

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

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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 the design of the study was quasi-experimental research with pretest, posttest, delayed posttest non-randomized control group design involving students' intact class groups. A sample of 92 NTC II students was drawn from a population of 179 students of state-owned technical colleges in Anambra state. The study was guided by two research questions and two null hypotheses which were tested at 0.05 level of significance. For collection of data, based on the units covered, Basic Electricity Achievement Test (BEAT), a 40-item multiple choice test served as the instrument. Validation of the instrument, as well as the lesson plans for both control and experimental groups were done by three experts from the faculty of education, Nnamdi Azikiwe University Awka. KR-20 was used to determine the reliability coefficient of the instrument which was found to be 0.82. The research questions were answered using mean and standard deviation, while the hypotheses were tested using Analysis of Covariance (ANCOVA). Findings revealed that considering the both genders, students in technical college who were taught Basic electricity using project-based learning method had higher achievement and retention scores than those taught with the conventional teaching method. Also, findings revealed that there was no significant difference in the mean achievement and retention scores of the 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 student's equal opportunity during classroom instructions irrespective of gender so as to enhance students' academic achievement and retention in the subject.

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Introduction

Gender related issues have continued to raise inclusive controversies in the school achievement and classroom behavior. 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 considered to be men oriented, (engineering, agriculture, etc) and some others to be women oriented (catering, nursing, etc) (Eze, Obidile & Akamobi, 2019). Attentions of psychologists and researchers have been drawn to the effect of gender on the academic achievement and retention of students in the recent times.

Gender refers to the state of existing as a male or a female. According to Adigun, Irunokhai, Sada & Adesina (2015), gender can be seen as the variation of substantial, natural, psychological and performance features relating to and distinguishing between the feminine and masculine population. Worthy of note is the reality that most technical classes comprise of students from both masculine and feminine populace. 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 students of male gender have better performance than their co-female students while Ojikutu in Ezeudu (2014) has 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, according to Amadike, (2015), is one among the fundamental subjects offered in electrical installation and maintenance practice, radio and television (RTV) and electronic trades. This is because; basic electricity is outlined in The National Business and Technical Examination Board (NABTEB) syllabus to be offered as a trade-related subject in 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. Federal Ministry of Education, (2013) pointed out that the establishment of Technical Colleges (TC) in Nigeria was intended for the production of craftsmen at (secondary) level as well as master craftsmen at the advanced craft (post-secondary) level. The performance of students in subjects taught in the technical colleges is measured via their academic achievement and concept retention thereafter.

Academic achievement implies how students perform in school subjects' achievement test which is indicated by their scores. (Jimoh, 2010). Quantifying students' achievement has to do with

the measure and comparison of student's academic position with those of other students of same academic level and age limit. Thus, the researchers define academic achievement as the extent to which student is able to accomplish the specific goals of a subject which is signified by the outcome of their performance, specifically in technical colleges. Sustainability of this accomplishment is an evidence of retention.

Retention is the ability to hold and remember acquired knowledge when it is needed (Hon-Hau, 2015). In this study, retention is viewed as being able to recall what is taught in an instructional environment at the time it is required. 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 highly needs good performance of the students at all school levels. 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 cases of low academic achievement or performance still persists as revealed by NABTEB results (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) revealed that a host of factors affect students' academic achievement which includes 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 instructional process.

The conventional teaching method 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 engraved with a lot of inadequacies which includes inability to stimulate students' innovative capacities, non-expansion of students' intellectual thinking ability, encouragement of cramming of facts, poor knowledge development, poor retention as well as students' high dependency on the teachers. These inadequacies of this conventional 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.

Argument and issues continued to be inclusive on the effect of gender on students' achievement and behaviour in the classroom. In the recent times, attention of psychologists and researchers have been drawn to the relationship between gender and the academic achievement of students. 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 establish the gender relative effects on Basic electricity students' academic achievement in technical colleges using a project-based learning method. This prompted the researchers to delve into this study area.

Method

Quasi-experimental research of pretest, posttest non-randomized control group was adopted as the design of this study. The research was conducted in Anambra state and the population was 179. This population was made up of the National Technical College (NTC) II Basic electricity students in state owned technical colleges in Anambra state. This was according to the available records at the Post Primary Schools Service Commission (PPSSC) Awka as at July 2019. Two schools were purposively selected with the sample size of 92 NTC II students. There was a random selection of one class from each school making a total of two intact classes. In selecting the intact classes that will be in experimental and control groups respectively, a simple random sampling technique (balloting) was used. The sample for the study comprised students in the two selected intact classes. The assignment of the intact classes to the treatment conditions was done randomly. 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. For collection of data, Basic Electricity Achievement Test (BEAT) was used as the instruments. The Basic Electricity Achievement Test (BEAT) comprises of two sections. Section A and B covered an enquiry on the

students' personal data and 40 multiple choice items respectively. Each item of the multiple choice has four options lettered A to D. Content areas selected from two topics (Transformer and Capacitors) constituted the instruments and the instruments 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 posttests, 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 instruments were both face and content validated by 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 Issele uku in Delta state (this is because they are not part of the population under study). The collected data was used to compute for the instrument's reliability using Kuder- Richardson formula 20 and 0.82 was obtained as the reliability coefficient.

Permission to carry out the experiment was sought by the researcher from the school authorities of the colleges that were part of 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 posttest while the retention test was on the eighth 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. The collected data were analyzed, mean and standard deviation were used to answer the research questions while Analysis of covariance (ANCOVA) was used to test the hypotheses at significance level of 0.05.

Result and Discussion

Research Question 1

What are the gender-based achievement mean scores of Basic electricity students in technical college taught using project-based learning method?

Table 1. Gender-Based Achievement Mean Scores of Basic Electricity Students in Technical College Taught Using Project-Based Learning Method

Gender (Experimental)	N	Pre-test \bar{X}	Post-test \bar{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 1 reveals that the pretest and the posttest mean scores of the students in male gender group who were taught using project-based learning method were 23.67 and 71.56 respectively while their female counterpart had 21.11 and 55.93 respectively. The mean gains of

47.89 for the male gender and 45.82 for the female gender shows that the achievements mean scores for the male students was higher than that of the females.

Table 2. Gender-based Retention Mean Scores of Basic Electricity Students in Technical College Thought Using Project-Based Learning Method

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

Table 2 shows that the posttest mean and retention mean scores of the students in male gender were 71.56 and 76.10 respectively while their female counterpart had 66.93 and 69.02 respectively. This implies that differences of 4.54 for the males and 2.09 for the females show that male students retained more than their female counterpart.

Null Hypothesis 1: Based on gender, significant difference does not exist in the achievement mean scores of technical college students taught basic electricity using project-based learning method.

Table 3. ANCOVA Test on Significant Difference in the Achievement Mean Scores of Technical College Students Taught Basic Electricity Using Project-Based Learning Method Based on Gender

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)

From the Table 3 above, it can be seen that the hypothesis is accepted since the p-value is 0.731 which is higher than the alpha level of 0.05 at degree of freedom of 47. Thus, based on gender, significant difference does not exist in the achievement mean scores of technical college students taught basic electricity using project-based learning method.

Null Hypothesis 2: Based on gender, significant difference does not exist in the retention mean scores of technical college students taught basic electricity using project-based learning method.

Table 4: ANCOVA Test on Significant Difference in the Retention Mean Scores of Technical College Students Taught Basic Electricity Using Project-Based Learning Method Based on Gender

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)

from Table 4, it can also be observed that the hypothesis is accepted too having the p-value of 0.267 which is equally higher than the alpha level of 0.05 at 47 degrees of freedom ($0.267 > 0.05$, $df\ 47$). This implies that based on gender, significant difference does not exist in the retention mean scores of technical college students taught basic electricity using project-based learning method.

The study revealed from research question one that the achievement mean scores of students in male gender was higher than that of their female counterpart after teaching them using project-based learning method. The finding supported the finding of Bako (2017) that students in male gender significantly do well more than their female counterpart in the use of project teaching methods to teach brooding skills. Also, the finding aligned with the finding of Lihan (2014) that the knowledge of students in male gender who were involved in the project-based learning environments was not only enhanced and developed but also had higher academic achievement 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 based on gender, significant difference do not exist in the achievement mean scores of technical college students taught basic electricity using project-based learning method. This finding agreed with the finding of Lihan (2014) that as regards gender, significant difference does not exist in the achievement mean scores of social studies students when thought using project-based learning approach. This finding was contrary to the finding of Bako (2017) that based on gender, significant difference exists in the 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 shoes that students in male gender had higher retention mean scores than their female counterpart after teaching them using project-based learning method. 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 based on gender, significant difference does not exist in the retention mean scores of technical college students taught basic electricity using project-based learning method. Gokhan (2011) agreed with this finding that significant difference does not exist in the retention mean scores of students taught using project-based learning method based on gender. Similarly, the finding also supported the finding of Okoyefi (2014) that based on gender, significant difference does not exist in the retention mean scores 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 technical college students, when taught their subjects such as Basic electricity using project-based learning method, had a lot of significant effect in their achievement and retention ability. Also, based on gender, significant difference does not exist in the achievement mean and retention mean scores of the students when taught Basic electricity using project-based learning method. This implies that project-based learning method brought about improvement in academic achievement and retention of both genders.

From the foundation given by the results of this study, the conclusion is that PBLM has the potential to academically improve Boys and Girls achievement and retention Informatics Engineering in the field of Basic electricity. Based on the research results, it can be recommended as follows;

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 curriculum for basic electricity to enhance students' participation and achievement by inclusion of the use of innovative teaching approach.
3. There should be organization of seminars, workshops and conferences by ministry of education in Nigeria for Basic Electricity teachers on the implementation strategies for project-based learning method for teaching of 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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