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COMPARATIVE EFFECT OF PROJECT-BASED LEARNING METHOD AND CONVENTIONAL TEACHING METHOD ON ACADEMIC ACHIEVEMENT AND RETENTION OF TECHNICAL COLLEGE STUDENTS IN BASIC ELECTRICITY

T. I. Eze[1], I. M. Onwusuru[2] and O.O. Ginigeme[3]
Department of Technology and Vocational Education, Faculty of Education, Nnamdi Azikiwe University, Awka.

Abstract
The need to improve the academic achievement and retention of technical college students in Basic Electricity necessitated this study as it sought to determine the comparative effect of project-based learning method and conventional teaching method on academic achievement and retention of technical college students in Basic Electricity. The study was carried out in Anambra state and adopted the quasi-experimental research design, precisely, pretest, posttest, delayed posttest non-randomized control group design which involves groups of students in their intact classes. A sample of 92 NTC II students was drawn from a population of 179 students of state owned technical colleges in Anambra state. Two research questions and two null hypotheses tested at 0.05 level of significance guided the study. Basic Electricity Achievement Test (BEAT), a 40-item multiple choice test which was based on the units covered in the study, served as the instrument used for data collection. The BEAT and lesson plans for both control and experimental groups were all validated by three experts from the faculty of education, Nnamdi Azikiwe University Awka. The reliability coefficient of the instrument was found to be 0.82 using KR-20. Mean and standard deviation were used to answer the research questions, while Analysis of Covariance (ANCOVA) was employed to test the hypotheses. Findings revealed that those taught using PBLM had higher posttest and delayed posttest scores than those taught using the conventional teaching method. Based on the findings of this study, it was concluded that PBLM has the potential to improve students' academic achievement and retention in Basic electricity. Consequently, it was recommended among others that Basic electricity teachers should use PBLM in the teaching of Basic electricity so as to enhance students' academic achievement and retention in the subject.


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Key Words: Project-based learning, Academic achievement, Retention, Basic Electricity, Technical colleges

Introduction

In contemporary Nigeria, greater emphasis is placed on industrial and technological development as it is seen as a means of creating employment, enhancing industrial productivity and improving the quality of life. Possession of necessary skills is the prerequisite for gaining such employment. Creation of skilled manpower is one of the goals of technical colleges.

Technical colleges are institutions set up to provide specialized training in specific career fields, trades, or professions. Such areas of the training include Computer Technology, Business Administration, Culinary Arts, Electronics, Medical assisting, Legal assisting, Automotive Technology, Woodwork, Metalwork and Cosmetology (Okoro, 2013). Training at technical colleges can take from less than two years up to four years to complete and typically a certificate, diploma, or associate's degree is awarded. Technical Colleges (TC) in Nigeria are established to produce craftsmen at (secondary) level and master craftsmen at the advanced craft (post secondary) level (Federal Ministry of Education, 2013). The courses offered at the technical colleges lead to the award of National Technical Certificate (NTC) and Advanced National Technical Certificate (ANTC). One subject that cuts across the entire electrical/electronic trade in technical colleges is basic electricity (BE).

Basic Electricity as outlined by The National Business and Technical Examination Board (NABTEB) syllabus is one among the trade-related subjects offered at the Technical Colleges level (NABTEB, 2011). It is the aspect of technical education which deals primarily with electricity and magnetism, forces of nature and material for the benefit of mankind. Basic Electricity is the fundamental subject of study in the field of electricity and electronics that is taught in technical colleges (Ogbuanya, Attahiru, Tiough&Obe, 2017). It is designed to provide the trainees with the basic knowledge and practical skills of electricity/electronics. The performance of students in this subject is measured via their academic achievement and concept retention thereafter.

Academic achievement is a measure of the degree of success in performing specific tasks in a subject area or area of study by students after a learning experience (Ali, 2013). Many criteria indicate academic achievement. These include the very general indicators such as procedural and declarative knowledge acquired in an educational system. There are also the more curricular-based criteria such as grades known as performance on an educational achievement test, and cumulative indicators of academic achievement such as educational degrees and certificates. All the criteria mentioned, represent intellectual endeavors and thus, more or less, mirror the intellectual capacity of a person. Good academic achievement in terms of grades and educational certificates alone, without retention is a negative indication with respect to the effectiveness of the teaching and learning process.

Retention is the ability to keep or retain what is learnt and be able to recall it when it is required (Safo, Ezenwa and Wushishi, 2013). Retention is an important variable in learning especially in technical subjects. This is because achievement lasts only when students are able to retain what they have learnt. A technical student that learns a concept and easily forgets will not perform well in the world outside school. Retention is important in sustenance of achievement. This is because if a student achieved a high score in a post test but a low score in the retention test, it is an indication that the student did not register the concept in the long term memory. In the quest towards modern technological advancement, Nigeria needs nothing short of good performance at all levels and areas of schooling. Basic Electricity is a fundamental subject in the electrical/electronic trade. Unfortunately, poor performance demonstrated by recurrent failure has been recorded in the electrical/electronic trades in the May/June NABTEB examinations as revealed by NABTEB External examiner's reports from 2006 to 2010 (Fakorede, 2010). In Anambra state technical colleges, the issue of low academic achievement or performance still persists as revealed by NABTEB results (NABTEB, 2018). A student's examination achievement is a major yard stick for the job placement as well as evaluating school performance and teaching methods.

Teaching methods are the principles and strategies used by teachers to enable student learning (Ginigeme .O, 2020). The effectiveness of any skill-oriented educational process depends largely on the quality of

teaching and learning. Literature affirms that the current teaching method used in technical colleges in Nigeria is mainly the conventional teaching method which is majorly lecture and demonstration.

The conventional teaching method refers to the traditional way of teaching that is teacher dominant. In other words, it is a teacher-centered approach to instruction (Tella, Indoshi&Othuon, 2010). According to Oludipe (2010), using this conventional (lecture) method a teacher can: take a large class at a time; disseminate large amount of information at a time and repeat a well prepared lecture severally. The authors further said that, the conventional teaching method however, may not provide opportunity for adequate class participation and shows minimal regard for individual differences among learners thereby inhibiting learning. It will be an uphill task to have good academic achievement when effective learning does not take place, hence the need to emphasize teaching methods that enhance effective class participation such as project-based learning method in order to ascertain its effect on students' academic achievement and retention.

Project-based learning (PBL) is another teaching method which is systematic and engages students in learning knowledge and skills through an extended inquiry process structured around complex, authentic questions and carefully designed products and tasks.(Kokotsaki, Menzies & Wiggins, 2016). The core idea of project-based learning is to connect students' experiences with learning activities in school and to provoke serious thinking as students' acquire new knowledge. Project-based learning has some advantages that make it stand out among other pedagogies. For example it supports self-directed and regulated learning (English &Kitsantas, 2013), brings increased academic achievement (Panasan&Nuangchalerm, 2010) and improves attitude towards learning (Bender, 2012). These could make the technique suitable for the instruction of basic electricity since the subject requires content knowledge, problem solving and creative thinking skills for it to be well understood by learners. The need to ascertain the effect of another teaching method arose from the low academic achievement(evidenced by recurrent failure in NABTEB examinations) that is being recorded in Basic electricity (NABTEB, 2018).

Low academic achievement in Basic Electricity has been a source of concern to students, teachers, parents and researchers. Sewasew, Mengestie

and Abate (2015), opined that the conventional method of instruction could arouse students' interest in a subject. This seems not to be sufficient as low academic achievement is still being recorded. Success has however been recorded in the use of project-based learning method in various fields of learning such as Home Economics (Okoro, 2013) and Agriculture (Olatoye& Adekoya, 2010); however its effect has not been ascertained in Basic Electricity. Thus, this study seeks to investigate the comparative effect of project-based learning method and conventional teaching method on technical college students academic achievement and retention in Basic Electricity.

1.1 Statement of the Problem

Recent NABTEB external examiner reports (2018) show that the academic achievement of technical college students in Basic Electricity has not been improving as expected. The poor academic achievement has been attributed to certain factors such as: inadequately qualified technical teachers; lack of students' interest; non-exposure to field trip and above all ineffective method of teaching. So far, conventional teaching method seems to be predominantly used.Consequently, there is a need to improve the teaching and learning of Basic electricity by exploring the use of student-centered teaching methods since they involve active participation of the learners. Hence, this study seeks to ascertain the comparative effect of project- based learning method (being a student-centered method) and conventional teaching method on technical college student's academic achievement and retention in basic electricity.

1.2 Purpose of the Study

The main purpose of this study was to determine the comparative effect of project-based learning method and conventional teaching method on technical college student's academic achievement and retention in Basic electricity. Specifically, the study seeks to determine the:

1. Effect of project-based learning method on the mean achievement scores of technical college students in basic electricity as compared with those taught using conventional teaching method.
2. Effect of project-based learning method on the mean retention scores of technical college students in basic electricity as compared with those taught using conventional teaching method.

1.3 Research Questions

The following research questions guided the study:

1. What are the mean achievement scores of technical college students taught basic electricity using project-based learning method as compared with those taught using conventional teaching method?
2. What are the mean retention scores of technical college students taught basic electricity using project-based learning method as compared with those taught using conventional teaching method?

1.4 Null Hypotheses

The following hypotheses guided the study and were tested at 0.05 level of significance:

HO_1. There is no significant difference in the mean achievement scores of technical college students taught basic electricity using project-based learning method and those taught using conventional teaching method.

HO_2. There is no significant difference in the mean retention scores of technical college students taught Basic Electricity using project-based learning method and those taught using conventional teaching method.

2. Method

This study adopted a quasi-experimental research design of pretest, posttest, delayed posttest non-randomized control group. The study was carried out in Anambra state. The population of the study is 179. These are the National Technical College (NTC) II students who offer Basic Electricity in state owned technical colleges in Anambra state. This is according to the available records at the Post Primary Schools Service Commission (PPSSC) Awka as at July 2019. The sample is made up of 92 NTC II. Purposive sampling technique was used to select two schools for the study. There was a random selection of one class from each school making a total of two intact classes. A simple random sampling technique (balloting) was adopted to select the Technical College that will be in the experimental and the control group respectively. The students in each of the intact class constituted the sample used for the study. The intact classes were therefore randomly assigned to the treatment conditions. The experimental group had 49 students comprising of 34 males and 15 females while the control group had 43 students comprising of 36 males and 7 females respectively. Instrument for data collection is the Basic Electricity Achievement Test

(BEAT). The Basic Electricity Achievement Test (BEAT) comprises of two sections. Section A is an enquiry on the students' personal data while section B has 40 multiple choice items, with each item having four options lettered A to D. The instrument covered the content areas of the two topics (transformers and capacitors) selected for the study. These were developed by the researcher from NABTEB examination past questions and curriculum content for Basic electricity. The same test items were used for pretest, posttest and delayed posttest (retention test).For post-test and delayed post tests, adjustment was made in the numbering and the options were equally interchanged. This was to reduce the effect of posttest on the retention test.

The content and face validity of the instrument was established using the opinion of 3 experts in the faculty of Education, Nnamdi Azikiwe University. In order to establish the reliability of the BEAT, a pilot test was administered to 40 NTC II technical students from a government technical college Isseleuku in Delta state. .The reliability of the instrument was computed from the data collected using Kuder- Richardson formula 20 and a coefficient of 0.82 was obtained

Permission to carry out the experiment was sought by the researcher from the school authorities of the technical colleges to be involved in the research. The duration of the study was eight weeks. The first week was used to conduct the pre-test; from the second week to the fifth week lessons were carried out, sixth week was for the post test while the retention test was on the eight week. Students were taught once each week, with every lesson lasting for 80 minutes. Project-based learning method is the instructional technique that was used for the experimental groups while conventional teaching method (lecture and demonstration) was used for the control groups with appropriate lesson plans. From the data collected, research questions were answered using means and standard deviation. Research hypotheses were tested using Analysis of covariance (ANCOVA) at significance level of 0.05.

3. Results

Research Question 1

What are the mean achievement scores of technical college students taught Basic Electricity using project-based learning method as compared with those

taught using conventional teaching method?

Table 1: mean achievement scores of technical college students taught Basic Electricity using project-based learning method as compared with those taught using conventional teaching method

Group	N	Pre-test $\overline{X}$	Post-test $\overline{X}$	Mean gain	Remark
Experimental (project-based learning method)	49	35.45	68.12	32.67	More Effective
Control (conventional teaching method)	43	21.51	50.89	29.38	Less Effective

Table 1 shows that the students taught with project-based learning method had a pretest mean score of 35.45 with a posttest mean score of 68.12, while those taught using the conventional teaching method had a pretest mean score of 21.51 with a posttest mean score of 50.89. The analysis reveals that the mean achievement scores of students taught with project-based learning method is higher than those taught using the conventional teaching method because the gain in mean of 32.67 for the experimental group is greater than 29.38 gain in mean for the control group. This means that the mean achievement scores of students taught with project-based learning method was higher than those taught using the conventional teaching method.

Research Question 2

What are the mean retention scores of technical college students taught basic electricity using project-based learning method as compared with those taught using conventional teaching method?

Table 2: Mean retention scores of technical college students taught Basic Electricity using project-based learning method as compared with those taught using conventional teaching method

Group	N	Post-test $\overline{X}$	Retention $\overline{X}$	Mean difference (Gain/Loss)	Remarks
Experimental (project-based learning method)	49	68.12	71.07	2.95	Retained
Control (conventional teaching method)	43	50.89	47.64	3.25	

Table 2 indicates that the students taught using project-based learning method had a post-test mean score of 68.12 with a retention score of 71.07 while those taught using conventional teaching method had a posttest mean score of 50.84 with retention mean score of 47.64. The mean difference (gain) of 2.95 means that students taught using project-based learning method retained whereas students taught using conventional teaching method did not being that the posttest mean score was higher than the retention mean score with the mean difference(loss) of 3.25.

Null Hypothesis 1: There is no significant difference in the mean achievement scores of technical college students taught basic electricity using project-based learning method and those taught using conventional teaching method

Table 3: ANCOVA test on significance of difference between mean achievement scores of technical college students taught Basic Electricity using project-based learning method and those taught using conventional teaching method

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	1445.007[a]	2	722.504	100.473	.000
Intercept	4369.875	1	4369.875	607.685	.000
Achievement	.397	1	.397	.055	.815
Treatment	1308.402	1	1308.402	181.949	.000
Error	826.968	90	7.191		
Total	164629.000	92			
Corrected Total	2271.975	91			

a. R Squared = .636 (Adjusted R Squared = .630)

Table 3 reveals that the difference in the mean achievement scores of technical college students taught basic electricity using project-based learning method and those taught using conventional teaching method is significant because the p-value of 0.000 is less than the alpha level of 0.05 at 90 degree of freedom. Therefore, the null hypothesis is rejected, thus, there is significant difference in the mean achievement scores of technical college students taught basic electricity using project-based learning method and those taught using conventional teaching method.

Null Hypothesis 2: There is no significant difference in the mean retention scores of technical college students taught basic electricity using project-based learning method and those taught using conventional teaching method.

Table 4: ANCOVA test on significance of difference in the mean retention scores of technical college students taught Basic Electricity using project-based learning method and those taught using conventional teaching method

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	1268.389[a]	2	634.194	40.306	.000
Intercept	1528.879	1	1528.879	97.167	.000
Retention	107.460	1	107.460	6.830	.011
Treatment	618.797	1	618.797	39.327	.000
Error	1038.481	90	15.735		
Total	45582.000	92			
Corrected Total	2306.870	91			

Table 4 shows that the p-value of 0.000 is less than that the alpha level of 0.05 with 90 degree of freedom (0.00 < 0.05, df 90). This means that the null hypothesis is rejected, thus, there is a significant difference in the mean retention scores of technical college students taught basic electricity using project-based learning method and those taught using conventional teaching method.

4. Discussion of Findings

The result in research question one showed the pre-test and post-test mean achievement scores of technical college

students taught basic electricity using project-based learning method as compared with those taught using conventional teaching method. The analysis revealed that the mean achievement scores of students taught with project-based learning method was higher than those taught using the conventional teaching method. This finding was in line with the finding of Halil, Haydar and Aziz (2018) who discovered that project-based learning had a positive impact on academic achievement. This means that students expressed that they achieved meaningful learning as a result of the project-based learning application and the method was adequate for the instruction process, improved their performance in the course and related the content with daily life. The result in hypothesis one also revealed that there is significant difference in the mean achievement scores of technical college students taught basic electricity using project-based learning method as compared with those taught using conventional teaching method. This finding supported the finding of Halil, Haydar and Aziz (2018) that there is a significant difference in the academic achievement of students on instruction of AUTOCAD programming as a result of project-based learning application. This could be because project-based learning stimulates critical thinking skills and involves the active engagement of learners as they collaborate in groups.

Data obtained in research question two in Table two showed that students taught using project-based learning method retained more than students taught using conventional teaching method. This finding was in tandem with the finding of Okoro (2013) that those taught Home economics with project-based method were able to retain more than those taught with lecture method. This invariably means that students who were educated by project-based learning were more successful and had higher retention scores towards the lesson than the students who were educated by the instruction based on student textbooks. Hypothesis two revealed that there is a significant difference in the mean retention scores of technical college students taught basic electricity using project-based learning method and those taught using conventional teaching method. This finding was in line with the finding of Gokhan (2011) that there is a significant difference between the retention scores of the experimental group and the control group. This finding further buttresses the ability of project-based learning method in helping students

acquire knowledge and skills which are rarely lost over time since the concepts will be well internalized.

Conclusion

This study has revealed that project-based learning method had a lot of significant effect on technical college students' achievement and retention ability in technical college subjects such as basic electricity. Application of project-based learning method has been shown to be more efficacious than teaching with conventional method. This could also be so for technical college students in other technical subjects.

Recommendations

The following recommendations were made;

1. Teachers and students as agents of educational reforms should be encouraged to make use of project-based learning method more often in order to enable them properly evaluate themselves, know their present stand in the subject content and discover the area to improve upon to achieve an improved academic achievement in Basic Electricity subject content.
2. The curriculum planners should modify basic electricity curriculum to include the use of innovative teaching method like the project-based learning method in order to enhance the participation and achievement of students in Basic electricity.
3. The ministry of education in Nigeria should organize seminars, workshops and conferences for Basic Electricity teachers on how to use project-based learning method in teaching Basic Electricity.
4. The ministry of education should also provide sufficient tools and materials required for implementation of project-based learning instructional technique.

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