

## **Effects of Project-based Learning Approach on Students' Achievement and Retention in Basic Science in Bosso Local Government Area, Niger State**

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### **Abstract**

The need to enhance the academic achievement and retention of students in Basic science called for this study as it sought to determine effects of project-based learning approach (PBLA) on academic achievement and retention of Junior Secondary School (JSS) students in Basic Science. The study was carried out in Bosso Local Government Area (BLGA) of Niger State and adopted the quasi-experimental research design, precisely, pretest, posttest, delayed posttest non-randomized control group design which involves groups of students in their intact classes. A sample of 411 JSS II students was drawn from a population of 8220 students of state-owned Secondary Schools in BLGA. Two research questions and two null hypotheses tested at 0.05 level of significances guided the study. Basic Science Achievement Test (BSAT), a 20-item multiple choice tests which was based on the units covered in the study, served as the instrument used for data collection. The BSAT and lesson plans for both control and experimental groups were all validated by three experts from the Department of science education, Federal University of Technology Minna Niger State. The reliability coefficient of the instrument was found to be 0.82 using KR-20. Mean and standard deviation were used to answer the research questions, while Analysis of Covariance (ANCOVA) was employed to test the hypotheses. Findings revealed that those taught using PBLA had higher posttest and delayed posttest scores than those taught using the conventional teaching method. Based on the findings of this study, it was concluded that PBLA has the potential to improve students' academic achievement and retention in Basic science. Consequently, it was recommended among others that Basic science teachers should use PBLA in the teaching of Basic science so as to enhance students' academic achievement and retention in the subject.

**Keywords:** Project-based Learning approach, Basic Science, Academic Achievement, Retention

## Introduction

Project work is a term done individually or cooperatively that combines the investigating the topic and presenting it in written form illustrated with photos, pictures, diagrams, etc. (Yurtluk, 2003; Gültekin, 2005). Project work is student-centred and driven by the need to create an end product (Bell, 2010). However, it is the route to achieving this end product that makes project work so worthwhile. The route to the end-product brings opportunities for students to develop their confidence and independence and to work together in a real-world environment by collaborating on a task which have they defined for themselves and which has not been externally imposed (Blumenfeld et al., 1991).

The basis of project-based approaches is hardly new. Early in the 1920s, William Heard Kilpatrick advocated project-based instruction (Sünbül, 2010). His notion was that such instruction should include four components: purposing, planning, executing, and judging (Foshay, 1999). Thomas (2000) stated that the idea of assigning projects to students is not a new one and the benefits of learning by practice have long been touted; the roots of the idea go back to John Dewey (Krajcik et al., 1994; Foshay, 1999). For over 100 years, educators such as John Dewey have reported on the benefits of experiential, hands-on, student-directed learning. Most teachers, knowing the value of engaging, challenging projects for students, have planned field trips, laboratory investigations, and interdisciplinary activities that enrich and extend the curriculum. Doing/creating projects is a long-standing tradition in education history (Merkhamet al., 2003). Project-based learning is an authentic learning model or strategy in which students plan, implement, and evaluate projects that have real world applications beyond the classroom (Dickinson et al., 1998; Westwood, 2008). Project-based learning has been defined in many ways. For this reason, there exists no single definition

Project-based learning is an instructional method centred on the learner. Students develop a question and are guided through research under the teacher's supervision (Bell, 2010). Instead of using a rigid lesson plan that directs a learner down a specific path of learning outcomes or objectives, project-based learning allows in-depth investigation of a topic worth learning more about (Erdem, 2002; Harris and Katz, 2001). Thomas, Mergendoller and Michaelson (1999) described projects within project-based learning as based on challenging questions and making

students having central role in design, problem-solving, decision making processes so giving students the opportunity to work relatively autonomously. In project-based learning, students plan, implement, and evaluate projects that have real-world applications beyond the classroom (Blank,1997). Project-based learning is a comprehensive approach to classroom teaching and learning that is designed to engage students in investigation of complex, authentic problems and carefully designed products and tasks (Blumenfeld et al., 1991). The use of project-based learning in class is possible after providing the information that is needed for the project. The classroom activities should be student-centred, cooperative, and interactive (Moursund,1999). Project training is one of the teaching methods aimed at students in our country and around the world. That is one of the methods which can be used in students that are responsible for students' training, development, and availability. Teachers who work in school demonstrate that when studying is active, students will learn easier and will help inspire other students.

At present, the teaching of science discipline is one of the major problems in the school curriculum. Traditional education methods of teaching science are teacher-oriented, which negatively impacts the knowledge of science of the students. Many secondary school students are negatively impacted by traditional methods, according to Geist and King (2008). Regardless of that fact, the traditional, taking a lot of time in talking rather than creating a conducive environment for effective peer learning.

The project method is an in-depth exploration of a real-world topic worthy of the student's attention and efforts (Chard, 2011). Project -based learning (PBL) is a teaching method in which students learn their valuable skills by doing real projects (Holubova, 2008). The project learning approach is teaching strategies that enable teachers to guide students through in-depth research in the real world. In Project Learning, students learn to take responsibility for their learning, this teaching helps students build a solid foundation on which they can work with others throughout their lives. This method places an emphasis on building a comprehensive unit around an activity that can be performed in or out of school (Pattnaik, Chakradeo and Banerjee, 2014).

According to Knoll (1997), project learning is considered a means by which students (a) develop independence and responsibility, and (b) practice social and democratic forms of behavior. Knoll noted that project learning was brought into the curriculum to help students learn at school, study

independently, and combine theory with practice. The project method is a challenge-based, goal-oriented activity that promotes successful and efficient collaboration where students' activities gain more weight than information communication by the teacher (Szállassy, 2008, p.49).

Project-based teaching is imaginative through cooperative learning. Students also create tangible results to represent what they have managed to learn. To respond to a complex issue, problem or challenge, students use technology and inquiry. PBL focuses on student-centered independent review and group studying, as referred to this one in control, with the teacher acting as advisor. Activities match the real-world tasks of professionals as nearly as possible instead of classroom-based tasks. This motivates academic interpretations and allows learners to perform different roles and develop knowledge that can be implemented more than a single well-defined approach.

Project-based learning engages students in gaining knowledge and skills through an extended inquiry process structured around complex, authentic questions and carefully designed products and tasks (Moursund,1999; Thomas, 2002). Project-based learning enhances the quality of learning and leads to higher-level cognitive development through the student's engagement with complex and novel problems (Blank,1997; Bottomsand Webb,1998). Students are exposed to a wide range of skills and competencies such as collaboration, project planning, decision making, and time management through project-based learning (Blank, 1997; Dickinson et al., 1998). When teachers successfully implement project-based learning, students can be highly motivated, feel actively involved in their own learning, and produce complex, high-quality work (Blumenfeld et al., 1991).

Project-based learning is still in the developmental stage. There is not sufficient research or empirical data to be able to state with certainty that project-based learning is a proven alternative to other forms of learning. Based on evidence gathered over the past years, project-based learning appears to be effective model for producing gains in academic achievement (Aladağ, 2005; Gültekin, 2005)

Academic achievement is a measure of the degree of success in performing specific tasks in a subject area or area of study by students after a learning experience (Ali,2013). Many criteria indicate academic achievement. These include the very general indicators such as procedural and

declarative knowledge acquired in an educational system. There are also the more curricular-based criteria such as grades known as performance on an educational achievement test, and cumulative indicators of academic achievement such as educational degrees and certificates. All the criteria, represent intellectual endeavors and thus, more or less, mirror the intellectual capacity of a person. Good academic achievement in terms of grades and educational certificates alone, without retention is avenues of the teaching and learning process.

Retention is the ability to keep or retain what is learnt and be able to recall it when it is required (Safo, Ezenwa and Wushishi, 2013). Retention is an important variable in learning especially in science subjects. This is because achievement lasts only when students are able to retain what they have learnt. A science student that learns a concept and easily forgets will not perform well in the world outside school. Retention is important in sustenance of achievement. This is because if a student achieved a high score in a posttest but a low score in the retention test, it is an indication that the student did not register the concept in the long-term memory. Basic science is a fundamental science education. Unfortunately, poor performance demonstrated by recurrent failure has been recorded in the basic examination by junior secondary school students in Basic science in BLGA in Niger State. A student's examination achievement is a major yardstick for the performance and teaching methods. The need to ascertain the effect of other methods call for the use of project-based learning approach.

### **Statement of the Research Problem**

Recent BECE external examiner reports (2020) show that the academic achievement of junior secondary school students in Basic science has not been improving as expected. The poor academic achievement has been attributed to certain factors such as: inadequately qualified technical teachers; lack of students' interest; non-exposure to field trip and above all ineffective method of teaching. So far conventional teaching approach (CTA) seems to be predominantly used. Consequently, there is a need to improve the teaching and learning of Basic science by exploring the use of student-centered teaching methods since they involve active participation of the learners. Hence, this study seeks to ascertain the comparative effect of project-based learning method (being a student-centered method) and conventional teaching approach (CTA) on Junior Secondary School (JSS) student's academic achievement and retention in basic science.

## **Aim and objectives of Study**

The main aim of study is to determine the effect of project-based learning approach (PBLA) on students' academic achievement and retention in Basic science in Bosso Local Government Area (BLGA) of Niger State. Specifically, the study sought to achieve the following objectives:

1. Determine the effect of PBLA on students' academic achievement in Basic science
2. Determine the effect of PBLA on student's retention in basic science

## **Research Questions**

The questions addressed in this study were as follows:

1. What are the mean achievement scores of JSS students taught basic science using PBLA as compared with those taught using CTA?
2. What are the mean retention scores of JSS students taught basic science using PBLA as compared with those taught using CTA?

## **Null Hypotheses**

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

HO<sub>1</sub>. There is no significant difference in the mean achievement scores of JSS students taught basic science using PBLA and those taught using CTA.

HO<sub>2</sub>. There is no significant difference in the mean retention scores of technical college students taught Basic science using PBLA and those taught using CTA.

## **Methodology**

This study adopted a quasi-experimental research design of pretest, posttest, delayed posttest non-randomized control group. The study was carried out in Bosso Local Government Area of Niger State. The population of the study is 220. These are the Junior Secondary students in government owned Junior Secondary Schools in Bosso LGA as at 2022 (NGSUBEB 2022). The sample was made up of 411 JSS 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 JSSs that were 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 201 students comprising of 120 males and 81 females while the control group had 210 students comprising of 131 male and 79 females respectively. Instrument for data collection is the Basic Science Achievement Test (BSAT). 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 selected for the study. These were developed by the researcher from NECO, BECE examination past questions and curriculum content for Basic science. 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 content and face validity of the instrument was established using the opinion of 3 experts in the Faculty of Education, Federal University of Technology Minna, Niger State. In order to establish the reliability of the BEAT, a pilot test was administered to 40 JSSII from a government JSS Gwagwalada Abuja, FCT. The reliability of the instrument was computed from the data collected using Kuder-Richards on formula 20 and a coefficient of 0.82 was obtained

Permission to conduct the experiment was sought by the researcher from the school authorities of the schools to be involved in the research. The duration of the study was six weeks. PBLA was 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 mean and standard deviation. Research hypotheses were tested using Analysis of covariance (ANCOVA) at significance level of 0.05.

## Results

### Research Question1

What are the mean achievement scores of JSS students taught Basic Science using PBLA method as compared with those taught using conventional teaching method?

**Table 1: mean achievement scores of JSS students taught Science using PBLA as compared with those taught using conventional teaching method**

| Group               | N   | Pre-test | Post-test | Mean gain | Remark         |
|---------------------|-----|----------|-----------|-----------|----------------|
|                     |     | X        | X         |           |                |
| Experimental (PBLA) | 201 | 17.78    | 34.06     | 16.28     | More Effective |
| Control (CTA)       | 210 | 10.76    | 25.45     | 14.69     | Less Effective |

Table 1 shows that the students taught with PBLA had a pretest mean score of 17.78 with a posttest mean score of 34.06, while those taught using the CTA had a pretest mean score of 10.76 with a posttest mean score of 25.45. The analysis reveals that the mean achievement scores of students taught with PBLA is higher than those taught using the CTA because the gain in mean of 16.28 for the experimental group is greater than 14.69 gain in mean for the control group. This means that the mean achievement scores of students taught with PBLA was higher than those taught using the CTA.



**Research Question 2**

What are the mean retention scores of JSS students taught basic science using PBLA as compared with those taught using CTA?

**Table 2: Mean retention scores of JSS students taught Basic Electricity using project-based learning method as compared with those taught using CTA**

| Group               | N   | Post-test | Retention | Mean difference | Remarks  |
|---------------------|-----|-----------|-----------|-----------------|----------|
|                     |     | X         | X         | (Gain/Loss)     |          |
| Experimental (PBLA) | 201 | 34.06     | 36.53     | 2.47            | Retained |
| Control (CTA)       | 210 | 25.45     | 29.82     | 4.37            |          |

Table 2 indicates that the students taught using PBLA had a post-test mean score of 34.06 with a retention score of 36.53 while those taught using CTA had a posttest mean score of 25.45 with retention mean score of 29.82. The mean difference (gain) of 2.47 means that students taught using PBLA retained whereas students taught using CTA did not being that the posttest mean score was higher than the retention mean score with the mean difference (loss) of 4.37.

**Null Hypothesis 1:** There is no significant difference in the mean achievement scores of JSS students taught basic science using PBLA and those taught using CTA.

**Table 3: ANCOVA test on significance of difference between mean achievement scores of JSS students taught Basic Electricity using PBLA and those taught using CTA**

| Source          | Type III Sum Of Squares | Df | Mean Square | F       | Sig. |
|-----------------|-------------------------|----|-------------|---------|------|
| Corrected Model | 1677.116                | 2  | 844.603     | 99.384  | .000 |
| Intercept       | 5486.605                | 1  | 5486.605    | 509.743 | .000 |
| Achievement     | .481                    | 1  | .481        | .078    | .609 |

|                 |            |     |          |         |      |
|-----------------|------------|-----|----------|---------|------|
| Treatment       | 1415.112   | 1   | 1415.112 | 168.193 | .000 |
| Error           | 781.744    | 409 | 8.421    |         |      |
| Total           | 176424.013 | 411 |          |         |      |
| Corrected Total | 285.631    | 410 |          |         |      |

R Squared = .766 (Adjusted R Squared = .761)

Table 3 reveals that the difference in the mean achievement scores of JSS students taught basic science using PBLA and those taught using CTA is significant because the p-value of 0.000 is less than the alpha level of 0.05 at 411 degree of freedom. Therefore, the null hypothesis is rejected, thus, there is significant difference in the mean achievement scores of JSS students taught basic science using PBLA and those taught using CTA.

**Null Hypothesis 2:** There is no significant difference in the mean retention scores of JSS students taught basic electricity using PBLA and those taught using CTA.

**Table 4: ANCOVA test on significance of difference in the mean retention scores of JSS students taught Basic Electricity using PBLA and those taught using CTA**

| Source          | Type III Sum of Squares | Df  | Mean Square | F      | Sig. |
|-----------------|-------------------------|-----|-------------|--------|------|
| Corrected Model | 1461.413 <sup>a</sup>   | 2   | 695.413     | 39.871 | .000 |
| Intercept       | 1528.879                | 1   | 1528.879    | 88.713 | .000 |
| Retention       | 110.317                 | 1   | 110.317     | 7.413  | .012 |
| Treatment       | 701.481                 | 1   | 701.481     | 71.431 | .000 |
| Error           | 917.614                 | 409 | 14.618      |        |      |
| Total           | 53415.017               | 411 |             |        |      |

|                 |          |     |  |  |  |
|-----------------|----------|-----|--|--|--|
| Corrected Total | 2107.418 | 410 |  |  |  |
|-----------------|----------|-----|--|--|--|

Table 4 shows that the p-value of 0.000 is less than that the alpha level of 0.05 with 411 degree of freedom ( $0.00 < 0.05, df 411$ ). This means that the null hypothesis is rejected, thus, there is a significant difference in the mean retention scores of JSS students taught basic electricity using PBLA and those taught using CTA.

### Discussion of Findings

The result in research question one revealed the pre-test and post-test mean achievement scores of JSS Students taught basic science using PBLA as compared with those taught using CTA. The analysis showed that the mean achievement scores of students taught with PBLA was higher than those taught using the CTA. This finding concerned with the finding of Halil, Haydar and Aziz (2018) who discovered that PBLA had a positive influence on academic achievement of students. This indicated that students show that they achieved meaningful learning as a result of the PBLA application and the approach was enough for the instruction process, enhance their achievement in the subject and related the content with daily life. The result in hypothesis one also indicated that there is significant difference in the mean achievement scores of JSS students taught basic electricity using PBLA as compared with those taught using CTA. This finding supported the finding of Halil, Haydar and Aziz (2018) that there was a significant difference in the academic achievement of students on instruction students taught basic science using PBLA as compared with those taught using CTA. The analysis revealed that the mean achievement scores of students taught with PBLA was higher than those taught using the CTA. This finding supported the finding of Halil, Haydar and Aziz (2018) that there is a significant difference in the academic achievement of students on instruction of AUTOCAD programming as a result of PBLA application. This could be because PBLA stimulates critical thinking skills and involves the active engagement of learners as they collaborate in groups.

Data obtained in research question two in Table two showed that students taught using project-based learning method retained more than students taught using CTA. This finding was in tandem with the finding of Okoro (2013) that those taught Home economics with PBLA were able to retain more than those taught with lecture method. This invariably means that students

who were educated by PBLA were more successful and had higher retention scores towards the lesson than the students who were educated by the instruction based on student textbooks. Hypothesis two revealed that there is a significant difference in the mean retention scores of JSS students taught basic science using PBLA and those taught using CTA. This finding was in line with the finding of Gokhan (2011) that there is a significant difference between the retention scores of the experimental group and the control group. This finding further buttresses the ability of PBLA in helping students acquire knowledge and skills which are rarely lost over time since the concepts will be well internalized

### **Conclusion**

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

### **Recommendations**

The following recommendations were made;

Teachers and students as agents of educational reforms should be encouraged to make use of project-based learning method more often in order to enable them properly evaluate themselves, know their present stand in the subject content and discover the area to improve upon to achieve an improved academic achievement in Basic Science subject content.

The curriculum planners should modify basic science curriculum to include the use of innovative Teaching method like the PBLA in order to enhance the participation and achievement of students in Basic science.

The School administrators and universal basic education board should organize seminars, workshops and conferences for Basic Science teachers on how to use PBLA in teaching Basic Science.

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