

IMPACTS OF PROJECT-BASED LEARNING METHOD ON ACHIEVEMENT OF BUILDING TECHNOLOGY EDUCATION STUDENTS IN COLLEGES OF EDUCATION OF NORTH WEST ZONE NIGERIA

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Abstract

The study examined the impact of project-based learning method on achievement of building technology students in colleges of education of North West Zone Nigeria. A pre-test, post-test, non-equivalent control group, quasi-experimental research design was adopted. The target population is 12,568 students of technical Education NCE (Tech) I, II & III students from four schools. The sample size for this study consisted of 132 (99 male and 33 female) building technology education students NCE II from two(2) out of four (4) colleges of education (technical) in the North west Nigeria. Two schools were purposively sample based on equivalence (facilities and manpower). The subjects were randomly assigned to experimental and control group. 64 students of (49 male and 15 female) were assigned to experimental group while 68 students of (50 male and 18 female) to control group. Two research questions and two null hypotheses, tested at 0.05 level of significance, guided the study. The instruments used for data collection were project-based learning method achievement test (PBLMAT). The items of the PBLMAT were drawn based on table of specifications built in order to ensure the content validity of the test. The instruments were also subjected to face validation by three (3) experts in Industrial and technology education department, federal university of technology, minna. The reliability co-efficient of the PBLMAT obtained was 0.76. The PBLM was made up of 80 items multiple-choice objective test questions to test students' cognitive knowledge and 5 practical questions, each comprising steps that tested students' project-based learning method PBLM a Likert scale with 30 items were used to determine the motivational beliefs of students taught Building Technology Achievements Test. Cronbach-Alpa and ANOVA were used for data analysis and were tested at 0.05 level of significance. The study revealed that there was a statistical significant difference in the mean scores of students taught using Project-based learning method (PBLM). The study also revealed that there was no statistically significant difference in the mean scores of male and female students taught using PBLM. Based on these findings, it was recommended that Colleges of education (Technical) adopt PBLM for effective teaching and learning of Building Technology.

Keywords: Project-based learning, Achievement, Method, Building Technology

Introduction

The overall growth and development of any nation is highly dependent on the extent of the impact of science and technology. Science and technology have greatly impacted every facet of human endeavours (Ratnasiri, 2006). The reality today is that science and technology have also permitted into teaching and learning process at all level of education which includes primary, secondary and tertiary institutions. It has specifically affected teaching and learning processes in secondary technical colleges as well as Colleges of Education(Technical) one of such area is the inclusion of vocational/ technical education and training (TVET) where building technology is offered and almost all the members of the society benefit from its products (Ogbuzuru, 2011). Building technology programme at the secondary technical college and College of Education (Technical) level is designed to produce skilled builders for the building industry. Building technology as a course comprises of different components or operations which requires different skills to perform them. These skills include workshop safety,

fenestration, bill of quantity drawing instruments, painting and decoration and their effects on building, designing of building plans, setting out of the building, excavation, block work on the concrete foundation, levelling of the building, roofing pattern, plastering and rendering of walls (Olawale, 2008). These skills requires that students should possess the necessary skills needed to carry out drawing in building technology (Ogbuzuru, 2011). Building technology is an aspect of TVET. The TVET is an education for work. According to Uwaifo (2016) TVET is any form of education whose purpose is to prepare person(s) for employment in an occupation or group of occupations. Similarly, Rolalrand (2004) stated that TVET is the acquisition of skills and techniques in chosen occupation or profession to enable an individual earn a living. Adeyemi and Uko-Aviomoh (2004) added that TVET is an aspect of education which leads to the acquisition of practical and applied skills which manifest in the ability to do something well.

Skills could be gained through experience and training on skill acquisition and development (Bakare, 2014). In addition Okorie (2010) stated that skill is a manual dexterity through repetitive performance of an operation. Okorie further explained that skill is expertness, practised ability, dexterity of fact .It is a well-established habit of doing things by the people.

Training in skills acquisition involves continuous practice in particular task till the learner becomes proficient in the operation and can perform them when required (Ali, 2016). Okorie (2010) further observed that to match procedural instructions with performance activities, skills are needed and there must be opportunities for participation and practice of such skills under real life situation to enable students acquired the needed skills. This is because skill acquisition is very necessary at this stage of Nigeria's economic and technological development.

But as important as acquiring skills look especially in building technology, the achievement of students has not being encouraging. Also, the level of interest towards the course is also at a low level as reported in the National Forum on Educational Technology (NFET 2011).

Student academic achievement according to (NFET 2001) is the attainment of articulated objectives by students, measured through a variety of identified instruments, which result in excellence and the ability to thrive in the rapidly changing world. The Forum on NFET noted that improved student achievement include improved scores on standardized tests, increased application and production of knowledge for the real world and increased ability of students to manage learning. This implies that academic achievement is a measure of what a student knows or can do after training. Students' achievements need to be improved in order to prepare them to succeed in the rapidly changing world. This may be achieved through the use of instructional guide for instruction. In this regard, Jonassen, Tessmer and Hannum (2014) stated that the use of Project-Based Learning Method (PBLM) for pedagogical purposes may help students develop better understanding of a subject which may lead to improved performance and desired outcomes in both practical skills and achievements.

Over the years, teaching method, based on behavioural learning theory has been adopted to teach vocational subjects in the technical colleges irrespective of the fact that technological advancement in industry requires that student be equipped with workplace basic skills such as thinking skills, problem solving and collaborative work skills which will make them adaptable to changes in workplace. According to Ratnasiri (2006) lecture method which are based on behavioural learning theory are the main teaching/learning method employed for implementing the curriculum in the technical colleges. Apart from the fact that these method are teacher-centered student are not given opportunities to participate in the classroom instruction. These methods which are predominantly used in teaching building technology in the technical colleges emphasize knowledge transmission from the teacher to passive student

and encourage rote memorisation of fact (Boyle, Duffy & Dimkavy, 2003) besides, teaching methods which are based on behavioural learning theories are directed towards isolating the learner from social interaction and towards seeing education as a one-on-one relationship between the learner and the objective material being learned (Okorie 2010). The consequence of the use of these methods in teaching vocational subjects such as building technology in technical colleges is that students are unable to retain their learning and apply it in new situations, Bakare (2014) indicated that traditional teaching-learning approaches based on behavioural learning theory do not adequately equip students with higher-order thinking skills, collaborative and problem solving skills, but constructivist theory does, perhaps, if thinking skills, oral discourse, authentic/situated learning, collaborative work and framing instructional techniques are combined during instruction to teach building technology in the technical colleges, it will assist in developing students thinking skills and problem solving abilities which may in turn help them to improve their learning methods employed by teachers in technical colleges thus, seem inadequate for equipping the students studying building technology with the workplace basic skills required for work in the building industries which is vast changing with technological advancements. This raises the questions as to whether besides the teacher-centered method there is no such teaching technique of the project-based learning method which can influence this ugly trend in the subject.

This raises the questions so as to acquire the desired skills, defined procedures described in a specific instructional design model should be carried out (Asad, Hassan & Sherwani, 2014). Berger and Kam (2011) expressed that PBLM is a 'the systematic development of instructional specifications using learning and instructional theory to ensure the quality of instruction. It includes development of instructional materials and activities; try out, and evaluation of all instruction and learner activities. There are several instructional design models which include: Experimental Learning Model or cycle. This is also known as 'Kolb's Cycle'; Dick and Cary Design Model; The Hannifen Peck Design Model; The Knirk and Gustafson Design Model; Jerold Kemp Design Model; The Gerlach-Elyl, PBLM among others. However, for many years now, educators and instructional designers alike used the PBLM as a guide in designing and effectively tracking a project's progress in education (National forum on education, 2004).

This means that even if an individual applies PBLM at the middle of the project, it will still retain its value and be able to provide a sense of structure to the whole programme. Educators find this approach very useful having stages clearly defined which makes implementation of instructions very effective. PBLM (Forest, 2014).

Several characteristics of Project-based learning method were given by Reiser and Dempsey (2014) and it was observed that PBLM is learner centred in which the learner is given first priority in the teaching-learning process. It is goal oriented in that the teacher sets attainable and measurable objectives. It focuses on meaningful performance through practical experience in which learners are actively involved. The model assumes that outcomes can be measured in a reliable and valid ways. It is empirical, iterative and self-correcting. And finally, instructional design model is typically a team effort. It is argued that though PBLM have similar components, they can vary greatly in the specific numbers of phases and their graphic representations (Gagne, 2011).

The PBLM is very important as supported by many authors (Reiser & Dempsey, 2014; Gagne 2011; & Bandhana, 2010). In PBLM there are various activities that must be considered in each step of the cycle which has the ability to fulfil the needs and requirements of today's students, through analyzing and identifying the problems and providing the solutions, accordingly. It involves standard practice usually used by instructional and training development. The PBLM is

a very flexible guide for constructing active and effective training and Instructional designing which are useful for building technology practical teaching. According to Reiser and Dempsey, (2014), Gagne (2011), Bandhama (2010) is the approach of receiving feedback while instructional materials are being created. PBLM is very effective model for instructional designing and also it saves time and money. In the Project-based learning method, each of the phases have an outcome that revolved into the later stages (Asad, Hassan & Sherwani, 2014). In the first phase of analysis, the evaluation can determine students' problem and its exciting solution, and in design phase the objective can evaluate the type of drawing to be carried out. In development phase the tester evaluate the desired requirements and ensure that learning takes place, and in the implementation stage is where the developed course is actually place into action and monitor its implementation while the evaluation stage involve an ongoing process or activity in all phases after every stages and review and analyses the feedback and to evaluates result from the learners, question that comes to mind here is can this approach to instruction enhance students' achievement?

Therefore this study was designed to access the impacts of PBLM on achievement of Building technology Students among colleges of Education in North West Zone Nigeria.

Statement of the Problems

Building technology education programme at Nigeria Certificate in Education (NCE, Technical) level is aimed at producing skilled craftsmen who will be able to perform basic functions in building technology both in private and public sector (National Board for Technical Education, 2011). Building technology education is a skill oriented programme whose graduates are expected to be self-employed or set – up their businesses after graduation. It has been observed that these objectives have not been achieved over the years (National Board for Technical Education 2011). The reason might be simply because they do not possess necessary skills which include workshop safety, fenestration, bill of quantity, drawing instruments, painting and decoration and their effects on buildings. Designing of building plan, setting out the building, excavation of trench, block work, on the concrete foundation, levelling of the building, roofing pattern, plastering and rendering, of wall, in the area that they were trained, and as a result they have no confidence in themselves to set up business which can be seen as their achievement. Students tend to learn only theory in school, hoping to learn practical's while at work place. (National Commission for College of Education, 2014)

The performance of students in building technology education has not been encouraging and is described as poor. This is evidenced in the performance of students (National Commission for Colleges of Education, 2013). This could be attributed to lack of interest of student. Teaching methodology of the teachers or as a result of insufficient guide to teach practical component of building technology. Lack of necessary instructional design model to implement the curriculum to the later by teachers. However several strategies have been used at this level to solve the problem such as the use of Computer assisted instruction (CAI), social media, inquiry, and V-mapping among others teaching strategies but this have persisted. Therefore PBLM is used as a teaching strategies which is interactive that may salvage the problems. The strategy considered by this study is the use of Project-Based Learning Methods. Therefore, the researchers seek to investigate the impacts of PBLM on achievement of building technology education students in Colleges of Education of North West Zone Nigeria.

Aim and Objectives of the Study

This study is aimed at investigating the impacts of PBLM on achievements of building technology education students in colleges of education students in North West Zone. Specifically the objectives of the study are as follows to:

- (I) Find out the impacts of PBLM on achievement of Building Technology education students at NCE (Technical) level.
- (iii) Determine whether gender has any impacts on the academic achievement of building technology education students when taught using PBLM.

Research Questions

The following research questions guided the course of the study:

- (i) Is there any difference in the Mean achievement scores of Students thought Building Technology using Project-Based Learning Method and lecture method?
- (ii) Does gender has any influence on the academic achievement of students thought building technology using the PBLM?

Research Hypotheses

The following Null hypotheses was tested at 0.05 level of significance

- Ho₁: There is no significant difference in the achievement scores of students taught Building Technology using PBLM and lecture method.
- Ho₂: There is no significant difference in the achievement scores of male and female students taught Building Technology using PBLM & Lecture method

Methodology

The study employed a pre-test and post-test, non-equivalent and non-randomised control group design of the quasi experimental research design. White (2014) stated that quasi experimental design involve selecting groups upon which a variable is tested without any random pre-selection. The research design was used to compares between the independent variable which is Project-based learning method, and the dependents variables which are achievements while the moderating variables is gender .The research design layout is as shown below.

Table 1: Quasi experimental research design is symbolically represented as follows.

Groups	Pretest	Treatment	Posttest
Experiment Group	O ₁	X ₁	O ₃
Control Group	O ₂	X ₂	O ₄

Where:

- O₁, O₂ - Pre-test Scores of Exp and Control Group
- O₃, O₄ - Post test Scores of Exp and Control Group
- X₁ - Project-Based learning method
- X₂ - Lecture Method

The strata has an experimental group which was taught using PBLM and a control group was taught using lecture method .The subjects was pretested before the treatment was given. After the treatment, the experimental group and control group were post tested.

The population of the study consisted of all students of the NCE (Technical) I, II & III students in Colleges of Education in North West Nigeria. The target population is 12,568 students of Technical Education NCE (Tech) 1, II&III students from four schools

The sample size for this study consisted of 132(99 male and 33 female) building technology

education students (NCE) II from two (2) out of seven (7) Colleges of Education (Technical) in North West Nigeria.

The two schools were purposively sampled based on equivalence (facilities and manpower), school type, gender composition (mixed schools), and exposure (students and teachers exposure to Building Technology in their schools). The subjects were randomly assigned to experimental and control group. 64 students of (49 male and 15 female) were assigned to experimental group while 68 students of (50 male and 18 female) to control group.

Federal College of Education (Technical) Bichi, Kano State students were assigned to experimental group while College of Education, Kafanchan, technical students were assigned to control group. These schools were believed to have shared common environmental conditions manpower and gender composition.

The following two research instruments were used by the researchers to generate data for the study. They include:-

1. **Treatment Instrument:** -Project-Based Learning Method (PBLM)
2. **Test Instrument:** Project-based learning method Achievement Test (PBLMAT)

The achievements instrument developed by the researchers is called PBLM Achievements Test (PBLMAT). It contains 80 multiple choice items with four options (A-D). There is only one correct option that carries 1 mark. The materials used to develop these items were the text books on building technology education for Nigeria Certificates in Education (Technical)

The test instruments had two sections (A&B). Section A contains the students bio-data. Section B contains 80 multiple choice items with four options (A-D) the items were constructed based on the concepts treated and the instructional objectives of the lesson. The items covered different levels of bloom taxonomy of educational objectives; knowledge, comprehension, application, analysis, synthesis and evaluation (Ali, 2016).

The BPAT was validated by two lecturers from Building Technology industrial and technology education, Department, Federal University of Technology Minna. The experts has examined and assessed all the items on the research instrument with reference to the following: Whether the items were appropriate for assessing students understanding of the topic to be taught? Whether the items were clear, readable and free from ambiguity for the level of the students they are designed to test? After the face and construct validation, the final instrument were modified based on the suggestions and feedback from the validators.

Pilot studies were carried out at Niger State College of Education Minna (School of Technical Education), the school was within the population but outside the sample schools. 30 students were sampled for the study, after the instrument, BTAT were administered, data from BTAT was collected using test-retest method, Pearson Product Moment Correlation Coefficient was used to analyse the data obtained and a reliability coefficient of 0.86was obtained while the reliability of the Building Technology education analysed using cronbach alpha and a reliability coefficient of 0.76 was obtained.

Method of Data Collection

The researchers visited the selected schools to seek for official permission from the school authorities through a letter of introduction before the commencement of the research. The course lecturers and, students were intimated on the purpose and significance of the study. The study lasted for six weeks. The first week was spent on administration of the pre-test which

is Building Technology Achievement Test (BTAT) by the researcher and research assistant that was trained on how to connect the system for projection to the students in the selected schools, the main objective of administering the test-re test is to determine the academic equivalent of students in the two groups before treatment. This was followed by administration of PBLM to experimental group which was projected using a projector in front of the classroom and lecture method was used to teach the control group by the researcher. Post-test of achievement test questions was administered in the last week to the two groups. The table below shows the Strategic Plan and Time Frame for the Research.

Table 2: The Strategic Plan and Time Frame for the Research

S/No	Steps	Activities	Duration
1.	Visitation	Visiting of two selected schools and inspection of the facilities.	1 week
2.	Lecturers orientation	Training of lecturers on the use of PBLM	1 week
3.	Administration	Administration of Pre -test post -test to the students	2weeks
4.	Treatment	Administering of treatment to the students.	2 weeks
5.	Administration of Questionnaire	Administration of questionnaire on students interest towards building technology which will be done concurrently during pretesting and post testing.	

The data gathered was analyzed using descriptive and inferential statistics. SPSS version 20 at 0.05 alpha level of significance was used for the analysis. The data collected from the pre-test was analysed with Analysis of Variance (ANOVA) and if significant, Analysis of Covariance (ANCOVA) was used to analyse the hypotheses while t-test was used to analyse the data collected from the interest inventory Mean and standard deviation was used to answer the research questions while ANCOVA was used to test null hypothesis raised for the study.

Results

Research Question 1: Is there any difference in the achievement of students taught Building Technology using Project-based learning method and lecture method?

Table 3: Mean and standard deviation of achievement scores of students exposed to project-based and lecture methods at pre-test and post-test

Groups	N	Pre-test		Post-test		Mean Gain
		\bar{X}	SD	\bar{X}	SD	
Experimental	64	42.78	5.53	71.50	5.70	28.72
Control	68	42.44	6.39	69.12	5.07	26.68

Table 3 reveals the mean and standard deviation of pre-test and post-test scores of students taught using the project-based method (experimental group) and the lecture method (control group). From the table, it was observed that the mean scores of the two groups at post-test differs, where students taught through project-based method had mean scores of 71.50 with standard deviation of 5.70 while their counterparts taught through lecture method had mean scores of 69.12 with standard deviation of 5.07. The table further shows that the project-based method recorded higher mean gain score of 28.72 as against 26.68 recorded by the lecture method. This implies that there is difference in the achievement scores of students taught through the two methods in favour of those exposed to the project-based method.

Research Question 2: Is there any difference in the achievement of male and female students taught by project-based method?

Table 4: Mean and standard deviation of achievement scores of male and female students exposed to project-based method at pre-test and post-test

Gender	Variance	N	Pre-test		Post-test		Mean Gain
			\bar{X}	SD	\bar{X}	SD	
Male		99	42.21	5.56	71.88	5.09	29.67
Female		33	44.50	5.43	70.38	7.54	25.88

Table 4 reveals the mean and standard deviation of male and female students exposed to project-based method at pre-test and post-test. From the table, the mean scores of students taught through the two methods at post-test differs, where male students had mean scores of 71.88 with standard deviation of 5.09 while their female counterparts had mean scores of 70.38 with standard deviation of 7.54. The table further shows that male students recorded mean gain score of 29.67 as against 25.88 recorded by their female counterparts. This implies that there is difference between the mean achievement scores of male and female students when exposed to project-based method.

Hypotheses

Pretesting: The purpose of pre-testing which was given to the achievement scores when taught by the project-based methods and the lecture method was to establish the equivalence of the groups before the study started. To analyze the pre-test scores, mean and standard deviations of the project-based (experimental method) and lecture method (control method) were computed and compared using Analysis of Variance (ANOVA) as presented in Table 3.

Table 5: Summary of ANOVA result of the pre-test scores of students in the experimental and control groups

Source of Variation	Sum of Square	df	Mean Square	F _{cal}	P _{value}
Between Groups	1.906	1	1.906	.053 ^{NS}	.818
Within Groups	2295.851	64	35.873		
Total	2297.758	65			

NS: Not Significant at 0.05 levels

Table 5 shows the ANOVA comparison of pre-test scores of Building technology students in experimental and control groups. The table reveals that no significant difference exists in the pre-test scores of the two groups ($F_{(1, 64)} = 0.053, p > 0.05$). Hence, Analysis of Variance (ANOVA) was used in testing all the null hypotheses in this study.

Ho₁: There is no significant difference in mean achievement scores of students taught Building Technology using Project-based learning and lecture method.

Table 6: Summary of ANOVA result of post-test achievement scores of students exposed to project-based and lecture methods

Source of Variation	Sum of Square	df	Mean Square	F _{cal}	P _{value}
Between Groups	93.561	1	93.561	3.225 ^{NS}	.072
Within Groups	1855.529	64	28.993		
Total	1949.091	65			

NS: Not Significant at 0.05 levels

Table 6 shows the ANOVA comparison of post-test scores of students exposed to project-based method (experimental group) and lecture method (control group). The table reveals that there is no significant difference in the post-test scores of the two methods ($F_{(1,64)} = 3.255, p > 0.05$). Hence, hypothesis one was retained. This implies that there was no significant difference in mean achievement scores of students taught Building Technology through project-based and lecture methods

HO₂: There is no significant difference in the mean achievement scores of male and female students taught Building Technology using Projects-based method.

Table 7: Summary of ANOVA result of mean post-test achievement scores of male and female students taught by project-based

Source of Variation	Sum of Square	df	Mean Square	F _{cal}	P _{value}
Between Groups	13.5	1	13.5	.407 ^{NS}	.528
Within Groups	994.5	30	33.15		
Total	1008.00	31			

NS: Not Significant at 0.05 levels

Table 7 shows the ANOVA comparison of post-test scores of male and female students exposed to project-based. The table reveals that no significant difference exists in the post-test scores of the two groups ($F_{(1,30)} = 0.407, p > 0.05$). Hence, hypothesis two was retained. This implies that there was no significant difference in the mean achievement scores of male and female students taught Building Technology using Projects-based method.

Summary of the Findings

The study investigates the impacts of projects-based learning on achievements of building technology among colleges of education students in north west zone, The summary of findings are stated below.

- (i) Significant difference exist in the achievement scores of students taught through the two methods in favour of those exposed to the project-based method (Experimental group) and their counterparts who were taught the same concept using lecture method (Control group). students in experimental group performed significantly better than the students in the control group.
- (ii) No significant difference exists in the mean achievement scores of male and female students taught Building Technology using Projects-based method. Therefore the male and female mean achievements score was relatively equal. Thus, projects-based learning methods are gender friendly.

Discussion

The data presented in table 2 provided answer to research question one, findings revealed that students taught with project-based learning method had a higher mean score than those students taught using lecture method in achievement test. The findings shows that project-based learning method has positive effect on students achievement is similar to the findings of Bandhana (2010) who in his study found out that the adoption of project-based learning method in the teaching of basic technology students improved the students achievement in electronics than the students taught with lecture method.

The analysis of covariance between the mean scores of boys and girls in the achievement test presented on table 6 showed that the null hypothesis was accepted. This means that there was no significant difference between the mean score of boys and girls in (the experimental group taught with the project-based learning method. Although, the mean score of boys was found to be the higher than that of the girls as shown in table 6, but the difference was not high enough to be significant. This findings is not in line with the findings of Asad, Hassan and Sherwani, (2014) who found that there was significant difference for both boys and girls achievement in physics in project-based learning method when compared with lecture method of teaching

Conclusion

Based on the findings of this study, the following conclusions were drawn PBLM is more effective for teaching of the Building technology among colleges of education (Technical) students. Project-based learning methods appears to promote students interest toward teaching and learning of Building technology among colleges of education (Technical) students in the North west zone .The PBLM to be gender friendly as it favoured both male and female students in the experimental group.

Recommendations

Based on the findings, the following recommendations were made:

- (i) The use of Projects-based learning methods in teaching Building technology should be encourage by stake holders in the education industries i.e. both federal and state ministries of education and other relevant agencies like NBTE, NCCE ,among others. This can be achieved through periodic seminars and workshops to teachers on how to use Projects-based learning methods for teaching. Curriculum Planners should examine the efficacy of projects-based learning method and recommend it for use in translating the curriculum at the classroom level where appropriate.
- (ii) No matter how effective certain method of teaching is; it may not yield the required result if the implementers of the method (the teachers) are not properly and adequately train on how to use the method. It is therefore recommended that the federal and State ministries of education should encourage teacher training institutions in the country (i.e. colleges of education) to regularly organize a training workshop for science teachers so as to provide them the technical known how regarding the proper use of any novel approach to technical teaching.
- (iii) Textbook publishers should produce textbooks in technical subjects using the PBLM model.

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