EFFECT OF PROJECT-BASED METHOD ON STUDENTS’ ACHIEVEMENT IN PHYSICS- IMPLICATION FOR GLOBAL COMPETITIVENESS

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Abstract
The study examines the effect of project-based method on students’ achievement in physics. Two research questions and one hypothesis were postulated to guide the study. The study design was quasi-experimental design pre-test and post-test. Total number of students comprised 60 s from two intact classes. Each intact class was made up of 30 students. The instrument was Physics Achievement Test (PAT) on “Electricity” made up of 30 items. The instrument was validated and reliability was found to be 0.84 using K-R20 correlation. The research questions were analyzed using mean and standard deviation, while t-test was used for finding the hypothesis for the study. The findings revealed that there is significant difference in performance between students taught using project based method and the control group taught using lecture method. From the study, it was revealed that students who were exposed to project-based method could produce equipment capable of innovative skills needed in meeting global competitiveness. Four recommendations were made toward promoting the use of project-based method.

Key words: project-based method, Achievement and Physics

Introduction
Research has shown that for several years the performance of students in physics has been very poor (Owolabi, 2004; NERDC, 2005; Meliga, 2004; Adeboye, 2003). Analysis of results given by West African Examination Council (WAEC) Chief Examiners show that the average mean performance score of students who sat physics for several years in 2008, 2009, 2010, & 2011 as 25, 26,20, and 24, respectively (WAEC Chief Examiners). WAEC Chief Examiners report over the years comment on students’ weakness in physics as follows:

“Many students could not read measurements from stop watch and ammeter to the required accuracy and poor computational skills.”

WACE Chief Examiners reports May/June, 2009. 287-304
“Student inability to set up experiment apparatus” and “weak manipulative/mathematics skills, lack of in depth understanding of various concept”

WACE Chief Examiners reports May / June 2012.
“Student could not handle practical aspect of physics and...”
Several studies advance reasons for the dismal failure as follows. Akor (2006) opined that lack of equipment affect teaching and learning which also affect performance in physics practical. Meliga (2004) observed that unqualified teachers bring about poor performance of students in physics and Folagin (1986) also observed that Government and parental factors contribute to students poor performance. Ada (2006) observe that lecture method of teaching does not lead to maximum achievement in certain types of learning, speech skills, cooperative groups thinking, and motor skills. Ameh & Dantani (2012) opined that lecture method effect academic achievement in chemistry in secondary schools as result of students being passive in the teaching and learning process. Also, Usoh (2008) opined that lecture method of teaching is not effective in the teaching of science subjects, since it does not encourage collaboration and experimentation. However, among all the reasons proffered, teachers’ persistent use of traditional teaching method appears to be most significant factor affecting students learning outcomes. Researchers believe that in the lecture method, theory is taught as an absolute knowledge; hence pupil-centered activities for developing scientific reasoning skills and processes are lacking. Njoku (2007) observes that Lecture method is also known to cause lack of interest and poor performance in science.

Lecture method is a teaching method where an instructor is the central focus of information transfer. Typically, an instructor will stand before the class and present information for the students to learn. According Ada (2006), in lecture method the teacher talk to the students and write on chalkboard. The students only listen and are not given the opportunity to contribute their ideas. Nwosu (2006) opined that lecture method of teaching is teacher centred and students are passive in the teaching and learning process. Studies reveal the Nigerian teachers persistently used traditional teaching method or lecture method which do not promote or foster critical thinking, students’ participation and 21st competencies (Ada, 2006; Nwosu, 2006; Njoku 2007; Usoh 2008). Hence the method used in teaching play an important role in students’ achievement.

Thus, methodology is very vital in any teaching/learning situation. The method adopted by the teacher may promote or hinder learning (Ogbeba, 2013). It may sharpen mental activities which are the basis of social power or may discourage initiatives and curiosity thus making self-reliance and survival difficult (Ameh & Dantani 2012). The way a teacher teaches any subject matter to learners may make them like or dislike the subject (Emaikwu 2012). Mtseem,( 2011) also opin that teaching method affects the responses of students and determines their level of interest, motivation and involvement in a lesson in such a way as to engage in good learning. Hence Okeke,(2000) observed that experimental activities are central to the mastery of the concepts and realization of the goals of physics.

Project-based method is a special kind of teaching method which involves knowledge, skills learnt by students through practical handling of problems in natural setting. It is a teaching approach
that engages students in sustained, collaborative real-world investigation (Ugwu, 2001). During project-based teaching, projects are organized around a driving question and students participate in a variety of tasks that seek to meaningfully address this question. The projects are complete tasks, based on challenging questions or problems that involves students in design, problem-solving, decision making or investigative activities or an opportunity to work relatively autonomously over extended period of time (Jones, Rasmussen & Moffih, 1997). In a project-based teaching, the central activities of the project must involve the transformation and construction of knowledge (by definition: new understandings, new skills) on the part of students (Bereiter & Scardimalia, 1999). The purpose of project-based method is to provide a structure where students can demonstrate mastery of a subject by creating and presenting, a research-based project that is driven by their own interest in a topic and allows them to work within the same parameters as real researchers. In carrying out the projects, students may be exposed to project whereby they may design or construct materials or improvised equipment lacking in the laboratory.

Improvisation of science materials and equipment is the making of substitutes from local materials found in our environment when the real or original equipment is not readily available. Through the projects, equipment that are otherwise unavailable in the laboratory could be designed for use by the students themselves. This answers Ogunleye, (2000) & Mkpahary, (2005) fears that there is inadequacy or total lack of physics equipment in our secondary schools. Even schools that have some equipment could not make use of the equipment due to their poor conditions while the few that were in good condition were not enough for the students. This makes it interesting to engage students in improvisation of projects not just to only leave permanent understanding in students but also to meet the need of the society. It is a fact that raw or discarded materials for improvisation can easily be obtained from our environment (Home, school, Radio-repair shop, Auto mobile repair shops, food market, timber market, electrical workshop, bicycle repair shop, etc.) With all these raw materials, students can engage in projects that can meet the needs of the society and find their place in global market in a rapidly competitive world.

Global competitiveness is the degree to which a country can under free and fair market conditions meet the test of international market, while simultaneously maintaining and expanding the real income of citizen. Uche (2005) observed that when students engage in projects that are useful to the society, they not only acquire the competences they needed in the market economy after school but they may gain the capacity to address real life problems. This therefore implies that through project-based method students may develop the capacity to produce or build material or equipment that will make them to become self reliant in the society. Gokhan (2011) revealed that the students who were educated by project-based learning were more successful and possessed higher attitude levels towards the lesson than the students who were educated by instruction based on students’ textbooks. They also found that project-based learning was more effective in the positive development of students’ academic achievement levels in attitude toward English language. This study sought to investigate the extent to which project-based method will affect students’ performance in electricity aspect of physics.
Statement of problem
Research/studies have shown that students’ performance in physics over the years has remained dismally poor (Owolabi 2004; NERDC 2005). Several reasons identified as causal factors to the poor performance, teaching method was the most significant. Traditional teaching / lecture method commonly used did not seem to enhance students understanding in physics, nor did such method engage students actively in the learning process. This study is to investigate the extent to which project-based method could affect students’ performance in electricity aspect of physics with the students being exposed to designing and constructing electricity equipments. The problem of this study therefore is “effect of project-based method on students achievement in physics”.

Purpose of the study
The purpose of the study is to investigate the effect of project-based method in students’ achievement in physics. Specifically, the study is:

1. To identify the level of students achievement in physics through project-based method.
2. To determine the extent to which students can improvise instructional material in electricity.

Research questions
The study was designed to seek answers to the following research question.
1. What would be the mean achievement scores of students taught with project-based method in experimental group and those taught by lecture method in the control group?
2. To what extent can students improvise instructional materials?

Research hypothesis
The hypothesis is formulated and tested
1. There is no significant difference in the mean score in students’ achievement in physics between group taught with project-based method and lecture method

Research design
The study is a quasi experimental design of pre-test and post-test with both experimental group and control group. It seeks the impact evaluation that assigns members to the experimental group and control group by a method other than random assignment.

Area of the study
The area covered was Alvan Ikoku Federal College of Education Owerri. Owerri is the capital of Imo State of Nigeria. The state is bounded in the South by Rivers State, in the West by Anambra State, in the East by Abia State and in the North by Ebonyi State.

Population of the study
The population for this study is 60 students which comprised all National Certificate of Education (NCE) year one students in Physics Education Department.

Sampling
The sample comprised 60 year one NCE students in two separate classes. Each class comprised 30 students. Purposive sampling was used to draw all the students from the 2 intact classes. Simple random sampling was used to draw the control and experimental class. The investigation employed 60 students, 30 for control group and 30 for experimental group.

Instruments
Physics Achievement Test (PAT)
In order to collect data related to achievement of the students a physics achievement test items was developed in
relation with NCCE standard for NCE1 by the researchers. This test items was used to measure the students’ academic achievement in the past activities. There were 30 generated test items from electricity in the Physics Achievement Test. Each item scored 2 points, total score was 60 points. It was used for students in both the experimental and control groups. The items were validated by three experts (lecturers in science education department).

Pilot study
To establish the reliability of the instrument, a pilot study was carried out using twenty students. The instrument (PAT) was administered after a period of two weeks interval and the test –retest reliability was computed using K-R20 correlation. The reliability value of test was found to be 0.83, the difficult value was found to be 0.59 and test discrimination value was found to be 0.47. Hence, it was revealed that the test was reliable. It was used with student in both the experimental group and control group. The physics achievement test had a reliability of 0.83, an average level of test discrimination (0.47) and an average level of test difficulty (0.59). In the light of data gathering for the physics achievement test, it can possibly be said that the test had a high level of reliability;

Instructional procedure
In the experimental group, project-based method was applied whereas in the control group, lecture method was used in the process of the study. The design of the study can be described as in the table 1 given below.

Table1: Experimental design used in the study

<table>
<thead>
<tr>
<th>Group</th>
<th>Pre-test</th>
<th>Experimental Design</th>
<th>Post-test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td></td>
<td>project-based method</td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td></td>
<td>Lecture Method</td>
<td></td>
</tr>
</tbody>
</table>

This experiment was conducted over 2 weeks of NCE1 students. In control group, lecture based on topic on electricity was taught for two weeks in connection with the course outline. During the lesson of electricity, the teacher lecture on electricity. In experimental group, the students were exposed with project-based method; “with the same content as of the control group”. The instruction programme for the experimental groups was prepared according to the principle of project-based method, it is based on the ideal that engages students in sustained collaborative real world investigations. The researcher provides all the necessary materials for the project to be performed by students.

Students’ first task was construction of four socket extension box (instructional material for electricity).

Material needed: 1.5 mm Nigeria wire, Bamp socket, Bamp play wood (25cm by 25cm), sandpaper. Equipment: measuring tape, hammer, saw, hand drilling machine, cutter, hand file and plier.

Procedure: The students measured and cut the wood by 25cm using saw, then make use of the sandpaper to smoothing the wood. The students divide the cut wood into four equal parts using the rule and pencil. Use the hand drilling machine, they made a hole in each part of the wood and label the hole A, B, C, D.
also use the hand file to smoothen the holes made with the drilling machine and cut out 2 pieces of 9 inches 1.5mm Nigeria wire on both sides and from point A joint the life wire together using plier and also the neutral wire. Pass the life and neutral wire through the hole at A and connect to the socket. At point A, using your screw, screw the socket to the wood. From point A, extend the wire to point B, joining the other one coming from point C, from point B, you join the wire coming from the hole. I.e. life to life and neutral to neutral, then from C to D then connect the socket on each holes. Finally join the plug to the power supply. Students collaborate in the project to produces a functional four socket extension box which can meet the global standard.

Collaborative project-based learning

Students’ second task was the construction of Wheatstone bridge.


Procedure: The students measure and cut the wood by using saw. The students smooth and polished the wood before measuring the points for the nails. The students put the meter rule and nails in the respective point on the wood and graduated copper wire of SWG 16 is used for connection at the terminals.
Results

The comparison of pre-test results of the students’ achievement in electricity both in experimental group and control group in pre-test are presented in Table2

Table2: Experimental design used in the students past activities

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>X</th>
<th>S.D</th>
<th>df</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>30</td>
<td>48.5</td>
<td>17.5</td>
<td>64</td>
<td>0.695</td>
<td>0.94</td>
</tr>
<tr>
<td>Control</td>
<td>30</td>
<td>48.2</td>
<td>17.9</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In table2, the pre-test score of the students in the experimental group and control group have been compared. The average pre-test score of the students in the experimental group has been found as $X_{\text{experimental}} = 48.5 + 17.5$ and the average pre-test score of the students in the control group has been found as $X_{\text{control}} = 48.2 + 17.9$.

Analyses of research question one and two

Research question one
What would be the mean achievement scores of students taught with project-based method experimental group and those taught by lecture method in the control group?

Research question two
To what extent can students improvise instructional materials?
Table 3: Comparison of post-test achievement score of the students in experimental and control group.

<table>
<thead>
<tr>
<th>Group</th>
<th>Pre-test</th>
<th>Post-test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X S.D</td>
<td>X S.D</td>
</tr>
<tr>
<td>Experimental</td>
<td>48.5 17.5</td>
<td>73.3 12.4</td>
</tr>
<tr>
<td>Control</td>
<td>48.2 17.9</td>
<td>62.3 15.4</td>
</tr>
</tbody>
</table>

The Post-test score of the students in the experimental and control groups have been compared in table 3. The average post-test score of the students in the experimental group was $X_{\text{experimental}} = 73.3 + 12.4$ and the average post-test score of the students in the control group has been found as $X_{\text{control}} = 62.3 + 15.1$. The students in the experimental group ($X_{\text{experimental}} = 73.3$) showed significantly better achievement, compared to the students in the control group ($X_{\text{control}} = 62.3$).

**Analysis of hypothesis**

There is no significant difference in the mean score in students’ achievement in physics between group taught with project-based method and lecture method.

Table 4: Show the pre-test and pro-test mean and standard deviation

<table>
<thead>
<tr>
<th>Group</th>
<th>Pre-test</th>
<th>Post-test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X S.D</td>
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<tr>
<td>Control</td>
<td>48.2 17.9</td>
<td>62.3 15.4</td>
</tr>
</tbody>
</table>
The results in table 4 showed that the difference between the two groups has been analyzed through the independent sample t-test. The has been found as \((t_{(64)} = 3.26)\). So according to these results, it can be said that there is statistically significant difference between the post-test scores of the two groups is 0.05 level \((p=.0018,p<.05)\). Therefore, it implies that there is a significant difference in students’ achievement in physics between experimental group and control group.

**Discussion of results**

The Post-test score of the mean achievement score of students taught with project-based method in the experimental and those taught in control groups have been compared in table 3. The average post-test score of the students in the experimental group was \(X_{\text{experimental}} = 73.3 + 12.4\) and the average post-test score of the students in the control group has been found as \(X_{\text{control}} = 62.3 + 15.1\). The students in the experimental group \((X_{\text{experimental}} = 73.3)\) showed significantly better achievement, compared to the students in the control group \((X_{\text{control}} = 62.3)\). When we look at the mean scores of the groups, it can be seen that the students in experimental group have reached higher achievement level compared to those in the control group. The experimental method, which is project-based learning, applied has been more effective than the lecture method in the control group. Based on the finding of this study, the finding of pre-test show that there was no significant difference between the experimental group and control group and on the post-test there is a significant difference between the experimental and control groups.

In conclusion, project-based method is better for students to take responsibility for their own learning (Gonzales & Nelson 2005). Some recommendation was made. If all the recommendation of the study is implemented they will significantly enhance student achievement in physics through project-based method.

With the present situation of lack of inadequate laboratory materials in our secondary schools, the teaching and learning of physics will only become more practical and effective when teachers improvise with local materials for students use in their is one sure way of achieving human capital development.
With improvisation of adequate and appropriate instructional materials in our schools, sustainability of sciences education for the achievement of vision 2020 by the federal government of Nigeria will be things of the past.

**Recommendation**

Based on the research findings, the following recommendations are made:

Project-based method should be encourage among physics teachers by school authority, Government and school authorities should organize training and workshop for science teachers on the use of project-based methods.

Teachers and parent should monitor students to make sure they carry out their project at school and home.

School and parent should provide the necessary material needed for any project for the students.

Schools should encourage science exhibition and competition among students.

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