RELATIVE EFFECTIVENESS OF COOPERATIVE AND INQUIRY LEARNING METHODS ON STUDENTS' ACADEMIC ACHIEVEMENT AND RETENTION IN BASIC ELECTRICITY

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Abstract
The study investigated the relative effectiveness of cooperative and inquiry learning methods on students' academic achievement and retention in Basic Electricity. Cooperative learning is an active learning method where students are arranged in pairs or small groups to help each other learn assigned material, while Inquiry learning is also a form of active learning method where progress is assessed by howwell students develop experimental and analytical skills rather than how much knowledge theypossess. Two research questions guided the study while two null hypotheses were tested at 0.05 level of significance. Quasi-experimental research design was adopted for the study, specifically, non-equivalent experimental group design. The study was carried out in Awka and Aguata Education Zones of Anambra State. The population consisted of all the 413 NTC II students offering Basic Electricity in the 12 technical colleges in Anambra State. The sample for the study comprised 60 National Technical College year II (NTC II) students from two intact classes in two Technical Colleges in two Education Zones, drawn using multi- stage sampling procedure. Basic Electricity Achievement Test (BEAT) was the instrument used for data collection. The instrument was validated by the experts and reliability test was conducted using Kuder- Richardson 21 formula. The reliability index was established at 0.80. The experimental group1 were taught Basic Electricity using cooperative learning method, while experimental group 2 was taught using inquiry learning method. The treatments lasted for five weeks. Data collected were analysed using mean, standard deviation and Analysis of Covariance (ANCOVA). The results revealed that cooperative learning method was more effective than inquiry learning method in facilitating students' academic achievement and retention in Basic Electricity. Based on the findings of the study, it was recommended among others, thatcooperative learning method should be formally adopted in technical colleges, secondary and vocational schools for instruction in Basic Electricity to improve the academic achievement and retention ability of students.

Keywords: Cooperative learning method, Inquiry learning method, Basic Electricity, Academic achievement, retention.

Introduction

Technical education, which appears to be the foundation of nation's wealth and development, 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 economic and social life. Technical

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Colleges (TC) in Nigeria are established to produce craftsmen and to equip students with the necessary basic knowledge, skills and attitude to be self-reliance. Thus, in contemporary Nigeria, greater emphasis is currently placed on industrial and technological development of the citizenry. Consequently, students are being encouraged to take up science and engineering related subjects in technical colleges.

One subject that cuts across the entire engineering and related technical subjects is basic electricity (BE). The National Business and Technical Examination Board (NABTEB) syllabus outlined basic electricity as one among the trade-related subjects offered at the Technical Colleges. However, this subject cannot be taught and learnt successfully based on mere theoretical knowledge without proper use of learning strategies and practical skills. The best way to make learning more concrete is to fully involve the learner.

Unfortunately, it is apparent that there is a steady decline in students' academic achievement in the technical subjects such as Basic Electricity. For instance, an analysis of the May/June results of National Business and Technical Education Board (NABTEB) examination from year 2006 to 2010 by Olatunde (2011), the then NABTEB registrar/chief executive, revealed that students performed poorly in Basic Electricity across the nation and Anambra State in particular. Various stakeholders have advanced reasons for this negative development in education in the state among which include; over years, teachers and students have been depending on excessive use of one particular learning method or the other to express and convey ideas, or fact in teaching and learning process (Onasanya, Adegbija, Olumorin&Daramola, 2009). This monotony in practice calls for diversification in the utilization of teaching methods to see if students' academic achievement could improve in teaching and learning of Basic Electricity in Anambra State. Therefore, cooperative and inquiry learning methods were introduced.

Cooperative learning method of instruction is where students are arranged in pairs or small groups to help each other learn assigned material (Wael, 2014). While Inquiry learning is a form of active learning where progress is assessed by how well students develop experimental and analytical skills rather than how much knowledge they possess. Evidence from previous studies indicated that academic achievement and retention is influenced by students' learning methods. Ajaja (2013) concluded that the adoption of cooperative learning method should be appropriate for the teaching and learning of biology. Also, Ugwu (2014) recommended that science teachers, and science teacher educators should adopt inquiry instructional and learning method when teaching in order to enhance students' academic achievement and interest in basic sciences.

This study was therefore propelled by the very interesting discoveries from literature that cooperative and inquiry learning methods significantly affect students' academic achievement and retention in science and technology related subjects.However, a question may be asked as whether these two learning methods will produce the same effects on students in their study of Basic Electricity trade. Thus, within the domain of this study, what is the relative effectiveness of cooperative and inquiry learning methods on students' academic achievement and retention in Basic Electricity?.

Research Questions

1 What is the relative effect of Cooperative and Inquiry learning methods on academic achievement mean scores of students taught Basic Electricity in Technical Colleges?

1. What is the relative effect of Cooperative and Inquiry learning methods on retention ability of students taught Basic Electricity in Technical Colleges?

Research Hypotheses

Ho_1: Thereisno significant difference inthe academic achievement means scores of students taught Basic Electricity using Cooperative learning method and that of those taught with Inquiry learning method.

Ho_2: Thereisno significant difference in the retention ability of students taught Basic Electricity using cooperative learning method and that of those taught with Inquiry learning method.

Literature Review

BasicElectricity

Electricity is the flow of electrons from one place to another. Basic Electricity (BE) is the fundamental subject of study in the fields of electricity and electronics at all levels of Education (Ogbu, 2010a). It deals with all the fundamental issues of current-electricity, static-electricity and electrons as studied in schools and colleges. Basic Electricity is so important that students' academic achievement in it is so crucial and major determinant of their performance in other electronics/electricity (E/E) subjects (Ogbu, 2010b). This demands competence, efficiency and effectiveness on the part of the teacher in order for students to achieve maximally in Basic Electricity.

This subject is offered by technical colleges, science and technical schools, etc. at NTC 1, 2 and 3. The examination syllabus for BE has been evolved from the Senior Secondary School Basic Electricity Curriculum. It is designed to test candidates' knowledge and understanding of electrical and electronic principles, maintenance and repair of domestic and industrial equipment and safe working procedures.

Cooperative Learning Method (CLM)

Cooperative learning method is the umbrella term for a variety of educational approaches involving joint intellectual effort by students, students and teachers together (Furtak, 2010). It requires a small number of students to work together on a common task, supporting and encouraging one another to improve their learning through interdependence and cooperation with one another (wael, 2014). The cooperative learning groups usually comprises two to five students in a group that allows everyone to participate in a clearly designed task (Sarah & Cassidy, 2006; Wendy, 2005). Students within small groups' cooperative learning are encouraged to share ideas and materials and divide the work when appropriate to complete the task. Small group competitive learning provides students with opportunity to explore and discuss topics with peers in a Bonds-on interactive environment. Haliru (2015) affirmed that students benefit academically and socially from cooperative small group learning.

Cooperative learning method cannot be taught through verbal instruction. Students can adopt cooperative learning method through a process that involves working together in groups, developing a product at the end and examining both the product and cooperative learning skills. "Cooperative learning method" (CLM) emerges in the literature as a method that assists instructors in carrying out this process. CLM emerges when students gather in order to reach a common goal (Johnson & Johnson, 2009). Each member of the group reaches his goal only if all the other members reach their own learning goals.Altun (2015) defines cooperative learning as working of students in small groups and helping each other in the learning process.

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Inquiry Learning Method

Inquiry means more than simply answering questions or getting right answers and emphasizing it. It is an innovative teaching and learning method which encourages active participation of students in the learning process (Akcay&Yagger, 2010). Inquiry is an approach to learning whereby students find and use a variety of sources of information and idea to increase their understanding of a problem, topic or issue (Kuhlthau, 2007). Inquiry requires more than simply answering questions or getting right answers, and emphasizes discovery rather than telling (Guisti, 2008). The word inquiry, according to Ugwu (2014) loosely means 'an investigation' but its meaning in the realm of education is much more complex. It includes questioning, designing, conducting and experiment and communicating the result to others or the society which mirrors scientists. Inquiry also espouses investigation, exploration, search, quest, research pursuit and study (Saskatchewan, 2010). Inquiry is a natural introduction to the branch of epistemology known as 'Nature of science' which deals with the characteristics of scientific knowledge (Kirshner, Sweller, &Clark, 2006). Thus Guisti maintains that in classroom the term used most often to refer to students – centred approach is inquiry. Inquiry engages interest and challenges students to connect their world with the curriculum (Kuhlthau, 2007). Ugwu (2014) views inquiry as a set of behaviours involved in the struggle of human beings for reasonable explanation of phenomena about which they are curious, involving activity and skill, with focus on the active search for knowledge or understanding to satisfy a curiosity'.

Adejo (2015) maintained that learning becomes more effective and long lasting when learners plan their own question, analyse and discuss their findings and finally construct their understanding. ILM is not only concerned with the preparation for long life learning but also extends knowledge beyond the classroom doors (Campell, 2006). Inquiry is focused on using and learning content as a means to develop information processing and problem solving skills and enables students to experience classroom events like real scientists. Inquiry is an integral part of the learning experience and can be used in both traditional class room problems and laboratory experience. The essence of inquiry is to ask questions that stimulate students to think critically, construct knowledge using scientific processes such as observing, classifying, measuring, inferring, predicting, formulating models, interpreting data, hypothesizing and experimenting which help students to build knowledge and communicate what they have learned thereby improve on their academic achievement.

Academic Achievement

It is evident that poor academic achievement of students in Technical Colleges in Nigeria affects all subject areas, BE inclusive. The major challenge is how to effectively teach the students in order to improve on their academic achievement.

Academic achievement, according to Igweh (2012) refers to some methods of expressing a students' scholastic standing. This can be regarded as a source or subject grade, an average for a group of courses/subjects in a programme of study for example in Basic Electricity. Good academic achievement leads to success while poor academic achievement leads to failure. Each of these two academic achievements is experienced by students in one form or the other.

In this study, any student who scores between 50 and 100 out of the obtainable 100 marks is considered to have good academic achievement while those who scores between 0 and 49 are considered to have poor academic achievement.

Retention

Retention is viewed as the ability to remember or recall what is taught at the time it is needed. According to Safo, Ezenwa and Wushishi (2013), retention is seen as the ability to keep or retain the knowledge of what is learnt and to be able to recall it when it is required. Horby in Safo, et al also defined retention as the ability of a person to remember something. This implies that for one to talk about retention, one must have been exposed to certain experiences or activities such as teaching. In the same vein, retention can only take place when something has been taught.

Retention is usually measured in collaboration with academic achievement. In agreement to this, Obodo in Iji (2010) asserted that retention is measured in collaboration with achievement. It is often seen as the achievement on a subject after a certain period of time. For instance, if a group of students are exposed to classroom instruction on a particular subject after which a test is given, such test only reveals the extent of the content of that subject learnt by the students. If another test is given (say two weeks or more) after the instruction, one can infer from the result of the test how much of the content of the instruction the students retained. Also, a student is considered to have good retention ability if after being taught a psychomotor skill such as conduit wiring, is able to perform the conduit after a month of being taught. However, the student's retention ability is poor if the student is unable to carry out conduit installation when called to do so.

Methodology

Quasi experimental research design was used for the study. Specifically, pre-test post-test non-equivalent experimental group were used. Quasi experimental research design was used because there was no random assignment of the subjects to treatment conditions. Nworgu (2015) agreed that in a situation where there is no randomization in the assignment of individual participants to treatment conditions, quasi experimental method is most suitable. This design is adopted because it is not possible for the researcher to randomly sample the subjects and assign them to groups without disrupting the academic programme and the timetable of the technical colleges involved in the study. Hence, the design is considered quite suitable for conducting this study. The population of the study consisted of all the 413 NTC II students offering Basic Electricity in the 12 technical colleges in Anambra State. The sample size for this study was 60 NTC II students from two technical colleges, which consist of 36 students from Federal Science and Technical College (FTSC), Awka in Awka Education Zone and 24 students from Government Technical College (GTC) Umunze in Aguata Education Zone, drawn using multi-stage sampling procedure.

The instrument used for data collection was Basic Electricity Achievement Test (BEAT) which was adapted from NABTEB past questions on Basic Electricity by the researcher based on the contents of the topics that were taught. BEAT has 50 items multiple choice objective questions. BEAT was used to obtain data in respect to pre-test, post-test and retention test. The pre-test, post-test and retention test are made up of the same items but differ among each other by reshuffling of the items, font size of the letters and colour of the paper used. Validation of the instrument used for data collection was done by three experts, one from Department of Educational Foundations and two from Technology and Vocational Education all in the Faculty of Education, Nnamdi Azikiwe University, Awka. The reliability of the instrument for this study

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was established using Kuder-Richardson 21 method. Manual computation of the scores for BEAT yielded a reliability coefficient of 0.80. The data collected in respect of research questions were analysed using mean and standard deviation while ANCOVA statistical tool was used to test the null hypotheses at 0.05 level of significance.

The decision is to use the difference in the academic achievement mean scores of students to determine the relative effectiveness of cooperative and inquiry learning methods and to reject Ho if the calculated F-ratio is greater than or equal to the critical F-ratio and accept Ho if the calculated F-ratio is less than the critical F-ratio.

Results

***Research Question 1*:** What is the relative effect of Cooperative and Inquiry learning methods on academic achievement mean scores of students taught Basic Electricity in Technical Colleges?

Answer to this research question is presented in Table 1.

Table 1: Pre-test and post-test Mean scores and Standard Deviation of academic achievement of students taught Basic Electricity with cooperative and those taught with inquiry learning methods

Source of variance	N	Pre-test mean	SD	Post-test mean	SD	Mean gain	Effect
Cooperative Learning Method	36	13.72	3.326	41.11	3.353	**27.39**	Positive
Inquiry Learning Method	24	13.17	3.497	30.75	5.534	**17.58**	Positive
Difference in mean gains						**9.81**	

The data in Table 1 show positive effect for both experimental group 1 and 2. However, the mean gain of 27.39 (41.11 - 13.72) for the experimental group 1 is higher than that of the experimental group 2 which is 17.58 (30.75 - 13.17). The standard deviation scores range from 3.35 – 5.53 for cooperative and inquiry learning methods respectively indicate that the respondents' responses are homogeneous. This shows that Cooperative learning method is more effective in enhancing students' academic achievement in Basic Electricity than Inquiry learning method of instruction.

***Research Question 2*:** What is the retention ability of students taught Basic Electricity using cooperative learning method and that of those taught with Inquiry learning method in Technical Colleges?

Answer to this research question is presented in Table 2.

Table 2: **Mean scores and Standard Deviation of retention ability of students taught Basic Electricity with cooperative and those taught with inquiry learning methods**

Source of Variance	N	Pre-test mean	Retention mean	SD	Mean gain	Effect
Cooperative Learning Method	36	13.72	38.47	5.609	24.75	Positive
Inquiry Learning Method	24	13.17	26.83	6.070	13.17	Positive
Mean Difference			**11.64**		**11.09**	

Table 2 reveal that the experimental group 1 with retention mean of 38.47 retained Basic Electricity concepts taught more than the experimental group 2 with 26.83 retention mean. Hence, with the mean retention difference of 11.64 between the experimental group 1 and experimental group 2, Cooperative learning method is more effective in enhancing retention ability of students in Basic Electricity than inquiry learning method of instruction. The standard deviation scores which range between 5.61 and 6.07 for cooperative and inquiry learning methods respectively show that their responses are concentrated and this indicate homogeneity in their responses.

Hypothesis 1

Ho: Thereisno significant difference inthe academic achievement mean scores of students taught Basic Electricity using Cooperative learning method and that of those taught with Inquiry learning method

The statistical test for this hypothesis is presented in Table 3.

Table 3: ANCOVA on academic achievement mean scores of students taught Basic Electricity using Cooperative learning method and those taught using Inquiry learning method

Source of Variance	Type III Sum of Squares	Df	Mean Square	F-Calculated	F-Critical	Sig.
Corrected Model	1570.427[a]	2	785.213	41.693		.000
Intercept	3866.571	1	3866.571	205.303		.000
PRETEST	24.549	1	24.549	1.303		.258
Learning Methods	1504.274	1	1504.274	**79.872**	**3.17**	**.000**
Error	1073.506	57	18.833			
Total	84636.000	60				
Corrected Total	2643.933	59				

a. R Squared = .594 (Adjusted R Squared = .580); Significant at 0.05 alpha level; df= 2 & 57.

The data presented in Table 3 show that the calculated F-value of 79.87 is greater than 3.17 F-critical value. Also, the p-value (p = 0.00), is less than 0.05 alpha level. Hence the null

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hypothesis (Ho) was rejected at 0.05 alpha level of significance and, 2 and 57 degree of freedom. This implies that there is significant difference in academic achievement of students taught Basic Electricity using cooperative learning method and those taught using inquiry learning method of instruction in favour of cooperative learning method.

Hypothesis 2

Ho: There is no significant difference in the retention ability of students taught Basic Electricity using cooperative learning method and that of those taught with Inquiry learning method

The statistical test for this hypothesis is presented in Table 4.

Table 4

ANCOVA on mean retention ability of students taught Basic Electricity using cooperative learning method and that of those taught with inquiry learning method

Source of Variance	Type III Sum of Squares	Df	Mean Square	F-Calculated	F-Critical	Sig.
Corrected Model	1950.678[a]	1	1950.678	58.071		.000
Intercept	61413.344	1	61413.344	1828.242		.000
Learning Methods	1950.678	1	1950.678	**58.071**	**4.02**	**.000**
Error	1948.306	58	33.591			
Total	72513.000	60				
Corrected Total	3898.983	59				

a. R Squared = .500 (Adjusted R Squared = .492); Significant at 0.05 alpha level; df = 1 & 58

The data presented in Table 4 show that the calculated F-value of 58.07 is greater than 4.02 F-critical value. Also, the p-value (p = 0.00), is less than 0.05 alpha level. Hence the null hypothesis (Ho) was rejected at 0.05 alpha level of significance and, 1 and 58 degree of freedom. The implication of this is that there is significant difference in retention ability between the students taught Basic Electricity using cooperative learning method and those taught using inquiry learning method in favour of cooperative learning method.

Discussion

Findings in Tables 1 and 3 revealed that the academic achievement of students taught Basic Electricity using cooperative learning method differed significantly from that of the students taught same lesson content using inquiry learning method in favour of the cooperative learning method. Specifically, the differences in performance might have been because of the fact that the students were required to work in small groups, generate their own solution, analyse and discuss their findings and finally construct theirunderstanding, thereby imbibing the scientific and technological processes involved in learning Basic Electricity, which enabled them to perform better than their counterparts taught Basic Electricity using inquiry learning method.

This finding is in agreement with Haliru (2015) who found that students taught Geography using cooperative learning strategy achieved academically more than those taught same lesson using traditional lecture method in senior secondary schools in Sokoto State. In the same vein, this finding is supported by that of Altun (2015) that students taught Science and Technology Course in Kartal district of Istanbul, Turkey using Cooperative learning method performed

significantly better than those taught same lesson using lecture method. Christian and Pepple (2012) in their study on ''Effects of Cooperative and Individualized Learning Strategies on Students' Academic Achievement in Chemistry in Rivers State'' also found out that the use of cooperative learning strategyin teaching Chemistry students improved their academic achievement in the subject than the students taught same with Individualised learning strategy.

The similarities between the findings of these studies and the current study reveals that the use of Cooperative learning method in teaching trade subjects/courses and some career areas can improve students' academic achievement.

The findings in tables 2 and 4 also revealed that the students in the cooperative learning method retained Basic Electricity concepts taught more than those using inquiry learning method. Table 4 indicated that this difference is significant hence cannot be attributed to chance.

These findings agreed with the findings of some related empirical literatures reviewed on effect of cooperative learning on retention ability of students in Basic Electricity. For instance, Altun (2015) found that students taught Science and Technology Course in Kartal district of Istanbul, Turkey using cooperative learning method performed significantly better in retention test than those taught same using conventional lecture method. Also, Ajaja (2013) found that the mean retention scores of the students taught Biology using cooperative learning strategy significantly differed from that of the students taught using Concept Mapping teaching method in favour of the cooperative learning group.

The significant improvement in retention ability of students exposed to Cooperative Learning Method (CLM) of instruction as found in this study could be attributed to certain features such as working together in groups in order to solve a problem. Also, CLM creates multi-sensory channels for learning thereby increasing students' participation in the learning process. Therefore, CLM creates platforms for students' active participation in the learning process rather than being mere recipients hence increasing their retention ability.

Conclusion

Based on the findings of this study, a number of conclusions can be drawn: CLM is an innovative and more effective mode of instruction with the capacity to improving students' academic achievement and retention ability in Basic Electricity.

Recommendations

The following recommendations were proffered based on the findings of this study.

1. CLM should be formally adopted in technical colleges, secondary and vocational schools for instruction in Basic Electricity to improve the academic achievement and retention ability of students.
2. Training programmes on effective utilization of CLM for instruction should be organized periodically for teachers of Basic Electricity and other trade related courses/subjects in the technical colleges, secondary and vocational schools.
3. The schools (technical colleges, secondary and vocational schools) should be provided with enabling and conducive learning environment and internet facilities to enable students maximize the benefits of CLM.

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4. The ministries of Education through the curriculum planners should ensure that they incorporate cooperative learning method in Basic Electricity curriculum, as it will help to promote students' academic achievement and retention in the subject.

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