

EFFECTS OF PROJECT- BASED LEARNING APPROACH ON ACHIEVEMENT AND INTEREST OF BASIC TECHNOLOGY STUDENTS IN JUNIOR SECONDARY SCHOOLS IN BIDA AND KONTAGORA AREAS OF NIGER STATE

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Abstract

The purpose of this study was to ascertain the effects of project-based learning approach on interest and achievement of basic technology students in junior secondary schools in Bida and Kontagora areas of Niger State. Three research questions and three null hypotheses guided the study. The design of the study was quasi-experimental, on-equivalent Control Group Design. The design was appropriate since randomization of subjects was not done and intact classes were used. The population for the study was 2,809 JSS II students made up of 1,246 male and 1,563 female students and the sample size was 200 students from the four intact classes used for the study. Each intact class came from one coeducational school, used for the study with two from Bida zone for one class each representing experimental and control groups. Similarly, the other two classes came from Kontagora Education zone, one each for Experimental and Control group. Purposive sampling was used in selecting the four schools. The four intact classes used were purposely drawn from the coeducational schools in the local government area of the State in order to determine which of the schools becomes the Experimental or the Control group. The instruments of Basic technology Achievement Test (BTAT) and Basic technology Interest Inventory (BTII) were used to collect data on interest and cognitive achievement of students in Basic technology respectively. The three research questions were answered using mean and standard deviation scores while Analysis of Covariance (ANCOVA) was used in testing the null hypotheses at 0.05 level of significance. The results revealed that the use of project-based learning as a teaching method increased students' interest and achievement in basic technology more than the conventional chalkboard method of teaching. Both

male and female students achieved highly as a result of the use of project-based learning on students' achievement in Basic technology. The male and female students' achievement in experimental group increased highly as a result of the use of project-based learning. Based on the results, it was recommended among others that Basic technology teachers be trained on how to master the technique needed for preparation and the use of project-based learning for effective teaching and learning of basic technology by students.

Keywords: Project-based learning, achievement, interest, basic technology

Introduction

Project-based learning is a method of instruction that uses ill structured problem as a context for students to acquire problem solving skills and basic knowledge. Uba (2014) defined problem solving as a way of learning which encourages a deeper understanding of the materials rather than superficial coverage, and also a problem-oriented learning by which students can not only get basic knowledge while learning, but also experience how to use their knowledge to solve real world problems. It may mean that problem solving method is not just for problem solving, but that it goes beyond helping students to acquire problem solving skills to helping them also to increase their understanding and knowledge through solving real life problem.

In other words, project based learning is a teaching strategy used to improve the knowledge and understanding of students in a subject using series of learning activities. It may involve thinking skills for the attainment of collective goals. In addition, it involves the end products that are elaborate and shape the production process, such as a computer animation piece which requires extensive planning and labour. When appropriate strategy like project based learning is adopted in teaching and learning process, it will go a long way to foster students' academic achievement especially in basic technology.

In Nigerian Junior Secondary Schools, basic technology is one of the pre-vocational subjects offered. According to Udofia (2008), the pre-vocational subjects provide students with a process of orientation in production and consumption through experiences in planning, testing, servicing, and evaluating different types of consumer and industrial goods. There are very specific methods to assure the success of teaching and it is essential that both teachers and educators are aware of them (Savery & Duffy, 2013). According to Howard (2014), pointed out that one of the interesting methods is project based learning which is capable of making the students have an active control over their own learning and at the same time enhancing their academic achievement.

Academic achievement, according to Dori (2015), refers to some method of expressing a student scholastic 'standing. This can be regarded as course or subject grade, an average for a group of courses/subjects in a programme of study. According to Gulbahar and Tinmaz (2012) and Nnodi (2012) in their studies carried out among junior secondary school social studies and business studies students respectively, it was revealed that students exposed to cooperative learning technique recorded greater achievement.

Series of researches (such as Omeje, 2013 & Biajone 2014) have been carried out on gender, influence on the academic achievement of students. Bas and Beyhan (2011) research reveals that there was no gender difference in academic achievement in a competitive learning group while Howard (2014) reported that gender differences exist on academic achievement of the students with male having higher scores than girls in integrated science. The empirical revelation in support of project-based learning technique has not shown the extent to which this technique is beneficial in basic technology. No empirical study in this regard has been made, hence the need for the study.

Statement of the Problem

The teaching and learning of Basic Technology in junior secondary schools still remain a problem to Basic Technology teachers due to the abstract nature of some many concepts in the subject. The high rate of failure in Basic Education Certificate Examination (BECE) has become a subject of constant comments by many people who discovered that the traditional principle of learning established by experimental psychologists are inadequate in solving practical problems.

The trend in science and technology teaching over the last few years has been towards emphasizing problem solving and students' centred learning. Several strategies (like hypermedia instruction, web based learning, just in time instruction etc) were employed to improve students' performance in school subjects in Nigeria. Among them also is the use of project-based learning for classroom instruction. Based on this, the researchers decided to determine whether project-based learning would improve Basic Technology students' achievement in Junior Secondary schools in Bida and Kontagora areas of Niger State.

Purpose of the Study

The major purpose of the study was to ascertain the effects of project – based learning approach on achievement and interest of basic technology students in junior secondary schools in Bida and Kontagora areas of Niger State. Specifically, the study sought to determine the effect of project-based learning on the:

1. achievement of JSS II students in Basic technology.
2. achievement of male and female JSS II students in Basic technology.
3. interest of JSS II students in Basic technology.

Research Questions:

1. What is the difference in the mean achievement score of students taught Basic technology using project-based learning (PBL) and those taught with conventional method?
2. What are the mean achievement scores of male and female students taught Basic technology using project-based learning?
3. What is the difference in the mean interest score of students taught Basic technology using project - based learning (PBL) and those taught with conventional method?

Hypotheses:

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

1. There is no significant difference in the mean achievement scores of students taught Basic technology with project-based learning and those taught with the conventional method.
2. There is no significant difference in the mean achievement scores of male and female students taught Basic technology with project-based learning.
3. There is no significant difference in the mean interest scores of students taught Basic technology with project-based learning.

Methodology

This study employed a quasi-experimental, non-equivalent Control-Group Design. Intact classes were used as experimental and control groups instead of randomization of samples. The study was conducted in Bida and Kontagora educational zones in Niger state. Niger State is made up of seven educational zones. The population for this study comprises all the 2,809 JSS II students in the two coeducational zones in the State. The population size was made up of 1246 males and 1563 females. The sample size was 200 students made up of 104 females and 96 males selected from the two educational zones used for the study.

Multistage sampling technique was used- first, the sampling of the educational zone: purposive sampling was used to select two (2) co-educational educational zones in the state. The schools selected from the zones had facilities for the study. Secondly, the sampling of the schools in order to assign to treatment condition was done using balloting without replacement technique; four intact classes from four coeducational schools were later used for the study, two of the classes (one experimental group and one control) from Bida and the other 2 (one experimental and one control) from Kontagora. The experimental group in each zone was exposed to project-based learning (PBL) while control group in each of the zones was exposed to conventional/chalkboard method.

Two instruments, structured by the researcher were used for the study. They are: Basic technology Achievement Test (BTAT) and Basic technology Interest Inventory (BTII). The BTAT consists of fifty (50) multiple choice questions; all from the five main contents of Basic technology namely; Introduction to Basic technology, Board practice and drawing materials/equipment, Hand cutting tools, Measuring tools and Basic forging operations. The BTAT was however developed from the listed contents by first constructing a table of specification from the five main contents under Basic technology. The objectives of the topics under Basic technology in JSS II Basic technology curriculum serve as a guide in developing the questions. Since Basic technology is important in different areas, 10 questions were drawn from each of the five contents under Basic technology. Odd numbers from 1 to 49 bear lower order questions while even numbers from 2 to 50 bear higher order questions. Each of the 50 BTAT questions carries 2 marks. Any student scoring 50% and above is assumed to have passed. A student answering correctly all the 10 questions on Introduction to Basic technology and some basic technology concepts must have scored 20 marks. Similarly on Board

practice and drawing materials/equipment and other related problems, each question carries 2 marks. Questions relating to Hand cutting tools are not exceptional as each of the questions bear 2 marks. Basic forging operations such as bending, upsetting, drawing down and radiusing have equal weighting with other concepts; each of the 10 questions carries 2 marks. On Measuring tools concepts and drawing, each of the 10 questions carries 2 marks also. The 50 BTAT questions when answered correctly attract 100 marks which correspond to 100%. Any of the students that scores 50% and above, is considered a high achiever. The second instrument is the Basic technology Interest (BTII) developed by the researcher. The instrument BTII was used to determine the students' interest level prior to treatment and after the treatment. The BTIS is a twenty (20) item interest scale. The instrument BTII is designed on the basis of a 4-point rating scale ranging from Strongly Agree (SA) (4 points), Agree (A) (3 points), Disagree (D) (2 points) to Strongly Disagree (SD) (1 point). Any student that scores a mean interest of 2.5 and above is considered high in terms of interest.

The instruments were face validated by five experts from the Federal University of Technology, Minna: three from Science Education, two from Industrial and Technology Education. The reliability coefficient of the instrument of BTII using the Cronbach Alpha formula was found to be 0.91. The research questions were answered using Means and Standard Deviations while the formulated null hypotheses were tested using the analysis of covariance (ANCOVA).

Result

Research Question1

What is the difference in the mean achievement score of students taught Basic technology using project-based learning (PBL) and those taught with conventional method?

To answer this question, mean scores and standard deviation of students in the Basic technology Achievement Test (BTAT) were determined and presented in Table 1 as shown.

Table 1: Mean and Standard deviation of the achievement scores for Experimental and Control Groups.

Groups	N	Post-Test Mean (X)	S D	Mean gain score
Experimental	100	63.88	2.07	28.70
Control	100	35.18	2.00	

The analyzed result presented in Table 1 reveals that the mean and standard deviation of post-test scores of the experimental group are respectively 63.88 and 2.07. Similarly, the mean and standard deviation of post-test scores of the control group are respectively 35.18 and 2.00. The experimental group had a mean score which is higher than that of the control group. Hence, the mean gain scores

between the experimental and control group is 28.70 which is in favour of the experimental group.

Research Question 2:

What are the mean achievement scores of male and female students taught Basic technology using project-based learning?

Table 2: Mean and standard deviation scores of the achievement scores of male and female students taught Basic technology using the project-based learning approach.

Sex	N	Post-Test Mean (X)	SD	Mean gain score
Male	52	67.19	2.12	6.90
Female	48	60.29	2.00	

Table 2 reveals the mean and standard deviation of the achievement scores of the male and female students taught Basic technology using project-based learning. From the result, the mean and standard deviation of post-test scores of male students are respectively 67.19 and 2.12. However, the mean and standard deviation of post test scores of the female students are respectively 60.29 and 2.00. Mean gain of the post test scores for male and female students is 6.90 favouring the male students.

Research Question 3

What is the effect of project-based learning on the mean interest scores of students taught basic technology using project-based learning and those taught with conventional method?

Table 3: Mean and standard deviation scores of the interest scores for Experimental and Control Groups.

Groups	N	Post-Test Mean (X)	S D	Mean gain score
Experimental	100	2.69	.34	.36
Control	100	2.33	.24	

The analysed result presented in Table 3 reveals that the mean and standard deviation of post-test of the experimental group are respectively 2.69 and .34. Similarly, the mean and standard deviation of post-test of the control group are respectively 2.33 and .24. The experimental group had a post-test mean score higher than the control group. Difference in the mean scores of experimental and control gives the mean gain score of .36 favouring the experimental group.

Hypotheses

1. There is no significant difference between the mean and achievement scores of students taught Basic technology with project-based learning and those taught with the conventional method.

Table 4: ANCOVA Result of Experimental and Control Groups on Basic technology Achievement Test (BTAT)

Sources of variation	Type III sum of Squares	df	Mean square	F	Sig
Corrected Model	71106.322 ^a	4	17776.580	66.247	.000
Intercept	46487.668	1	46487.668	173.244	.000
Pretest achieved	28647.080	1	28647.080	106.758	.000
Teaching methods	39494.920	1	39494.920	147.185	.000
Sex	4002.483	1	4002.483	14.916	.000
Group * sex	.547	1	.547	.002	.964
Error	52325.498	195	268.336		
Total	614076.000	200			
Corrected total	123431.820	199			

a. R Squared = .576, Adjusted R Square = 0.567

Table 4 shows that the main effect of project-based learning on achievement of students taught Basic technology using the package and those taught using the chalk board/conventional method produced F value of 147.185 which is significant at 0.000. The value of $F = 147.185$ is also significant at 0.05. $F = 147.185$ is significant at $p = .000$; $p < 0.05$. The experimental group treated with project-based learning approach produced significant difference on achievement. The hypothesis which states that there is no significant difference on the mean achievement scores of students taught Basic technology with and those taught Basic technology with the conventional method was therefore rejected. Adjusted R square value of 0.567 is the value of a in the ANCOVA table for achievement using the Statistical Package for the Social Sciences (SPSSx). This SPSSx is a statistical computer program designed to manipulate data and to display the results of this manipulation (Hinkle, Wiersma & Jurs, 1988).

2. There is no significant difference between mean achievement scores of male and female students taught Basic technology with project-based learning.

Table 5: ANCOVA Result of mean achievement scores of male and female students taught Basic technology with project-based learning.

Sources of variation	Type III sum of Squares	df	Mean square	F	Sig
Corrected Model	71106.322 ^a	4	17776.580	66.247	.000
Intercept	46487.668	1	46487.668	173.244	.000
Pretest achieved	28647.080	1	28647.080	106.758	.000
Teaching methods	39494.920	1	39494.920	147.185	.000
Sex	4002.483	1	4002.483	14.916	.000
Group * sex	.547	1	.547	.002	.964
Error	52325.498	195	268.336		
Total	614076.000	200			
Corrected total	123431.820	199			

Table 5 shows that effect of PBL on male and female students taught Basic technology using the package produced F value of 14.916 which is significant at .000 probability level. The value of $F = 14.916$ is also significant at 0.05. This means that $F = 14.916$ is significant at $p = .000$; $p < .05$. The male students treated with project-based learning produced significant difference on achievement from post test scores. The hypothesis which states that there is no significant difference in mean achievement scores of male and female students taught Basic technology with project-based learning was therefore rejected.

3. There is no significant difference in the mean interest scores of students taught Basic technology with project-based learning and those taught Basic technology with Conventional method.

Table 6: ANCOVA Results of Experimental and Control Groups on Basic technology Interest Scale (BTIS)

Sources of variation	Type III sum of Squares	df	Mean Square	F	Sig
Corrected Model	7.235 ^a	4	1.809	21.473	.000
Intercept	12.919	1	12.919	153.375	.000
Pre-test on interest	.023	1	.023	.273	.602
Teaching method	5.988	1	5.988	71.085	.000
Sex	.336	1	.336	3.990	.047
Group * sex	.479	1	.479	5.682	.018
Error	16.425	195	.084		
Total	1285.438	200			
Corrected total	23.660	199			

Table 6 shows that the main effect of project-based learning on interest of students taught basic technology using the package and the chalkboard method produced F value of 71.085 which is significant at .000. The value of $F = 71.085$ is also significant at 0.05. $F=71.085$ is significant at $p = .000$; $p < .05$. The experimental group treated with project-based learning produced significant difference on students' mean interest scores in Basic technology. The hypothesis which states that there is no significant difference on the mean interest scores of students taught Basic technology with project-based learning approach and conventional method as measured by the Basic technology interest inventory (BTII) was therefore rejected.

Discussion

The result presented in table 1 shows that the post-test mean achievement score (63.88) of students, taught Basic technology with project-based learning is higher than the post-test mean achievement score (35.18) of students taught Basic technology with chalkboard method. From table 5, it was confirmed that the achievement of experimental and control group differs significantly showing that treatment using project-based learning produced significant difference on achievement of students in Basic technology. This finding is in line with Mohammed (2015) who stated that PBL is used to enhance and support learning for improvement in students' performance in applied electricity. This finding is equally in conformity with Nnodi and Nuigbo (2012) who opined that PBL has improved greatly and have aided in the development of instructional materials for teaching and learning. Bas and Beyhan (2010) stated that computers facilitate effective presentation of information in PowerPoint environment.

The world is about to leave behind any one that is not full ICT compliant; that ICT is a powerful tool which take the form of texts, pictures, tables, graphs, Emails, fax, chat groups, discussion groups, SMSs, socializing portals, dictionaries, e-encyclopedia, power point presentations, websites and audio videos, that can play instructional roles which include making learners feel more relaxed to learn various topics and tasks and making them active as learning is technologically based.

The use of Project - based learning on Basic technology in teaching and learning is worthwhile. This finding is in agreement with Sungur and Tekkeya (2015) who pointed out that the Computer applications exist to aid every level of education. Sungur & Tekkeya also indicated that computers are used extensively in scientific research to solve mathematical problems. Problem of poor achievement of students in Basic technology in Basic technology has been solved using project-based learning. Uba (2014) also shows that the achievement of students exposed to Computer Software package was better than their counterparts exposed to conventional classroom instruction. Software packages like project-based learning should therefore be encouraged in teaching. The findings of this study have been found to be very useful to Basic technology teachers in agreement with Gulbaha and Tinmaz (2012) who stated that basic technology has always been a factor in the development of a nation. The researchers indicated that without Basic technology, the understanding of National problems would be superficial and the way to resolve certain problems of a nation is to actively encourage the use of simple mathematical models. With project-based learning,

Basic technology teachers now have a Computer package for teaching Basic technology concepts.

The results in table 2 shows that the post-test mean achievement of male and female students taught Basic technology using project-based learning favoured the two genders. However, male students taught Basic technology using project-based learning had mean score slightly higher than the female students taught Basic technology with project-based learning. Table 5 shows that the male students taught Basic technology with project-based learning produced significant difference on achievement when considered single. This result agrees with the findings of Omeje (2013) that e-learning Project - based learning improved students' achievement but that gender was a significant factor in students' acquisition of science process skills in Biology.

Also on gender, the result of this study agrees with Herbert and Stipek (2005) that boys had higher Basic technology competency than girls. Although Udofia (2008) indicated that gender issue is inconclusive from previous research findings, however, Uba (2014) later found out that brain-based adaptive learning had a significant effect on the academic competence of male and female students. Equally, PBL had a significant effect on the achievement of male and female students in Basic technology. This was seen in their mean achievement scores of 67.19 and 60.29 respectively as observed in table 2 in favour of male students. Project-based learning should therefore, be encouraged in teaching and learning Basic technology in junior secondary schools. This result is also in conformity with the findings of Sungur and Tekkeya (2015) that computer packages should be used for teaching male and female students for better understanding and higher achievement. The results presented in table 3 shows that the post-test mean interest score of students in experimental group was higher than the mean interest score for the control group. Also, table 6 shows that the experimental group treated with project-based learning produced significant difference on students' interest in Basic technology. This result is in line with the findings of Savery and Duffy (2013) that there was an improvement in students' interest in Basic technology when instructional package like Challenge-Based Learning (CBL) is used in teaching cutting tools to students.

Interest of students in learning with computer is encouraged with this result. Students in experimental group had higher mean interest scores than their counterparts who were taught Basic technology using the Chalkboard method. This is in agreement with Bas and Beyhan (2010) who pointed out that with Computer usage in teaching, students can listen to a piece of content in the classroom and be more interested in the learning content. No wonder, students in experimental group in this study cherished most, the summary slide with diagrams and audacity software played in Basic technology using Computer. Learning by viewing the screen is therefore, called for as stated in the Chinese proverb (Howard, 2014). The proverb states that what one sees and does often cannot be easily forgotten but is understood. This is seen in PBL as all students in experimental group were interested in the computer software package.

Implications of the Findings

The enhancement of teaching and learning promoted by the findings of this study has called for the basic technology teachers to use project - based learning in teaching Basic technology. As the use of project-based learning has made both male and female students to achieve highly in the concept of basic technology, project-based learning is not gender biased in terms of achievement. It should, therefore, be employed in teaching and learning to enable the students understand, develop critical and creative thinking in their minds and eradicate the problem of poor achievement in both internal and external examinations.

Conclusion

The use of project-based learning increased students' achievement and interest in Basic technology more than the chalkboard method. Basic technology teachers should be innovative by considering project-based learning for use as it enhances the achievement and interest of both male and female students in the Experimental group. Students taught Basic technology using the project-based learning performed higher than their counterparts taught the same Basic technology using the chalkboard method. There was a significant difference in gender on achievement and interest of students in Basic technology. Although both male and female students scored highly in achievement and interest, there was significant interaction effect in the students' interest in Basic technology. The achievements of both male and female students were enhanced as a result of the use of the project-based learning. Teachers of basic technology should be encouraged to use the project-based learning that is not gender biased for better performance by students.

Recommendations

Based on the findings of this study, the following recommendations were made:

- i. Basic technology teachers should use project-based learning strategies in teaching basic technology since the use has been found to enhance students' achievement and interest in Basic technology.
- ii. School Principals should provide and equip basic technology school workshops for more effective teaching to promote students' understanding.
- iii. Niger State Government should provide in-service training in all the seven education zones of the State to enable teachers master the use of project-based learning strategies in every concept in Basic technology.
- iv. Professional bodies like Science Teachers Association of Nigeria (STAN) and Nigeria Association of Teachers of Technology (NATT) in their annual conferences should promote project - based learning strategies in order to make teachers use this method in teaching Basic technology.

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