikiwe University Awka. The reliability coefficient of Metalwork Achievement Practical Test (MAPT) was established using Kunder Richardson 20 Formula and the reliability coefficients of 0.78 was obtained. Arithmetic mean was used to analyze data relating to research questions, while analysis of covariance ANCOVA was used to test the null hypotheses. Findings revealed that students taught metalwork technology using cognitive apprenticeship instructional method had better accomplishment, possessed better problems solving skills and retained better than those taught with lecture-demonstration teaching method. Conclusion was drawn that cognitive apprenticeship instructional method is an innovative and effective mode of instruction with aptitude to improve students' learning outcome. Consequently, it was recommended among others that technical teachers should use cognitive apprenticeship instructional method in teaching metalwork trade so as to enhance students' achievement, problem solving skills and knowledge retention in technical colleges.**

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***Index Terms*— Cognitive Apprenticeship Instructional Method, Skill Achievement, Problem-Solving, Retention, Metalwork Technology and Technical Colleges.**

I. INTRODUCTION

The ability of Nigeria to realize the vision of becoming one of the twenty largest economies in the world is largely dependent on her capacity to transform her youth into highly skilled and competent citizens capable of competing globally (Eneh, 2011). The major part of the responsibility for preparing such a workforce rests on the nation's education sector. Therefore, to realize this vision and in order to be competitive in the global economy, Nigeria needs to develop the appropriate knowledge and skills Federal Republic of Nigeria, (FRN 2013). Technical education is the foundation of nations' wealth and development. It is a type of education that is meant to produce semi-skilled, skilled and technical manpower necessary to restore, re-vitalize, energize, operate and sustain the national economy and substantially reduce unemployment (Ogumbe, 2015). Technical Education is a form of education involving in addition to general education the study of technologies and related sciences and the acquisition of practical skills, attitudes, understanding and knowledge relating to occupations in various sectors of the economic and social life. Technical education is an aspect of education that leads to acquisition of practical and applied skills as well as basic scientific knowledge through training.

The goals of Technical Vocational Education and Training (TVET) as contained in National Policy on Education (FRN, 2013) are as follows: to provide trained manpower in applied science, technology and business particularly at craft, advanced craft and technical level; provide technical knowledge and vocational skill necessary for agricultural, commercial and economic development, give training and impart the necessary skills to individual for self-reliance economically. The above stated goals of TVET are expected to be achieved after technical education recipients undergo and receive proper training

Engineering trade is one of the Technical Vocational Education and Training (TVET) programmes offered in technical colleges for the purpose of producing craft skilled manpower required for the Nigeria's economic and technological development. Technical college is the post basic school level of vocational education system in Nigeria, which was established to produce craftsmen and master craftsmen. Technical college programme was to prepare students for entry into various occupations. In technical colleges, students are trained to acquire relevant knowledge and skills in different occupations for gainful employment. According to Federal Republic of Nigerian, (FRN, 2013), the students of technical colleges upon graduation are expected to either be employable in the industry or be self-employed. In order to achieve this goal, technical college curriculum was split into different trades with corresponding modules so as to enable learners choose and accomplish trade of their interest successfully. Technical colleges offer the following programmes; block laying, bricklaying and concreting; carpentry and joinery; electrical/electronic; fabrication/welding, mechanical engineering craft practice, automobile and metalwork.

Metalwork is a practical process of transforming metals to form various shapes and sizes, parts, assemblies, or large-scale structures Lkama, and Dabo, (2019). Metalwork technology in the technical colleges is a subject that is aimed at studying the technical competencies in trade-related areas which include welding and fabrication, foundry and forging and machine shop practice. Fabrication pertains to working with sheet metals to produce articles like funnels, watering cans and containers of beverages. Welding deals with the joining of two or more metals together with the aid of heat and welding rod. Foundry concerns with melting and casting of metals into different shapes and sizes. Also, it is the art and act of using metals to produce useful products. Metalwork technology according to the Federal of Government Nigeria FGN, (2013), is a vocational subject offered at the senior secondary schools and technical colleges' level for the purpose of enabling students to acquire further knowledge and develop skills. Metalwork technology according to Okoye, (2018) refers to activities of using metals or metal based materials for the purpose of fabrication, construction and other associated project and design activities. The technical college metalwork curriculum is designed to meet requirements necessary to prepare students for employment, self-reliance and/or entrepreneurial ventures (Mustapha, 2012). It exposes students to career opportunity by exploring usable options in the world of work, and enable youths to have an intelligent understanding of the increasing complexity of technology. There is hardly any human activity where metalwork technology has not made impact. The achievement of the above stated objectives would depend on the mode of instruction and motivation of students learning metalwork in technical colleges.

According to United Nation Education Scientific and Cultural Organization, UNESCO (2001), on completion of metalwork module in technical colleges, the students should be able to; (i) Understand workshop safety rules and their application in handling and using hand tools, portable power tools and machine tools. (ii)Understand the physical properties, manufacturing process and application of ferrous and nonferrous metals in common use. (ii) Select and use common measuring, marking out, cutting and striking tools and (iv) Understand the basic working principles of drilling machine and be able to use it for various types of screws treads rivets, and be able to rivet and cut screws by hand. Also, understand the application of various types of screw threads and rivets, and be able to rivet and cut screws by hand. (v)Understand the ISO system of tolerances and fits, and their application in engineering production. (vi). Produce simple engineering components using mild steel and casting process. Additionally, (vii). Understand the essential features and working principles of the lathes, sharpening and milling and carry out basic operations such as turning, stepped turning facing, taper turning, knurling, chamfering and undercutting. The success in understanding and acquiring the above mentioned contents depend on the effectiveness of instructional method. The use of varieties of teaching methods is a must for teachers if learning is to be effective and efficient, and hence there is need for teachers to be multi-talented in other to be conversant with the use of various teaching methods in the teaching and learning process (Dorgu, 2015). Lkama, and Dabo, (2019), contrary to this speculation stated that, most of teachers in technical college are becoming addicted to use of particular teaching method particularly lecture-demonstration teaching method.

Lecture-demonstration teaching method (L/DTM) is known as the traditional talk-chalk method of teaching. Here the teacher does the talking while students serve as receiver only by listening and taking down notes. Eze and Osuyi (2018) described lecture-demonstration teaching method as the type of teaching method in which the teacher is the principal actor while the learners watch with the intention to act later. In the same vein, Odundo and Gunga (2013) outlined the advantages some L-DTM of teaching and learning to include; teachers covering a lot of grounds in a single class period, dissemination of large quantity of information to students in a short period of time, and non-use of any equipment and laboratory. In addition, the method enable provision of quality learning materials by the teacher, encourages self-discovery learning and develops, students listening and communication skills.

Despite the outlined benefits of L-DTM, it has several shortcomings, it shows no regard for individual differences among learners and does not provide opportunity for adequate class participation in the teaching and learning process. As a result, students learn comparatively little of what has been taught as they only hear and see the teacher. In most cases, the students are passive and boredom is easily associated with the method. Therefore, the continual use of L-DTM in Nigerian schools reduces the ability of students to grasp relevant concepts (Mba, 2012). It causes dissatisfaction, inadequate knowledge development, low interest and high dependency of students on teachers. This is a challenge which necessitates the investigation of the use of alternative instructional method like the cognitive apprenticeship instructional method (CAIM).

A cognitive apprenticeship is a trade apprenticeship and learning takes place as experts (teacher or more knowledgeable peer) and novices interact socially though focused on completing a task; the focus, as implied in the name, is on developing cognitive skills through participating in authentic learning experiences. Cognitive means relating to the mental process involved in knowing, learning, and understanding things. Apprenticeship involves learning a physical, tangible activity. In apprenticeship, the processes of the activity are visible. In schooling, the processes of thinking are often invisible to both the students and the teacher. Cognitive apprenticeship therefore is a model of instruction that works to make thinking visible. Collins, Brown, and Newman, (1989) briefly define cognitive apprenticeship as learning-through-guided-experience on cognitive and metacognitive, rather than physical, skills and processes. Core to cognitive apprenticeship as a method of learning are the concepts of situational and legitimate peripheral participation Vansessa and Kerry (2014). Situated learning occurs through active participation in an authentic setting, founded on the belief that this engagement fosters relevant, transferable learning much more than traditional information-dissemination methods of learning. However, it is more than just learning by doing; situated learning requires a deeper embedding within an authentic context. This situational is a key component of the learning environment and thus needs to be considered in a cognitive apprenticeship

Cognitive apprenticeship is an instructional innovation which was introduced to address the problem of inert knowledge Cooper and Eric (2015). The term underscores the importance of activity in learning and highlights the situated nature of learning. In cognitive apprenticeship instructional method, the teacher often model strategies for students. Then, the teacher or more skilled peer support students' effort in doing the task. Finally, students are encouraged to continue their work independently. Consider, for instance, the tailors' apprentices, whose involvement starts with both initial preparations for the tailors' daily labour and finishing details on completed garments. The apprentices progressively move backward through the production process to cutting jobs. Under these circumstances, the initial circumferential perspective, running errands, delivering messages, or accompanying others, takes new significance. It provides a first approximation to an armature of the structure of the community of practice.

Essentially, the apprentices are learning about both the overall process of the larger task and profession and criteria for evaluating performance through the completion of small tasks. As they gain experience, they are offered larger, more central tasks to complete. Their understanding of how these tasks affect the end product in a holistic manner supports their performance, as does their knowledge of the criteria that will be used to assess the end product.

Teaching and learning through cognitive apprenticeship requires making implicit processes visible to learners so they can observe and then practice them (Collins, Brown, & Newman, 1989).

Furthermore, Collins, Brown, and Newman developed six teaching methods - modelling, coaching, scaffolding, articulation, reflection and exploration. These methods enable students to cognitive and metacognitive strategies for using, managing, and discovering knowledge. The following methods support the goals of cognitive apprenticeship theory. In modelling the instructor sets the example, demonstration of the temporal process of thinking. In explanation, the teacher explaining why activities take place as they do. In coaching, the monitoring of students' activities and assisting and supporting them where necessary. In scaffolding the instructors' support of students so that they can cope with the task situation. The strategy also entails the gradual withdrawal of teacher from the process, when the students can manage on their own. In reflection the student evaluates and analyses his performance. In articulation the results of reflection are put into verbal form. Also, in explorations the students are encouraged to form hypotheses, to test them, and to find new ideas and viewpoints. (Enkenberg, 2001). No matter which aspect of the cognitive apprenticeship instructional method component that is used, students will ultimately have to practice the task on their own after practicing with the teacher, using materials clearly provided by the teacher and imitating the teacher's actions to complete the task themselves. What seems to be unique in this method according to Igboko and Ibejime, (2016) is that it sufficiently enables the learner to concretize phenomena through personal interpretation of experience which could enhance their practical skill achievement.

Skill achievement refer to goal-directed actions that are observable as small units of engagement in daily life occupations, such as motor skills, process skills, and social interaction skills Tella,(2010). Amaechi, and Thompson, (2016) defined achievement test as the type of mental test in which the subject is asked to do something rather than to say something. Achievement test are used to assess the attainment of the objective in psychomotor domain (Okoro, 2008). The criteria for achievement of psychomotor outcome will relate to the actual performance or the finished product and to the necessary level of achievement. In view of the above, students' psychomotor achievement is the translation of the student's performance in practical test into scores or marks. This means that skill achievement measures the aspect of behaviour that can be observed at a specific period. Skill achievement involves relative judgments with individual differences evident; standards of excellence are important; comparable replication is involved; considerable periods of time are required to reach high levels of skill and then to improve. Major implications of these characteristics are considered from the perspectives of learners, teachers, and administrator. Skill may indeed contribute to achievement which could be as result of appropriate use of instructional method that enhance problem solving ability.

Problem-solving is a process that focusses on a problem. Jerome and Olalekan (2000) defined problem-solving as a skill that requires finding a solution that is unique and novel to identified problems. It is also the ability to adopt relevant techniques to handle the task at hand and to generate possible strategies to solve problems that are familiar. Problem–solving is also a process of finding answers or approaching solutions creativity Selvaratnan, (2007. This process requires the learners to be totally involved in the learning process. Also, Okoli (2010) defined problem–solving as the process of applying previously acquired knowledge to obtain a satisfactory solution to new and unfamiliar problem. Problem solving is a mental process that includes problem finding, problem shaping and problem–solving. It involves higher–order cognitive process that requires modulation. This means that students need to develop critical thinking abilities to be able to solve problems. Students apply critical and creative thinking skills to prior knowledge during the problem-solving process. The end result of problem-solving is typically some kind of decision, in other words, choosing a solution and then evaluating it. These types of problems require the ability to apply a variety of strategies and knowledge to finding a solution. The instructional method used by teachers, challenge students to work at higher intellectual level that would improve their problem-solving skills and retention of learning.

Retention of learning is simply the ability to remember what has been learnt. Eze, Ezenwafor, and Obidile (2016), stated that retention is the ability to retain the knowledge of what is learnt and to be able to recall it when it is required. Also, psychomotor retention scores indicate the percentage or degree of originally learned skill that is remembered or recalled as a function of elapsed time. This implies that a learner who repeats an acquired piece of knowledge with less error is said to have retained the material learnt. It is affected by degree of reinforcement, the method of learning. It is therefore seen as the achievement on a subject after a certain period of time. Ozden and Gultekin, (2008) contented that the use of appropriate instructional method could enhance students' retention. The assumption is that when effective instructional method is employed for instruction, it aids students to internalize what they have been taught in order to correctly and successfully remember and apply it on a later date. Since it is presumed by the researchers that cognitive apprenticeship instructional method could enhance students' learning, it is equally important to determine whether retention can be achieved which invariably enhance skill performance.

Presently**,** teaching and learning of technical subjects especially metalwork technology continue to suffer as a result of over dependence on lecture-demonstration teaching method alone. It is essential that technical education teachers devise alternative means by which knowledge and skills could be imparted to learners taking the advantage of cognitive teaching model. Hence the need to study cognitive apprenticeship teaching method on students' achievement, problem solving and retention in metalwork technology in technical colleges.

II. Statement of the Problem

Research findings have consistently indicated that metalwork is one of the perceived difficult trade subject by both teachers and students in technical colleges. The current trend in the teaching and learning of metalwork is where instructional materials for teaching and learning are not readily available in technical colleges' workshops. However, this make teaching and learning of metalwork very difficult and problematic making students learning it with tears which leads to sever failure and high drop level in the mechanical related trades. Federal Republic of Nigeria, (2014)in its National Policy on Education points out that the goals of technical education is to produce graduates who could secure employment in industries, pursue further education in advanced craft in a higher technical institution or set up their own business and become self-employed. To achieve this, government at all levels have made efforts to ensure qualitative education at the technical colleges and bring about high quality products both in academic and employability. Despite the huge investment by Nigerian government on technical colleges program aimed at improving the image and performance of technical college students, the performance of the students in metalwork has not been encouraging specifically in Delta state. One of the technical colleges in Delta state has the following performance in Metalwork NABTEB examination from 2017 to 2019. In 2017 only 65 students sat for the examination and 37 % passed while 63% failed; in 2018,only 38 students sat for the examination 40% passed and 60% failed; and in year 2019, only 39 students sat for the examination 47% passed and 53% failed. This indicates serious decline in academic performance in the subject This persistent poor performance has been partly ascribed to inadequate teaching and instructional methods adopted by technical teachers, and that is why NABTEB chief examiner in his report after May/June 2017 marking exercise suggested that technical teachers should consider alternative teaching methods in teaching technical subjects (NABTEB, 2017).There is considerable indication in the literature to show that metalwork instruction is predominantly based on lecture-demonstration to teach the concepts is ineffective. So it is obvious that the subject cannot thrive without appropriate instructional methods. The method being predominantly used for teaching in technical colleges according to Gerard and Eric (2011) though has its own advantages, seems not to be yielding the desired result in metalwork trade in technical colleges. This is because there is still persistent high failure rate among technical college students especially in metalwork trade. It is against this background and quest for better ways of effective teaching of metalwork technology and to enhance students' achievement that the researchers decided to embark on this study. Therefore; could this problem of persistent poor performance among metalwork technology students in technical colleges be enhanced by the use of Cognitive Apprenticeship Instructional Method (CAIM)?

III. Purpose of the Study

The purpose of the study was to determine the effect of cognitive apprenticeship instructional method (CAIM) on students' skill achievement, problem-solving and retention in metalwork technology in technical colleges. Specifically, the study determined:

1) The effect of CAIM on skill achievement mean scores of metalwork students in technical colleges taught with cognitive apprenticeship instructional method and those taught with L-DTM.
2) The effect of CAIM on problem-solving mean scores of metalwork students in technical colleges taught with cognitive apprenticeship instructional method and those taught with L-DTM.
3) The effect of CAIM on retention mean scores of metalwork students in technical colleges taught with cognitive apprenticeship instructional method and those

taught with L-DTM.

IV. Research Questions

The following research questions guided the study.

1) What are the effect of CAIM on skill achievement mean scores of metalwork students in technical colleges when they are taught with cognitive apprenticeship instructional method and when they are taught with L-DTM?

2) What rare the effect of CAIM on problem-solving mean scores of metalwork students in technical colleges taught with cognitive apprenticeship instructional method and those taught with L-DTM

3) What are the effect of CAIM on retention mean scores of metalwork students in technical colleges when they are taught with cognitive apprenticeship instructional method and when they are taught with L-DTM?

V. Null Hypotheses

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

1) There is no significant difference between the skill achievement mean scores of students taught metalwork using cognitive apprenticeship instructional method and those taught with the L-DTM.

2) There is no significant difference between the problem solving mean scores of students taught metalwork using cognitive apprenticeship instructional method and those taught with the L-DTM.

3) There is no significant difference between the retention mean scores of students taught metalwork using cognitive apprenticeship instructional method and those taught with the L-DTM.

Significance of the Study

The findings of this study revealed the effects of lecture-demonstration and cognitive apprenticeship instructional method on students' achievement problem-solving skills and retention in the teaching of metalwork. Therefore, the findings of this study would be of immense benefit to auto-mechanics teachers, metalwork students, curriculum planners, and educational researchers.

The findings of this study would guide the metalwork teachers in employing the effective method in order to enhance students' academic achievement, problem-solving and knowledge retention in metalwork. The findings of the study would guide the metalwork students on how to effectively use the method that appears to be effective in the teaching and learning of metalwork.

Also, curriculum planners would benefit from the findings of this study because it would help them to develop, and integrate effective teaching methods that could enhance students' academic achievement, problem-solving and retention ability. More so, knowledge of the finding of this study will not only enable the curriculum planner to recommend effective teaching methods, but also to plan, and conduct in-service training with regard to such method(s).

Finally, educational researchers would benefit from the findings of this study when carrying out similar research, and reviewing related literature. It would provide empirical data which could serve as a reference point for further research studies on the cognitive apprenticeship instructional method.

VI. Method

The study adopted the quasi-experimental research design. Specifically, the pre-test post-test non-equivalent control group experimental design was used. The study was conducted in the six technical colleges in Delta State**,** Nigeria. The population of this study was 264 vocational (VOC) II students studying metalwork (automobile and fabrication /welding technology) in all the six technical colleges in Delta State. The sample size of the study was 113 metalwork students. The purposive sampling technique was used to sample four schools from the six technical colleges that form the population. The instrument for data collection was Metalwork Achievement Practical Test (MAPT). The instrument was validated by three experts. Two of the experts were from the Department of Technology and Vocational Education and one expert from Measurement and Evaluation Unit of the Department of Educational Foundation all in Nnamdi Azikiwe University Awka. The reliability of the instrument was determined using Kuder–Richardson 20 (K-R20) formula and reliability coefficient of 0.75 was obtained.

Experimental Procedure

The researcher sought and obtained permission from the authorities concerned for the involvement of their colleges, teachers and students in the study. The study lasted for nine weeks (one week for pre-test and briefing of teachers involved, six weeks for treatment and two weeks extra for the retention test). The researcher used the first week to brief the teachers on the method to be used before the commencement of the experiment. After briefing the teachers involved in the exercise a pre-test was administered to both groups (experimental and control groups) by the regular metalwork teachers in the participating colleges to determine the initial abilities of the students prior to the experiment.

Teaching commenced on the second week and end on the seventh week. The teaching was conducted during the normal lesson periods of the schools using intact classes. The regular metalwork teachers taught their classes using the time-table of their various schools. The experimental group was taught using cognitive apprenticeship instructional method while the control group was taught using the lecturer-demonstration teaching method. The primary focus of the teaching process was concentrated on heat treatment/process, forging operations, tools and equipment use for forging operations, lathes machines operations/accessories and safety precautions when using lathes machines. Teaching for the experimental group was designed specifically to employ the CAIM elements.

The instructional activities were deliberately sequenced through modelling, coaching and scaffolding. Also consistent with the CAIM methods approach (as defined in this study), students in the experimental groups were systematically encouraged to engage in articulation, reflection and exploration during each teaching and learning experience by sharing ideas on areas of difficulties and defining problems to be solved.

At the end of the treatment, a post-test was administered to both groups using MAPT items by the metalwork teachers (research assistants). The exercise provided a post-test data for each of the dependent variables. The MAPT was administered as retention test after two weeks interval, but with the original test questions reshuffled. The researchers marked the students' responses of the test and statistically analysed the data.

The data collected was analysed using mean scores and analysis of covariance (ANCOVA). The mean was used to answer the research questions while Analysis of Covariance (ANCOVA) was used to test the null hypotheses at 0.05 level of significance. In the test of the null hypotheses using ANCOVA**,** when the p-value was less or equal to the level of significance (0.05), the null hypothesis was rejected**.** Also when the p-value was greater than the level of significance (0.05), the null hypothesis was not rejected.

VII. Results

Table 1

Mean and Standard Deviation for Pre-test and Post-test Skill Achievement Scores of Students

Skills Achievement

Groups		**Pre-test**		**Post test**		
	No	**Mean**	**S D.**	**Mean**	**SD.**	**Mean Gain**
Exp. Group	57	20.38	4.20	71.57	8.96	51.19
Control Group	56	19.13	3.72	44.70	6.33	25.57

Table 1 shows the mean and standard deviation of achievement scores of students in experimental and the control groups. The mean scores indicates that the experimental group had higher mean scores after pre-test. The mean gain for experimental group is 51.19 while that of the control group is 25.57. This shows that the experimental group achieved more than the control group.

Table 2

Mean and Standard Deviation for Pre-test and Post-test Problem-Solving Scores of Students

Problem Solving

Groups		**Pre-test**		**Post test**		
	No	**Mean**	**S D.**	**Mean**	**SD.**	**Mean Gain**
Exp. Group	57	28.38	5.20	77.59	9.06	59.21
Control Group	56	23.13	4.12	64.70	7.13	41.57

Table 2 shows that the mean and standard deviation of problem solving scores of students in experimental and the control groups. The mean scores indicated that the experimental group had higher mean scores after pre-test. The mean gain for experimental group is 59.21 while that of the control group is 41.57. This shows that the experimental group had requisite problem solving skills more than the control group.

Table 3: Mean and Standard Deviation for Retention Scores of Students

Groups		**Retention Scores**		
	No	**Mean**	**SD**	**Mean gain**
Experimental Group	57	74.27	2.70	29.38
Control Group	56	44.89	0.19	

Table 3 showed the mean and standard deviation of retention mean scores of students in experimental and the control groups. The mean scores indicated that the experimental group had higher retention scores. This shows that the experimental group retained what was taught them than those in control group.

Table 4: ANCOVA for Differences in Achievement of Students

Source	Type III Sum of Squares	Df	Mean Square	F	P-value
Corrected Model	20589.088a	2	10294.544	168.902	.000
Intercept	13799.495	1	13799.495	226.407	.000
Pretest	14.625	1	14.625	.240	.625
Method	19894.341	1	19894.341	326.405	.000
Error	6765.439	111	60.950		
Total	415738.000	113			No significant
Corrected Total	27354.526	112			

a. R Squared = .753 (Adjusted R Squared = .548)

Table 4 shows that there is significant main effect of treatment in the post test achievement of students in the experimental and control groups $F(1, 113) = 326.405$, $p < 0.05$. This means that there was significant difference in the mean achievement scores of students in the experimental group and the control group. The hypothesis that there is no significant mean difference in the achievement of students taught with cognitive apprenticeship instructional method and demonstration method is therefore rejected.

Table 5: ANCOVA for Differences in Retention Mean Scores of Students

Source	Type III Sum of Sq.	Df.	Mean Sq.	F	P-v
Corrected Model	25462.489[a]	2	12731.244	827.139	.000
Intercept	64.972	1	64.972	4.221	.042
Posttest	4625.066	1	4625.066	300.487	.000
Method	166.039	1	166.039	10.787	.001
Error	1708.502	111	15.392		
Total	359487.000	113			
Corrected Total	27170.991	112			

a. R Squared = .937 (Adjusted R Squared = .736)

Table 4 shows that there is significant main effect of treatment in the post test retention mean score of students in the experimental group and the control groups $F(1, 113) = 10.787$, $p < 0.05$. This means that there was significant difference in the mean retention scores of students in the experimental and control groups. The hypothesis that there is no significant difference in the retention mean scores of students in experimental and control group is therefore rejected.

VIII. Discussion of Results

The study revealed that students who were taught meter work technology using CAIM achieved higher post-test scores than those taught using lecture-demonstration teaching method. This could be as a result of activities that were incorporated in CAIM components, which may have strengthened the cognitive ability of the students. This result is in line with the findings of Tella, (2010), Migida, (2013) and which reported respectively that CAIM had significant effect on post-test achievement scores of students.

Also, the study revealed that students taught using CAIM retained better what they have learnt over a period of time than those taught with lecture-demonstration teaching method. This means that the CAIM used in teaching the students was significant on students' retention. This finding is in line with (Ozden & Gultekin, 2008), and Maigida, (2013)who found that, students who were taught using CAIM were able to retain the concepts than those students taught using lecture-demonstration teaching method. This could be as a result of activities and experiences involved in CAIM which made the students to develop their own knowledge meaning and retain the concept taught.

IX. Conclusion

The study found out that, the use of cognitive apprenticeship instructional method is more effective compared to lecture-demonstration teaching method in improving the skill achievement, problem-solving and retention ability of students in metalwork in technical colleges. Drawing from the findings of this study, it was concluded that for metalwork students to do well, cognitive apprenticeship method should be employed in teaching metalwork concepts. This will motivate and promote the interest of the students in terms of achieving good results. Moreover, based on this study, there is a need for metalwork teachers in the technical college to develop interest in using cognitive apprenticeship teaching method to teach metalwork related subjects.

X. Recommendations

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

1) Cognitive apprenticeship instructional method should be formally adopted as a method of instruction in technical colleges.

2) Teachers of meter work technology should acquire the

knowledge and skills for using cognitive apprenticeship instructional method through in-service training, conferences, seminars and workshops.

3) School administrators should encourage meter work teachers to use cognitive apprenticeship instructional method by providing opportunities for in-service training to equip them with competencies needed in it.

4) Education stakeholders and relevant professional associations such as Nigerian Association of Teachers of Technology (NATT), Association of Vocational and Technical Educators of Nigeria (AVTEN) should sponsor further research on the efficacy of cognitive apprenticeship instructional method on other technology subject areas so as to arrest the declining skill achievement of students in technical colleges.

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