EFFECT OF PROBLEM-BASED LEARNING STRATEGY ON UPPER BASIC TWO STUDENT'S ACHIEVEMENT IN BASIC SCIENCE IN MAKURDI METROPOLIS, BENUE STATE

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Abstract
This study investigated the effect of problem-based learning strategy on upper basic 11 students' achievement in Basic Science in Makurdi metropolis, Benue State, Nigeria. This study also tested the effect of PBL strategy on gender. Two research questions and two hypotheses guided the study. A quasi experimental, pre-test and post-test design was adopted for the study. A total of 80 upper basic 11 students out of 7882 students from two secondary schools in Makurdi metropolis, selected by stratified random sampling technique constituted the sample. One instrument; namely, Basic Science Achievement Test (BSAT) developed by the researchers and validated was used for data collection. The reliability coefficient of the instrument was established through a pilot study using Cronbach's alpha correlation which was found to be 0.81. The data collected were analysed using mean, standard deviation and ANCOVA. The study revealed that students in the experimental group achieved significantly higher mean score than students in the control group in academic achievement in basic science, P=0.000<0.05.There was no significant difference in mean academic achievement when male and female students were exposed to PBL strategy, P=0.072>0.05. Based on these findings, the study recommended among other things that Basic Science teachers should be encouraged to use PBL strategy as a medium of instructions since it improved academic achievement of the students in Basic science.

Keywords: Problem-Based Learning, Achievement, Upper Basic II Students, Gender, Basic Science

Introduction

The Nigerian educational system is facing a lot of challenges. The most striking one is poor achievement in science, especially in Basic science among upper basic students. (Obomanu&Adaramola,2011). Despite the importance of Basic Science to individual student and the society at large, as documented (Ochu & Haruna, 2015; Obomanu & Adaramola, 2011) that students have been achieving poorly in the subject in Nigeria, especially Benue State. According to Ochu and Haruna (2015), this poor achievement in basic science by students has led many of them to the arts or social sciences due to insufficient prerequisite science subjects. This creates a gap in national development. Basic science, formerly known as integrated science is the first form of science a child encounters at the secondary school level. This prepares students at the upper basic level for the study of core science subjects (Biology, Chemistry and Physics) at the senior secondary (SS) level (Oludipe, 2012). This means that for a student to be able to study single science subject at the SS level successfully, such a student has to be well grounded in Basic Science at the upper basic level. Unfortunately, there is an observable drastic and constant reduction in the level of achievement in mathematics, which is also applicable to science by students at all levels of education in Nigeria (Emaikwu, 2012; Ochu & Haruna, 2015). Research has revealed that this low achievement in Basic Science among other things is because of poor or non-innovative methods of teaching (Obomanu & Adaramola, 2011; Ochu & Haruna, 2015). This persistent poor achievement in science and wrong method of teaching portrays that the current educational paradigm is weak or inappropriate (Oludipe & Oludipe, 2010).

It is as a result of the need for these changes in instructional method to enhance learning that the researcher intends to recommend a departure from the conventional lecture method of teaching to one of the most recent constructivist-based teaching strategies known as problem-based Learning (PBL) strategy. Conventional lecture method is the method of teaching that is characterised by the following: it is teacher-centred. It inhibits active participation of students in the classroom; it reduces students to mere note-taking and passive listeners and learners, perception and assimilation of the subject matter is slow. It is examination oriented.

It is in view of this that, this study used PBL strategy to find out its effect on students' Learning PBL represents a paradigm shift from conventional teaching and learning philosophy (Hung, 2011). This is because PBL is students-centred learning theory, where learning is carried out in small groups, usually 5-8 students per group; ill-structured problem that requires further research forms the basis for the organised focus of the group and stimulates learning (Briggs, 2015; Vincent & Renee, 2015).

PBL is a learner-centred theory because the learner is encouraged to construct his/her knowledge by dealing with real life situation (Shweta, 2015).

The role of the teacher is to facilitate the student's learning by providing opportunities for learners to engage in constructive processing, Torp and Sage (as cited in Briggs, 2015).

The results of studies on gender differences are contradicted. Many researches on gender difference in academic achievement in science education especially in basic science had been carried out by different researchers, Erinosho (2005); Oludipe, (2012) found that there is no statistical significant difference in academic achievements of students in respect to gender. Still some, Aguele and Uhumniah, (2008) found that male students achieved higher than the female students in science. Khwaileh and Zaga (2011) found that female students outperformed the male students. This reveals an unresolved controversy which this study investigated.

Statement of the Problem

Literature search has shown little or scarce records to attest to the effects of PBL, strategy on students' achievement in Basic Science or whether it is gender dependent or not. The problem of this study therefore is to find out the effect of problem-based learning strategy on upper Basic 11 students achievement in Basic science in Makurdi metropolis.

The Purpose of the Study

(i) Specifically the study sought to:
Find out if there is a difference in academic achievement of upper basic 11 students taught using PBL strategy and those taught using conventional lecture method.

(ii) Compare the academic achievement of male and female students in Basic science when exposed to problem-based learning strategy.

Research Questions

The following questions guided the study:

(i) What is the difference in mean academic achievement scores of upper basic 11 students in Basic science who were taught using Problem-Based Learning Strategy and those who were taught using conventional lecture method?

(ii) How do male and female students differ in mean academic achievement in Basic science when exposed to problem Based learning strategy?

Hypotheses:
The following null hypotheses were tested at 0.05 level of significance:
(i) There is no significant difference in the mean achievement scores of students in basic science who were exposed to problem-based learning strategy and conventional lecture method.
(ii) There is no significant difference in the mean achievement scores of male and female students in Basic science who were exposed to problem-based learning strategy.

Methodology
The research design for this study was quasi-experimental design. Quasi experiment involves an existing group of participants who receive treatment and another existing group of participants scores as a control group (Harris, McGregor, Perencerich, Furuno, Zhu, Peterson & Finkelstein, 2006) in this design participant were design to the treatment or control condition along with all the others in their existing group, the quasi experimental design for this study was pre-test, post-test type. The intact classes were randomly assigned to experimental and control groups were used. Both group were taught the same basic science content; but in the experimental group, PBL strategy was applied while in the control group, conventional lecture method was used.

The study was conducted in Makurdi metropolis of Benue State Nigeria. Benue state is situated in the middle belt region of Nigeria with an area of 8,459km^2. Makurdi has Tiv as the predominant ethnic group.

The target population for this study comprised 7882 upper basic 11 students from 96 secondary schools in Makurdi metropolis who offered basic science as one of their core subject, as of the time this study was carried out. The sample for this study comprised 80 upper basic 11 students in the intact classes used from the co-educational upper basic 11 students. Two schools were selected by stratified random sampling. One of the schools was assigned as control group and the other one as experimental school. In the experimental school, problem-based learning strategy was used while in the control school, conventional lecture method was used.

The researcher developed Basic Science Achievement Test (BSAT) for data collection. This was a 30-item test drawn based on the three basic science concepts covered in upper basic 11 curriculums under the six weeks of teaching. It was based on the Junior School Certificate Examination (JSCE) standard, since this study was expected to improve the student's achievement at this level. The instrument was used for pre-test and post-test. To ensure content validity BSAT was based on the table of specification.

Validation of the Instrument
Basic Science Achievement Test was subjected to content validation. The instrument was given to two lecturers of science education and one lecturer who is an expert in mathematics education and also knowledgeable in statistical analysis for validation. All these validators were from the department of curriculum and teaching, Benue State University, Makurdi. The valuators' advice was sought in terms of adequacy of instrument in soliciting the desired response, relevance of the instrument, their critical comments and corrections led to the reconstruction and changes in some questions.

The lesson plans for the study which were developed by the researcher based on the PBL strategy were also subjected to these same valuators for validation. Their advice was sought in terms of contents relevance, duration of study, clarity of terms used and logicality of

presentation. Their comments were used to adjust the lesson plans. The corrected instrument and lesson plans were further subjected to trial testing through pilot study.

Reliability of the Instrument

A pilot study was carried out to test the reliability of the research instrument this pilot study was carried out on 85 students from 2 secondary schools where Basic Science is offered, which were not sampled for the main study. The students were pretested and their scores recorded and used for computing the reliability coefficient. Two teachers from the two schools were trained to teach the experimental and the control groups respectively. The lesson notes prepared by the researcher based on the three concepts in Basic Science were given to them for use. The two groups were taught for six weeks after which the post-test was administered and the scores were recorded again. These scores were then used for reliability analysis of the instrument using Cronbach's alpha. The reliability coefficient for BSAT was found to be 0.81. This indicates that the instrument is reliable.

Method of Data Collection

Research assistants were trained to help with data collection. The training involved orientation on the Basic science concepts with their objectives to be taught which covered habitat, crude oil and petrochemicals and work, energy and power; orientation on the use of lesson plan based on PBL strategy. The teachers were allowed to teach for six weeks. After which the researcher went round the two selected schools to administer the post-test and retrieved the scripts on the spot. All these tests were marked by the researcher and the assistant.

Method of Data Analysis

The data collected was subjected to statistical analysis in order to answer questions and test the hypotheses. The mean and standard deviation were used to answer research questions. Hypotheses 1 and 2 were tested using Analysis of covariance (ANCOVA).

Results

Research Question One

What is the difference in mean academic achievement scores of upper basic 11 students in Basic science who were taught using Problem-Based Learning Strategy and those who were taught using conventional lecture method?

Table 1: Mean and Standard Deviation of Achievement of Students in Basic Science for PBL Strategy.

Group		Pre-test		Post-test		
	N	mean	SD	mean	SD	mean Gain
Problem-Based learning strategy	39	14.22	2.58	20.44	4.74	6.22
Conventional lecture method	41	10.10	3.18	13.34	4.63	3.24

Table 1 presents the mean and standard deviation of academic achievement for pre-test and post-test of students exposed to PBL strategy and those who were exposed to conventional lecture method. It was observed that the pre-test mean for the two categories were 14.22 and 10.10 respectively. The table also shows that the post-test mean achievement of students exposed to Problem-Based Learning strategy and those exposed to conventional lecture method had a mean achievement of 13.34. It was observed that the mean gain, between the pre-test and the post-test mean of the experimental groups was 6.22. That is

the mean gain was higher than the control group's mean gain which was 3.24. The experimental group achieved higher than the control group.

Research Question Two:
How do male and female students differ in mean academic achievement in Basic Science when exposed to problem Based Learning Strategy?

Table 2: Mean Academic Achievement of Male and Female Students Exposed to Problem-Based Learning Strategy

Gender		Pre-test	Post-test	Mean Gain
Male	Mean	13.75	21.25	7.50
	N	20	20	
	S.D.	3.09	5.49	
Female	Mean	14.47	19.58	5.11
	N	19	19	
	S.D.	2.04	3.79	
Mean Difference				2.39

Table 2 shows the result of the mean academic achievement of male and female students exposed to Problem-Based Learning Strategy. From Table 2, it was observed that students were homogeneous academically before treatment (Pre-test) with mean scores of 13.75 and 14.47 for male and female students respectively. The Table also shows the mean gain between pre-test and post-test mean of the male students was 7.50. This mean gain was higher than the female's mean gain which was 5.11. This gives a mean difference of 2.39 in favour of the males. The male students achieved slightly higher than the female students.

Hypothesis One
There is no significant difference in the mean achievement scores of students in basic science who were exposed to problem-based learning strategy and conventional lecture method.

Table 3: ANCOVA Test of Difference in the Mean Achievement Scores of Students in Basic Science who were Exposed to Problem-Based Learning Strategy and Conventional Lecture Method

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	2131.882[a]	2	1065.941	71.551	.000	.453
Intercept	959.573	1	959.573	64.411	.000	.271
Type	1002.408	1	1002.408	67.286	.000	.280
Strategy	1309.333	1	1309.333	87.888	.000	.337
Error	2577.300	173	14.898			
Total	41366.000	176				
Corrected Total	4709.182	175				

Table 3 is ANCOVA table for the significant difference in the mean achievement scores of students in basic science who were exposed to problem-based learning strategy and conventional lecture method. The table gives $F_{(1,173)} = 87.888$ and $P = 0.000$. Since $P<0.05$, the null hypothesis was rejected. This means that, there was a significant difference in the mean achievement scores of students in basic science who were exposed to problem-based learning strategy and conventional lecture method. The partial eta value of 0.337 means that the effect size is 33.7% which is reasonable.

Hypothesis Two

There is no significant difference in the mean achievement scores of male and female students in basic science who were exposed to problem-based learning strategy.

Table 4: ANCOVA Test of Difference in the Mean Achievement Scores of Male and Female Students in Basic Science who were Exposed to Problem-Based Learning Strategy

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	906.221[a]	2	453.111	34.506	.000	.431
Intercept	673.097	1	673.097	51.259	.000	.360
Type	839.104	1	839.104	63.902	.000	.413
Sex	24.033	1	24.033	1.830	.179	.020
Error	1194.938	91	13.131			
Total	28625.000	94				
Corrected Total	2101.160	93				

Table 2 is ANCOVA table for the significant difference in the mean achievement scores of male and female students in basic science who were exposed to problem-based learning strategy. The table gives $F_{(1,91)}$ = 1.830 and P = 0.179. Since P>0.05, the null hypothesis was not rejected. This means that, there was no significant difference in the mean achievement scores of male and female students in basic science who were exposed to problem-based learning strategy. The partial eta shows an effect size of 0.020 (2%) which is not reasonable meaning that gender influence is not substantial.

Discussion of Findings

The research has revealed that students in experimental group achieved higher than students in control group. This means that students taught using the PBL strategy performed significantly better in Basic Science achievement test than their counterparts who were taught using their conventional lecture method. The reason for the better achievement may be linked to the fact that method is a significant factor in student's achievement in basic science. This is because the method provided opportunities for students' interaction with the physical and social environments to explore, ask questions and experience science concepts. By so doing students were actively participating in making discoveries through ill-structured questions and discussing them among their peers in the group.

This finding confirms what Afolabi and Akinyemi (2009), and Oludipe and Oludipe, (2010), found in their researches that students taught using PBL technique performed better than those taught using conventional lecture method which led to higher achievement in physics among senior secondary11 students as well as integrated science.

Based on gender, the study showed that male students had a mean achievement test score higher than the female students but the mean difference was statistically insignificant. This indicates that gender has no significant effect on the achievement of Basic Science students when exposed to PBL strategy. This result agrees with Afolabi and Akinyemi (2009) who found that gender has no significant effect on the performance of physics students when taught using PBL technique. Also Oludipe (2012) found that there was no statistically significant difference in the pre-test, post-test and delayed post-test academic achievement means scores of male and female students.

Conclusion

Based on the findings it can be concluded that the use of PBL strategy enhances student's achievement in Basic Science than the use of conventional lecture method of teaching. The result of non-significant difference in the mean academic achievement between students that were exposed to PBL strategy indicated the efficacy of the PBL strategy as a medium of instruction for the teaching of Basic Science. With the use of PBL strategy, the study revealed no gender disparity in achievement. This therefore implies that if the right instructional design is used by Basic Science teachers, it is believed that both male and female students will perform equally well in Basic science.

Recommendations

On the basis of the findings of the research work, the following recommendations are made;

(i) Teacher training institutions should include PBL strategy in the science methodology content and make provision to train pre-service teachers in the use of PBL strategy.

(ii) Authors of Basic Science should include activities that will encourage the use of problem-Based Learning strategy by the teachers and students.

(iii) Basic Science Curriculum developers should make provision for and emphasise on the use of PBL strategy by the curriculum implementers (teachers), because this method has enhanced students' achievement in Basic Science.

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