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EFFECT OF COGNITIVE APPRENTICESHIP INSTRUCTIONAL METHOD ON ACADEMIC ACHIEVEMENT AND RETENTION OF AUTO MECHANICS TECHNOLOGY STUDENTS IN TECHNICAL COLLEGES

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Abstract:
The need to improve students' academic achievement in auto mechanics technology necessitated this study. The study investigated the effect of cognitive apprenticeship instructional method on students' academic achievement and retention in auto mechanics 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 237 vocational II auto mechanic students in the six technical colleges in Delta State. A sample of 114 was used for the study. Instrument for data collection was Auto Mechanic Achievement Test (AMAT). 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 NnamdiAzikiwe University Awka. The reliability coefficient of Auto Mechanics Achievement Test

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(AMAT) was established using Kunder Richardson 21 Formula and the reliability coefficients of 0.75 was obtained. Arithmetic mean was used to analyse data relating to research questions, while analysis of covariance ANCOVA was used to test the null hypotheses. Findings revealed that students taught auto mechanics technology using cognitive apprenticeship instructional method achieved and retained better than those taught with demonstration method. Conclussion was drawn that cognitive apprenticeship instructional method is an innovative and effective mode of instruction with capacity to improve students' learning outcome. Consequently, it was recommended among others that technical teachers should use cognitive apprenticeship instructional method in teaching auto mechanics course so as to enhance students' academic achievement and knowledge retention.

Keywords: cognitive apprenticeship, academic achievement, retention, auto mechanics technology, technical colleges

1. Introduction

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 intended to prepare students for entry into various occupations. In technical colleges, students are trained to acquire relevant knowledge and skills in different occupations for employment in the world of work. According to [1], 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. One among the various trades offered at the technical colleges is the automobile trade whose components include auto electric works, motor vehicle mechanics, vehicle body building and agricultural implement mechanics.

Auto mechanics, according to [1], is one of the vocational trades offered at the technical college level as motor vehicle mechanics. The philosophy of auto mechanics programme according to [2] is to produce competent craftsmen andtechnicians in auto mechanics trade for Nigeria's technological and industrial development. It is important therefore, that auto mechanics technicians are equipped with current skills and knowledge to be able to efficiently carry out maintenance work and repair modern highly automated and computerized electronics gadgets in modern vehicles. To achieve these objectives, it is expected that auto mechanic teachers should use instructional methods that have strong link to the needs of the workplace. The appropriate teaching and learning of auto mechanic will qualify students for the world of work. It will enhance their academic achievement and as well qualify them for higher educational level that would enable them become knowledgeable in the field of technology. It is against this backdrop that researchers, such as [3, 4, 5] suggested that other teaching methods such

as demonstration teaching method could be used for teaching within vocational education community.

Demonstration teaching method refers to the type of teaching method in which the teacher is the principal actor while the learners watch with the intention to act later. In demonstration teaching method, according to [6], the role of the teacher is to illustrate how to do something or illustrate a principle first by explaining the nature of the act verbally, followed by demonstrating the act in a systematic manner and later the students repeat the act. Although the demonstration method is a wonderful way to explain things to students, it however seems not to be yielding the desired result in auto mechanic trade in technical colleges. This is because there is still persistent high failure rate among technical college students especially in auto mechanic trade. This is a challenge which necessitates the investigation of the use of another instructional method like the cognitive apprenticeship instructional method (CAIM).

The cognitive apprenticeship is an instructional method that originates from the traditional apprenticeship but incorporates elements of structured learning. It is a learning relationship in which an expert (teacher or more knowledgeable peer) stretches and supports a novice's understanding of the use of the culture's skills. 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. The focus of this learning through guided experience is the combination of cognitive, meta-cognitive and physical skills rather than only the physical skills as in the case of traditional apprenticeship in auto mechanics.

In cognitive apprenticeship instructional method, learners are invited into the actual practices of a knowledge domain and are asked to perform these practices as an apprentice or intern [7]. Learning in CAIM is embedded in a setting that is more like work with an authentic connection to students' lives. Students interact with experts, who model and explain their actions and decision observed that modeling, coaching, scaffolding, articulation, reflection and exploration are the primary components of cognitive apprenticeship instructional method [8].

In modeling the instructor sets the example. In coaching the instructor guides the students. In scaffolding the instructor offers feedback and hints to students. In articulation, students articulate their knowledge and problem-solving process. In reflection, students compare their own problem-solving process with that of the teachers, while the students try to solve their own problems in exploration. No matter which aspect of the CAIM 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 [9] is that it sufficiently enables the learner to concretize phenomena through personal interpretation of experience which could enhance their academic achievement.

Academic achievement represents the outcome that indicates the extent to which a person has accomplished specific goals that were the focus of activities in instructional environments, specifically in schools. In teaching and learning situations, academic achievement is synonymous with academic performance. They could be seen as the outcome of students' effort in examinations [10]. [11] posited that academic achievement is used to measure student's success in educational institutions or how well students meet standard set out by examining bodies or the institution. [12] contended that a student's academic achievement is dependent on several factors such as, learning environment, instructional methods and teaching strategy, teachers' attitude and enthusiasm, as well as students' attitude and background. Among these factors, the instructional method used by teachers, challenge students to work at higher intellectual level that would improve their academic achievement and retention of learning.

Retention of learning is simply the ability to remember what has been learnt. [12], 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. Retention is usually measured in collaboration with academic achievement. It is therefore seen as the achievement on a subject after a certain period of time. [13] 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.

2. Statement of the Problem

Technical college graduates upon graduation are supposed to have three options. These options, according to [1] is to 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 various levels have tried to ensure quality education in technical colleges. Despite all the efforts by Government to ensure qualitative education at the technical colleges and bring about high quality products both in academic and employability, there seems to be persistent reports of high failure rate among graduates of technical colleges as reported by [1, 2]. This has become worrisome to educationists who attributed the high failure rate of students to a number of factors such as inadequate instructional materials, dearth of committed teachers, nonchalant attitude of students to their study and the use inappropriate instructional techniques. However, reseachers such as [4, 5, 6, 14] have revealed that among the numerous factors, the instructional method used by the teacher plays a predominant role on academic achievement of students in technical colleges.

The demonstration method mostly used in technical colleges among other methods are socially acceptable methods of teaching which have been used by teachers

to present skills, knowledge and appreciation to the learners in the class room or laboratory. This method being predominantly used for teaching in technical colleges according to [7] though has its own advantages, seems not to be yielding the desired result in auto mechanics trade in technical colleges. This is because there is still persistent high failure rate among technical college students especially in auto mechanic trade Therefore; could this problem of persistent poor academic achievement among auto mechanics students in technical colleges be enhanced by the use of Cognitive Apprenticeship Instructional Method (CAIM)?

2.1 Purpose of the Study

The purpose of the study was to determine the effect of cognitive apprenticeship instructional method on students' academic achievement, retention and interest in auto mechanics technology. Specifically, the study determined:

1) The effect of CAIM on academic achievement mean scores of auto mechanic students in technical colleges taught with cognitive apprenticeship instructional method and those taught with demonstration method.
2) The effect of CAIM on retention mean scores of auto mechanic students in technical colleges taught with cognitive apprenticeship instructional method and those taught with demonstration method.

2.2 Research Questions

The following research questions guided the study.

1) What are the effects of CAIM on academic achievement mean scores of auto mechanic students in technical colleges when they are taught with cognitive apprenticeship instructional method and when they are taught with demonstration method?
2) What are the effects of CAIM on retention mean scores of auto mechanic students in technical colleges when they are taught with cognitive apprenticeship instructional method and when they are taught with demonstration method?

2.3 Null Hypotheses

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

1) There is no significant difference between the academic achievement mean scores of students taught auto mechanics using cognitive apprenticeship instructional method and those taught with the demonstration method.
2) There is no significant difference between the retention mean scores of students taught auto mechanics using cognitive apprenticeship instructional method and those taught with the demonstration method.

3. 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**.** The population of this study was 237 Vocational (VOC) II students studying automobile mechanics in all the six technical colleges in Delta State. The sample size of the study was 114 VOC II auto mechanics students. The purposive sampling technique was used to sample two schools from the six technical colleges that form the population. The instrument for data collection was Auto Mechanics Achievement Test (AMAT). 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 21 (K-R21) formula and reliability coefficient of 0.75 was obtained.

3.1 Experimental Procedures

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 auto mechanics 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 auto mechanics 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 demonstration method. The primary focus of the teaching process was concentrated on identification, functions and coupling of the various components of the vehicle engine and vehicle transmission system. 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 AMAT test items by the auto mechanics teachers and their assistants. The exercise provided a post-test data for each of the dependent variables. The AMAT was re-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 analyzed the data.

The data collected was analyzed 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.

4. Results

Table 1: Mean and Standard Deviation
for Pre-test and Post-test Achievement Scores of Students

Groups		Academic Achievement				
		Pretest		Post test		
	No	Mean	Stand dev	Mean	Stand dev	Mean Gain
Experimental	58	20.38	4.20	71.57	8.96	51.19
Control	56	19.13	3.72	44.70	6.33	25.57

Table 1 showed the mean and standard deviation of achievement scores of students in experimental and the control groups. The mean scores indicated that the experimental group had higher mean scores after pretest. 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 Retention Scores of Students

Groups	Retention Scores		
	No	Mean	Stand dev
Experimental	58	74.27	2.70
Control	56	44.89	0.19

Table 2 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 demonstration group.

Table 3:ANCOVA for Differences in Academic Achievement of Students

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	20589.088[a]	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	114			
Corrected Total	27354.526	113			

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

Table 3 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 4: ANCOVA for Differences in Retention Mean Scores of Students

Source	Type III Sum ofSquares	Df	Mean Square	F	Sig.
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	114			
Corrected Total	27170.991	113			

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.

5. Discussion of Results

The study revealed that students who were taught auto mechanics technology using CAIM achieved higher post-test scores than those taught using 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 [15, 16, 17] 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 demonstration teaching method. This means that the CAIM used in teaching the students was significant on students' retention. This finding is in line with[13, 16, 17] who found that, students who were taught using CAIM were able to retain the concepts than those students taught using 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.

6. Conclusion

Based on the findings of the study, it was concluded that cognitive instructional method is an effective method for improving students' academic achievement and retention in auto mechanics technology.

7. 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 auto mechanics 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 auto mechanics 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 academic achievement of students in technical colleges.

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