GENDER-RELATIVE EFFECT OF PROJECT-BASED LEARNING METHOD ON ACADEMIC ACHIEVEMENT AND RETENTION OF TECHNICAL COLLEGE STUDENTS IN BASIC ELECTRICITY

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Abstract

The gender-related controversies associated with effects of various teaching methods gave rise to this study. This study was conducted to ascertain the gender-relative effect of project-based learning 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. This was precisely, pretest, posttest, delayed posttest non-randomized control group design which involved 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 male and female technical college students taught Basic electricity using project-based learning method had higher achievement and retention scores than those taught using the conventional teaching method. Also findings revealed that there was no significant difference in the mean achievement and retention scores of the male and female students taught basic electricity using PBLM. Based on the findings of this study, it was concluded that PBLM has the potential to improve male and female technical college 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 and grant students equal opportunity during classroom instructions irrespective of gender so as to enhance students' academic achievement and retention in the subject.

Keywords: Gender, Project-based learning, Academic achievement, Retention, Basic Electricity, Technical colleges

Introduction

The controversies on gender in the school achievement and classroom behavior have continued to be inconclusive. Review of literature reveals that there have been diverse opinions on the effect of teaching methods on particular genders in different subjects. These variations could be attributed to sex-role stereotype. Based on our socio-cultural background, certain vocations have been regarded as men's(engineering, agriculture, etc)while others as women's (catering, nursing, etc) (Eze, Ezenwafor & Obidile , 2016). The effect of gender on the academic

achievement and retention of students has in recent times been attracting attention from researchers and psychologists.

Gender is the state of being male or female. According to Adigun, Irunokhai, Sada & Adesina (2015), gender is the range of physical, biological, mental and behavioral characteristics pertaining to and differentiating between the feminine and masculine population. Worthy of note is the reality that most technical classes comprise both male and female students. Controversies exist as to the performance of gender groups in technical subjects. This is because it is being perceived as a male dominated area. Sex/gender stereotypes has led to certain vocations being attributed to a particular gender. Ogbonna in Oludipe (2012) is of the view that male students perform better than their female counterparts while Ojikutu in Ezeudu (2014) is of the opinion that there are no differences in academic achievement of gender groups in technical subjects. This study is concerned with the variations in performance of gender groups in technical subjects with particular reference to Basic Electricity.

Basic electricity is one of the fundamental subjects offered in electrical installation and maintenance practice, radio and television (RTV) and electronic trades (Amadike, 2015). This is because The National Business and Technical Examination Board (NABTEB) syllabus outlined basic electricity as one among the trade-related subjects to be offered at the Technical Colleges level (NABTEB, 2011).

A technical college is an institution where one can study science and technical subjects often as part of the qualifications and training required for a particular job. 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 performance of students in subjects taught in the technical colleges is measured via their academic achievement and concept retention thereafter.

Academic achievement connotes performance in school subjects as symbolized by a score on an achievement test (Jimoh, 2010). Achievement is quantified by a measure of the student's academic standing in relation to those of other students of same academic level and age limit. Thus, the researcher defines academic achievement as the performance outcomes that indicate the extent to which a person has accomplished specific goals that were the focus of activities in instructional environments, specifically in technical colleges. Sustainability of this accomplishment is an evidence of retention.

Retention is the ability to keep or retain the knowledge of what is learnt and be able to recall it when it is required (Hon-Hau, 2015). For the purpose of this study, retention is viewed as the ability to remember or recall what is taught at the time it is needed. Many researchers for example, Okoro, (2013) and Obidile (2017) have in the past carried out studies on retention in one field or the other in relation to teaching methods. They all viewed retention as important in sustenance of achievement. In the quest towards modern technological advancement, Nigeria needs nothing short of good performance at all levels of schooling. Unfortunately, low academic achievement 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

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(NABTEB, 2018). This low academic achievement has affected the products of technical colleges adversely both in Anambra state and the nation in general. Researchers such as Ali (2013) and Ganai and Muhammad (2013) observed that students' academic achievement is affected by a host of factors including teaching methods. Research over the years has shown that teachers have been depending on excessive use of words to convey ideas and facts, otherwise referred to as the conventional teaching method, in the teaching and learning process.

The conventional method of teaching is the traditional teaching method otherwise referred to as the talk-chalk method of classroom teaching. It is a teacher-centered approach to instruction. Tella et al., (2010) averred that teacher-centered methods are associated with inadequate stimulation of students' innovative capacities, shallow intellectual thinking, cramming of facts, poor knowledge, poor retention and dependency of students on their teachers. These inadequacies of this teaching method which is currently in use could be responsible for the recurrent low academic achievement being recorded. It is therefore the opinion of the researcher to try out other student-centered teaching methods such as project-based learning method to ascertain its effect.

Project-based learning (PBL) is an innovative, systematic teaching method that promotes student engagement through deep investigations of complex questions. Bako (2017) defined project-based learning method as one of the modern methods of teaching in which the students' point of view is given importance in designing the curricula and content of studies. This approach is based on the philosophy of pragmatism and the principle of learning by doing. In the opinion of Proulx (2014), project-based learning method is a systematic process which facilitates acquisition and transfer of learning, anticipation, planning, and implementation individually or paired under the supervision of a teacher. It emphasizes a process where learners plan their own learning processes individually or in a group to reach certain goals, developing their skills of collaboration, responsibility, collecting information, and organization of collected information. Project-based learning is defined by Erdem and Akkoyunlu (2012) as a learning approach based on project development, imagination, planning and construction. PBLM is selected for this study because it concentrates on hand dexterity which is of great essence in basic electricity based on its objectives. PBL could enhance students understanding of basic electricity, keep students busy and active in the class and give teachers opportunity to build stronger relationship with their students by acting as their hands-on learning facilitator. Students here refer to both genders.

The controversies on gender in the school achievement and classroom behavior have continued to be inconclusive. The effect of gender on the academic achievement of students has in recent times been attracting attention from researchers and psychologists. Eze, Ezenwafor& Obidile(2016),Owodunni & Ogundola (2013) among other researchers have carried out studies on the effect of teaching methods on gender groups but there has not been any study done to determine the effects of project-based learning method on male and female technical college students in Basic electricity. This prompted the researcher to carry out this study.

Statement of the Problem

Recent NABTEB results show that the issue of low academic achievement for male and female technical college students in Basic electricity persists. This trend has been attributed to teaching methods. Gender awareness in recent times has militated against gender stereotypes, thus giving room for more females to have equal educational opportunities as their male counterparts. Despite the recent events and developments, it is evident that there has been continual inconsistency in the recent research findings on the academic achievement and

retention of gender groups. It is also clear that there is no consensus on which of the gender group achieves more or higher than the other. Hence, there is therefore a need to investigate the effect of a student-centered instructional strategy (in this case project-based learning method) on academic achievement and retention of gender groups in basic electricity.

Purpose of the Study

The main purpose of this study was to determine the relative effect of project-based learning method on academic achievement and retention of technical college students 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 based on gender.
2. Effect of project-based learning method on the mean retention scores of technical college students in basic electricity based on gender.

Research Questions

The following research questions will guide the study:

1. What are the mean achievement scores of technical college male and female students taught basic electricity using project-based learning method?
2. What are the mean retention scores of technical college male and female students taught basic electricity using project-based learning method?

Null Hypotheses

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

1. There is no significant difference in the mean achievement scores of male and female technical college students taught basic electricity using project-based learning method.
2. There is no significant difference in the mean retention scores of male and female technical college students taught basic electricity using project-based learning method.

Method

The design of this study is quasi-experimental research design of pretest, 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 students. 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 and were developed by the researcher from NABTEB examination past questions and

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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 students from a government technical college Issele uku in Delta state (this is because they are not part of the population under study). 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. The six weeks period between the pre-test and post-test was long enough to disallow the pre-test from affecting the post-test. To prevent class interaction, during the test administration, the male students were separated from the females to ensure that the results gotten could solely be attributed to the gender the data emanated from. 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. ANCOVA was used to check initial group difference since intact classes were used.

Results

Research Question 1: What are the mean achievement scores of technical college male and female students taught basic electricity using project-based learning method?

Table 1: Mean achievement scores of technical college male and female students taught basic electricity using project-based learning method

Gender (Experimental)	N	Pre-test X	Post-test X	Mean gain	Remark
Male	38	23.67	71.56	47.89	More effective
Female	11	21.11	66.93	45.82	

Data analyses in Table 2 reveals that the male students taught using project-based learning method had a pretest mean score of 23.67 with a posttest mean score of 71.56 while the female students taught using project-based learning method had a pretest mean score of 21.11 with a posttest mean score of 55.93. The gain in mean (47.89) of male students was higher than that of their female counterpart (45.82). This means that the mean achievement scores of male students taught using project-based learning method is higher than their female counterparts taught using project-based learning method.

Research Question 2: What are the mean retention scores of technical college male and female students taught basic electricity using project-based learning method?

Table 2: Mean Retention Scores of Male and Female taught using Project-based Learning Method

Gender (Experimental)	N	Post-test $\overline{X}$	Retention $\overline{X}$	Mean difference	Remarks
Male	38	71.56	76.10	4.54	Retained more
Female	11	66.93	69.02	2.09	

Table 2 shows that the male students taught using project-based learning method had a posttest mean score of 71.56 with a retention score of 76.10 while the female students taught using project-based learning method had a post mean score of 66.93 with a retention score of 69.02. The mean difference of 4.54 shows that male student retained more than their female counterpart having a difference in mean of 2.09. The analysis therefore revealed that mean retention scores of male students taught using project-based learning method is higher than their female counterparts.

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

Table 3: ANCOVA test on significant difference in the mean achievement scores of male and female technical college students taught basic electricity using project-based learning method

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	78.437[a]	2	19.609	3.691	.007
Intercept	98.331	1	98.331	18.507	.000
Achievement	.068	1	.068	.013	.910
Gender	.629	1	.629	.118	.731
Treatment	7.982	1	7.982	1.502	.223
Error	600.385	47	5.313		
Total	23057.000	49			
Corrected Total	678.822	48			

a. R Squared = .116 (Adjusted R Squared = .084)

Table 3 reveals that the p-value of 0.731 is greater than 0.05 alpha level at 47 degree of freedom. Therefore, the null hypothesis is accepted, thus, the difference in the mean achievement scores of male and female technical college students taught basic electricity using project-based learning method is not significant.

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

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Table 4: ANCOVA test on significance of difference in the mean retention scores of male and female technical college students taught basic electricity using project-based learning method

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	6356.390[a]	1	6356.390	276.005	.000
Intercept	644403.000	1	644403.000	27981.086	.000
Gender	6.614	1	6.614	1.245	.267
Treatment	6356.390	1	6356.390	276.005	.000
Error	2671.474	47	23.030		
Total	655788.000	49			
Corrected Total	9027.864	48			

a. R Squared = .704 (Adjusted R Squared = .702)

The result in Table 4 shows that the p-value of 0.267 is greater than the alpha level of 0.05 at 47 degree of freedom (0.267 > 0.05, df 47). This implies that gender effect on retention is not significant. Therefore, the null hypothesis is accepted, thus, the difference in the mean retention scores of male and female technical college students taught basic electricity using project-based learning method is not significant.

Discussion of Findings

Research question one revealed that the mean achievement scores of male students using project-based learning method is higher than their female counterparts taught using project-based learning method. The finding supported the finding of Bako (2017) that male students significantly performed better than female in the use of project teaching methods to teach brooding skills. Also, the finding aligned with the finding of Lihan (2014) that male students who participated in the PBL environments not only enriched and expanded their knowledge but also achieved academically higher than their female counterpart. This could be owing to the opinion that males are more practically-oriented than females. Result from hypothesis one revealed that the difference in the mean achievement scores of male and female technical college students taught basic electricity using project-based learning method is not significant. This finding agreed with the finding of Lihan (2014) that as regards gender, there was no significant difference in the mean achievement scores in the efficacy of project-based learning approach on social studies education. This finding was contrary to the finding of Bako (2017) that there was a significant difference in the male and female students' acquisition of brooding skills in facilitating agricultural education. This variation in the finding could be as a result of geographical change, and use of different subject coverage.

Result in research question two revealed that the mean retention scores of male students taught using project-based learning method is higher than their female counterparts. This finding opposed the finding of Okoro (2013) that female students retained more than their male counterpart in Home Economics class when taught using project-based learning method. This variation could be as a result of different subject coverage because it is generally believed that Home Economics is a female dominated subject compared to basic electricity that is considered a male inclined subject. The result analyzed in hypothesis two revealed that the difference in the mean retention scores of male and female technical college students taught basic electricity using project-based learning method is not significant. Gokhan (2011) agreed with this finding that there is no significant difference in the mean retention scores of both male and female

students taught using project-based learning method. Similarly, the finding also supported the finding of Okoyefi (2014) that there was no significant difference in the mean retention scores of male and female students exposed to project-based learning method. This could be because although there may be varied opinions on the performance of particular genders in technical subjects, both genders' level of retention was averagely the same owing to the effect of project-based learning method on them.

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. Also, there is no significant difference in the mean achievement and retention scores of male and female students taught Basic electricity. This implies that project-based learning method brought about improvement in academic achievement and retention of both genders.

Recommendations

Based on the findings of the study, the following recommendations were made;

1. Basic electricity teachers should not introduce gender discrepancies in the classroom. They should as much as possible eliminate instructional techniques and materials that may bring about gender differences in the classroom.
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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