IMPACT OF COGNITIVE APPRENTICESHIP TEACHING APPROACH ON THE ACADEMIC ACHIEVEMENT OF ELECTRICAL INSTALLATION WORKS STUDENTS' IN NIGER STATE

I. I. Izom[a], G. A. Usman[b], A. M. Abbas[c] and B. I. Nana[c]
a. Department of Electrical Engineering Technology,
Minna Institute of Technology and Innovation, Niger State
b. Department of Industrial And Technology Education,
Federal University of Technology, Minna, Niger State
c. Department of General Studies, Minna
Institute of Technology and Innovation, Niger State
*muminislam2012@gmail.com, 07030542036

Abstract
This paper is based on a work that was designed to study the impact of cognitive apprenticeship teaching method on the academic achievement of electrical installation work students' in selected technical colleges in Niger State,.The study adopted quasi-experimental design for data collection to find out the results. The sample size for this study was 96 TC II electrical installation work students. The sample size was made up of 74 male and 22 female year two students. Out of the six (6) technical colleges in Niger State, four (4) were selected for this study using a simple random sampling technique. Ttwo schools each of the sampled technical colleges were assigned to experimental and control groups. Electrical Installation Works Achievement test (EIWAT). EIWAT) was validated by experts in Electrical Installation Departments in non sampled schools. The reliability coefficient was determined using test-retest method and Pearson Product Moment Correlation formula was used to calculate the reliability coefficient which was fund to be 0.75. The scores obtained by both groups were analyzed Analysis of Covariance (ANCOVA) to determine their achievements. The in depth investigation of the findings obtained through this analyzed data revealed that the ***cognitive apprenticeship teaching method*** *had great impact on academic achievement of students. The results show that the cognitive apprenticeship instructional method increases the academic performance of electrical installation works students than those exposed to the lecture method. It was therefore, recommended that schools should intensify the use of cognitive apprenticeship teaching approaches in teaching student.*

Introduction

Electrical installation work is a fundamental subject of study in the fields of electricity and electronics at all levels of Technical Education (Ogbu, 2010). It deals with all the fundamental issues of basic electricity, domestic and industrial installations; cable jointing and battery charging as studied in schools and colleges. Electrical installation work is so important that students' academic performance in it is so crucial and major determinants of their performance in other electronics/electricity subjects. Meanwhile, according to the National Board for Technical Education, (2007) the goal of acquiring skills in Electrical Installation work is to produce competent hands with job knowledge and practical skills for a successful career in electrical installation work, so this demands ability, competence and value on the part of the instructional approaches in order for learners to achieve maximally in learning Electrical installation work (Collins & Brown, 2007). Even if schools have been comparatively victorious in organizing and passing on large bodies of theoretical and truthful knowledge, too little interest is paid to the reasoning and strategies that teachers employ when teaching the students how to solve compound or real life responsibilities.

The lecture method which is mostly used in teaching electrical installation works is based on the bahavioural learning theories which, according to Boyle, Duffy and Dunleavy, (2003), emphasize knowledge transmission from the teacher to passive students and encourage rote memorization of facts. The outcome of this is that the students are unable to retain their learning and to apply it to new situations. Limitation of the present teaching method, partly accounted for the poor performance of students in electrical installation works certificate examinations in recent years as reported by National Business and Technical Examination Board (NABTEB) 2015. The rising effect of globalization and the fast rate of technological revolution in the workplace have been acknowledged by UNESCO and ILO (2002) which states that all vocational and technical education (VTE) systems in this present century should be geared

towards lifelong learning. This requires that schools should, in addition to academic skill, inspire workplace skills such as resourcefulness, problem solving, mutual skills and higher order thinking skills in order to boost the student's flexibility and job mobility which will make them adjust to the present changes (Hallak & Poisson 2002). This is a challenge which requires a shift from the instructional approaches based on the behavioural learning theories to those rooted in constructivism education theories, one of which is the cognitive apprenticeship instructional technique.

According to Aziz (2003), Cognitive apprenticeship is a teaching method which was introduced to tackle the problem of inert knowledge. This method is based on the basic principle of learning and centered on the use of such tactic as modelling, coaching, scaffolding, articulation and exploration (Collins & Brown, 2007). He further explained that modelling deals with experts carrying out the task so that learner can watch; in this case the expert shows how a process unfolds and tells reason why it happens that way. It is important to integrate both the demonstration and the explanation during instruction because the learners need access to explanations as they observe details of the modelled achievement; Scaffolding is the help a teacher gives trainee in delivering a task; it involves problem solving by teacher and students with the intention that the students will assume increasingly more of the task on their own as soon as possible; Coaching: Observe students as they try to complete tasks and provide hints and helps when needed. This simply means reminding the students of some aspect of the task that is known but has been temporarily overlooked. The content of the coaching interaction is immediately related to specific attempts to accomplish the target task; Articulation: Includes any method of getting students to articulate their knowledge, reasoning or problem solving process. It is all about demonstrating the knowledge and cognitive processes involved in the task or processes the student is learning; Exploration involves pushing students into a manner of solving problem through exploration, students learn how to set achievable goals and to manage the pursuit of goals. They also learn to set and try out hypotheses and to seek knowledge independently; Reflection: It involves expert letting students compare their own diagnostic skills with theirs, accompanied with the vague replay in which significant features of specialist and student achievement are pointed out (Collins & Brown, 2007).

However, achievement means performance in a school subject as symbolized by a score or mark on a task (Momoh - Olle, 2002). It is affected by the level of learning, the manner of learning and the learners' recollection power among other factors (Demmert, 2001). Student's achievement in technical education, according to Inan, (2010) is the learning outcome of the student which includes knowledge and skills acquired and retained through a course of study within and outside the classroom condition. Academic achievement in electrical installation works is the excellence and degree of skills acquired and retained by students. Osulaa, (2001) remarked that achievement is dependent upon several factors among which are instructional techniques, the learning atmosphere, drive for stimulating students' curiosity in learning and ability of the students to preserve learning. Hence, this study is to assess the impact cognitive apprenticeship instructional approach has on the student's academic achievement on electrical installation works.

Research Questions

This study is guided with the following research questions:

1. What are the performance of students trained with the cognitive apprenticeship instructional technique and those taught with conventional method in domestic installation works?
2. What are the performances of students trained using cognitive apprenticeship instructional technique and those taught with conventional method in industrial installation works?
3. What are the performances of students trained using cognitive apprenticeship instructional technique and those taught using conventional method in cable jointing?

Research Design of the Study

The study adopted quasi-experimental design. The Quasi-experiment design is simply defined by Osuala, (2001) as not a true experimental design. Since the main component of a true experiment is randomly assigned groups, this means a quasi-experimental design does not have randomly assigned groups. A Quasi experimental design typically allows the researcher to control the assignment to the treatment condition, but using some criterion other than random assignment. The design is meant to carry a study in which the participants are studied before and after the experimental manipulation. This design was adopted because the quasi - experimental design would not disrupt the academic programme of the school involved in the study (Okoro, 2003).

The Study Area
The study area is Niger State which is bounded by Kogi State, Kaduna State, Kwara State, Kebbi State and Zamfara State. The area of this study will cover the six technical colleges owned by Niger state offering electrical installation works; these include, G.T.C, Minna, G.T.C, Eyagi, Bida, Mamman Kontagora Technical College, Pandogari, Suleiman Barau Technical College Suleja, Government G.T.C, New Busssa and G.T.C, Kontagora.

The Study Population
The population for the study comprised all the year two technical colleges (TC II) electrical installation works students in the six technical colleges in Niger State. The figure was obtained from the 2015/2016 academic session at the Niger State Science and Technical Schools Board, Minna.

Sample and Sampling Techniques
The sample size for this study was 96 TC II electrical installation work students. The sample size was made up of 74 male and 22 female year two electrical installation work students. Out of the six (6) technical colleges in Niger State, four (4) were selected for this study using a random sampling technique and randomly two schools each of the sampled technical colleges were assigned to experimental and control groups. The experimental group is G. T. C, Minna and G.T.C, Bida while the control group is Suleiman Barau Technical College, Suleja and G.T.C, Kontagora. Therefore, each of the experimental and control group consisted of 37 male and 11 female.

An Instrument used for Data Collection
The instrument used in this study to collect data was electrical installation works achievement test (EIWAT) items which consisted thirty (30) items; then 10 from each topic taught.

Method of Data Collection
The technical college electrical installation works class teachers of both experimental and control groups administered electrical installation works achievement test (EIWAT) as pre-test before the experiment and at the end of the experiment they also administered post-tests to the subjects. The researcher, marked the students answer sheets to obtain their scores on pre-test and post-test for both experimental and control groups as raw data. The scores obtained by both groups (experimental group and control group) in both tests would be analyzed to determine their achievements.

Experimental Procedure
A pre-test was first given, followed by the treatment, which last for four weeks. Both the control and experimental groups were taught three lessons with the conventional lesson plan and cognitive apprenticeship lesson plans respectively. The study was carried out during the normal school lesson hours by following the school timetable, different lesson plan provided by the researcher in each topic for the participating teachers, at the end of the treatment, a post-test was conducted on both groups with the electrical installation works achievement test (EIWAT) and the scores obtained from both groups were compared to determine if there is any significant difference in the achievement of the two groups.

Method of Data Analysis
Mean and standard deviation were used to answer the research questions while the research hypothesis was tested using analysis of covariance (ANCOVA) at 0.05 levels of significances

Results and Discussion
Research Question One
What are the performances of students taught domestic installation using cognitive apprenticeship instructional technique and those taught using a lecture method in domestic installation works?

Table 1: Mean and standard deviation of the pre-test and post-test scores of experimental and control groups .

			Pretest		Posttest	
Groups	**N**	**Instructional Method**	**X**	**SD**	**X**	**SD**
Experimental	48	Cognitive	5.63	0.98	9.48	0.77
Control	48	Lecture	4.50	0.71	5.08	1.16

The data in Table 1 indicate that the experimental group had a mean of 5.63 and a standard deviation of 0.98 in the pre-test and mean score of 9.48 and standard deviation of 0.77 in the post-test making the pre-test - post-test gain in the experimental group to be 3.85. The control group had a mean score of 4.50 and a standard deviation of 0.71 in the pre-test and a mean of 5.08 and standard deviation of 1.16 in the post-test, resulting in a gain of 0.58. This implies that the experimental group performed better than the control group in domestic installation work.

Research Question Two

What are the performances of students taught industrial installation with cognitive apprenticeship instructional approach and those taught by the lecture method in industrial installation works?

Table 2: Mean and standard deviation of pre-test and post-test scores of experimental and control groups.

Groups	N	Instructional Method	Pretest		Posttest	
			X	SD	X	SD
Experimental	48	Cognitive	5.38	0.67	7.75	1.76
Control	48	Lecture	3.90	0.88	5.35	0.64

The data in Table 2 indicate that the experimental group had a mean of 5.38 and a standard deviation of 0.67 in the pre-test and mean score of 7.75 and standard deviation of 1.76 in the post-test making the pre-test - post-test gain in the experimental group to be 2.37. The control group had a mean score of 3.90 and a standard deviation of 0.88 in the pre-test and a mean of 5.35 and standard deviation of 0.64 in the post-test, resulting in a gain of 1.45. This implies that the experimental group performed better than the control group in industrial installation works.

Research Question Three

What are the performances of students taught cable jointing with cognitive apprenticeship instructional approach and those taught by the lecture method in cable jointing?

Table 3: Mean and standard deviation of pre-test and post-test scores of experimental and control groups.

Groups	N	Instructional Method	Pretest		Posttest	
			X	SD	X	SD
Experimental	48	Cognitive	2.63	0.67	8.90	0.75
Control	48	Lecture	3.00	0.83	4.90	0.72

The data in Table 3 indicate that the experimental group had a mean of 2.63 and a standard deviation of 0.67 in the pre-test and mean score of 8.90 and standard deviation of 0.75 in the post-test making the pre-test - post-test gain in the experimental group to be 6.27. The control group had a mean score of 3.00 and a standard deviation of 0.83 in the pre-test and a mean of 4.90 and standard deviation of 0.72 in the post-test, resulting in a gain of 1.90. This implies that the experimental group performed better than the control group in cable jointing.

Hypothesis One

There is no significant difference between the mean scores of students taught using cognitive apprenticeship instructional method and those taught by the lecture method in domestic installation works.

Table 4: Analysis of covariance of the scores of experimental and control groups in the EIWAT in domestic installation works

Source of Variation	Df	Sum of Square	Mean Square	f-cal	f-critical
Between Groups	1	468.25	234.12	300.61	1.74
Within Groups	95	87.16	0.94		
Total	96	3463.86			

In Table 4, *F-cal* > *F-critical*; for the null hypothesis that there is no significant difference between the mean scores of the students taught with the cognitive apprenticeship instructional approach and those taught by the lecture method in domestic installation, the hypothesis is rejected at 0.05 level of significance. This implies that there is a significant difference between the mean scores of experimental and control groups in learning domestic installation in favour of the experimental group.

Hypothesis Two

There is no significant difference between the mean scores of students taught using cognitive apprenticeship instructional method and those taught using a lecture method in industrial installation.

Table 5: Analysis of covariance of the scores of experimental and control groups in the EIWAT in industrial installation

Source of Variation	Df	Sum of Square	Mean Square	f-cal	f-critical
Between Groups	1	138.15	69.07	39.27	1.74
Within Groups	95	163.59	0.22		
Total	96	301.74			

Table 5, shows that f-*cal greater than* f-*critical*; hence, the null hypothesis that there is no significant difference between the mean scores of the students taught using cognitive apprenticeship instructional strategy and those taught using a lecture method of industrial installation, the hypothesis is rejected. This implies that any significant difference between the mean scores of the experimental group and the control group in industrial installation is significant.

Hypothesis Three

There is no significant difference between the mean scores of students taught using cognitive apprenticeship instructional method and those taught using a lecture method in cable jointing.

Table 6: Analysis of covariance of the scores of experimental group and control group in the EIWAT in cable jointing

Source of Variation	Df	Sum of Square	Mean Square	f-Cal	f-Critical
Between Groups	1	384.09	192.04	351.07	1.74
Within Groups	95	50.87	0.55		
Total	96	3434.96			

From the table 6, *f-cal* greater than *f-critical*, therefore the null hypothesis that there is no significant difference between the mean scores of the students taught using cognitive apprenticeship instructional method and those taught using a lecture method in cable jointing, the hypothesis is rejected. This means that a significant difference exists between the mean scores of the experimental group and the control group in cable jointing.

Major Research Findings

From the information obtained in this study, the following major research findings were made:

i. Student trained domestic installation using a cognitive apprenticeship instructional technique had higher compared to those taught using lecture method. This shows that cognitive apprenticeship instructional method increases the academic performance in electrical installation works.

ii. Learners taught industrial installation using cognitive apprenticeship instructional method scored higher in the post-test than those taught by the lecture method. This implies that the cognitive apprenticeship instructional method increases the academic performance in electrical installation works than the lecture method.

iii. Students taught cable jointing with the cognitive apprenticeship instructional technique have higher scores on the post-test compare to those taught by the lecture method. This shows that the cognitive apprenticeship instructional method boosts the students' academic performance in electrical installation works.

iv. There was a significant difference in the mean scores of students taught by the cognitive apprenticeship instructional technique than those taught by the lecture method for domestic installation of an electrical installation work.
v. The significant difference is observed in the mean scores of students taught with the cognitive apprenticeship instructional practices as compare to those taught by the lecture method in the industrial installation of an electrical installation work.
vi. The mean scores of students taught with the cognitive apprenticeship instructional technique is significantly different compared to that of those taught by the lecture method in the cable jointing of an electrical installation work.

Discussion of Findings of the Study

The outcome of the electrical installation works achievement tests (EIWAT summarized in Tables 1 – 6 shows that the experimental group taught using cognitive apprenticeship instructional technique had high scores than the control group and also these scores are significantly differ.

The study found that students taught domestic installation, industrial installation and cable jointing in electrical installation works with the cognitive apprenticeship instructional technique maintained higher scores on the post-test than those taught by the lecture method. This signifies that cognitive apprenticeship instructional method enhances the higher student academic performance in electrical installation works than the lecture method. This finding is supported by the revelation of *Aziz, (2003)* that cognitive apprenticeship method enables students to compare their performance with others and the teacher's work. Such comparisons aid students in diagnosing their difficulties and in incrementally adjusting their performance until they achieve competence.

Also, the study establishes that students taught using cognitive apprenticeship teaching strategy have their average scores significantly differ than those taught using a lecture method in learning domestic installation, industrial installation and cable jointing of an electrical installation work. According to Johnson, (2002) this finding could be explained by the fact that the cognitive apprenticeship instructional strategy used in an active learning environment where students can freely explains their work and listening to corrections from their teacher and fellow students without any obstruction, thereby increases their self-confidence, self-reliance and performance. Such students should have their performance to be significantly different compare to those exposed to lecture method.

From the findings of this study, cognitive apprenticeship instructional method tested was confirmed to elevate the students' academic performance in electrical installation works. This means that these elements of a cognitive apprenticeship instructional approach when used is more successful compare with the lecture method in improving the academic success of the students in the course. The significant differences observed in the mean scores of students taught domestic installation, industrial installation and cable jointing can be attributed to the application of the various components (coaching, scaffolding, articulation, reflection and modelling) of a cognitive apprenticeship instructional approach. The findings of study are supported by Idris, (2012) in another study found that the implementation of the cognitive apprenticeship teaching method to a greater extent brings about better academic performance of the students and also made them to have a sounding understanding of both theoretical and technical aspects of their course of study expected of electrical installation work students.

Implications of the Study

The results of this study will expose the teacher to the fact that using the cognitive apprenticeship instructional approach for teaching and learning is better than using the lecture method. Therefore, teachers should utilize these findings of this study in their teachings.

Since there is a positive effect on the use of the cognitive apprenticeship instructional approach as shown by the results of this study, all stakeholders in education should organize seminars and workshops to keep teachers, textbook authors and curriculum planners alongside each other with various ways of using the cognitive apprenticeship instructional approach for effective teaching and learning of technical courses.

The findings from this study also call for a critical review of the various institutions' curriculum that produces teachers for the technical colleges with the aim of including and emphasising the cognitive

apprenticeship instructional approach in teaching and learning. Finally, other researchers will use these findings as a reference point for other studies.

Conclusion

The instructional methods tested in this study vary significantly in their impacts on academic achievement of learners in electrical installation works. Effective teaching and learning of electrical installation works are based on the ability of the teachers to select and use the most appropriate instructional strategies. The performances of the students are also higher when they are exposed to activities during class instruction.

Recommendations

From the findings obtained from this study, the following recommendations are made

i. The electrical installation works teachers should be properly trained by government through workshops and seminars in the selection and utilization of instructional strategies and materials
ii. The curriculum developers, while modifying the curriculum of work in technical colleges, should specify instructional strategies that will best be used for teaching different content areas.
iii. Teachers should make efforts to ensure that students are properly exposed to practical activities through demonstration in order to facilitate easy understanding of lessons and skills acquisition.
iv. The electrical method of teaching which involves the combination of two or more instructional strategies should be adopted in lesson delivery by teachers of electrical installations to enhance effectiveness in teaching and learning.

References

Aziz G., (2003). Cognitive Apprenticeship, Technology, and the Contextualization of Learning Environments. *Journal of Educational Computing, Design & Online learning,* 4, Fall.

Boyle, E. A., Duffy, T & Dunleavy, K, (2003). Learning Styles and Academic Outcome: The Validity and Utility of Vermunt's Inventory of Learning Styles in a British Higher Education Setting. *British Journal of Educational Psychology* , 73, (2), 267 - 90.

Collins, A., & Brown, J. S. (2007). Cognitive Apprenticeship: Teaching the Craft of Reading, Writing and Mathematics. Technical Report No. 403. Center for the Study of Reading, University of Illinois at Urbana-Champaign, Champaign, IL, USA. Bolt Beranek and Newman, Inc., Cambridge, MA, USA. Course on Curriculum Development, New Delhi, India, 9-17 March 1999, pp. 10-6. United Nation

Demmert, V. P. (2001). The Design and Facilitation of Asynchronous Discussion Activities in Web-based Courses. Unpublished Doctoral Dissertation. Indiana University.

Idris, A. M. (2012). Effect of Cognitive Apprenticeship Instructional Method on Auto-Mechanics Students, Assumption University Journal of Technology, 16, 2, 89 - 98.

Inan, F. A. (2010). Perspectives on the Design and Evaluation of Adaptive Web - based Learning Environments. *Contemporary Educational Technology, 1, 2, 148 - 159.*

Momoh-Olle, J.Y., (2002). Effects of Cognitive Performance and Advance Verbal Organizers on the Retention of an O' Level physics Textual Materials. The Nigerian Teacher Today %, 182, 28 - 38.

NABTEB. (2015). May/June 2015 National Technical Certificate (NTC) and National Business Certificate (NBC) Examinations: Chief Examiner's Report. National Business and Technical Examinations Board (NABTEB), Fiesta Printing Press Ltd., Benin City, Edo State, Nigeria.

NBTE, (2007). National Technical Certificate (NTC) and Advanced National Technical Certificate (ANTC). Curriculum and Module Specifications in Motor Vehicle Mechanics. National Board for Technical Education (NBTE), Kaduna, Kaduna State, Nigeria.

Ogbu, J.E. (2010) Development and validation of Basic Electricity interaction categories. *Ebonyi Technology and Vocational Education Journal.* 4, (1), 191 - 202.

Okoro, O.M. (2003). Vocational and technological education in developing countries: The place and role of the teacher. *Ebonyi Technology and Vocational Education journal* (ETVET), 1, (1), 1 - 8.

Osuala, E.C., (2001). *Introduction to Research methodology. 3rd edition.* Onitsha: Africana FEB Publishers.

UNESCO & ILO, (2002). Technical and Vocational Education and Training for the Twenty-First Century. Recommendations. United Nations Educational, Scientific and Cultural Organization (UNESCO), Paris, France. International Labour Organization (ILO), Geneva, Switzerland.