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Effects of Project-Based Learning Strategy on Students' Performance in Geometry Among Junior Secondary Schools In Katsina State, Nigeria

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ABSTRACT
This research determined the influence of project-based learning strategy on Junior Secondary students' performance in geometry. The research adopted quasi experimental design. The population of the study was 44586 junior secondary school two (JSS11) students. 180 students were purposefully and randomly sampled among Junior Secondary two (JSS1I) students of three junior secondary schools in the state. Two research questions and two null hypotheses were formulated and tested at 0.05 level of significance. A validated instrument, i.e Geometry Performance Test (GPT) was used for data collection. The reliability coefficient of the GPT was obtained using Pearson Product Moment Correlation as 0.87. The study used Means, Standard deviation and t-test Statistics as tools for the data analyses. The results showed that there was a significant difference between those taught using project-based learning strategy and those taught using lecture method in favour of those taught using project-based learning strategy. In addition, the results revealed that boarding students significantly perform better compared to day students when taught using project-based learning strategy. Based on the findings, it was recommended among the other things that Secondary school teachers should be encouraged to use project-based learning strategy in the teaching of mathematics. And also, Parent should encourage their wards to be studying in the boarding schools as well as government to build more boarding schools.
Keywords: Project-based Learning, Boarding Students, Day Students, Performance,

INTRODUCTION
For more than a decade now, the different instructional strategies employed in teaching Mathematics have not improved students' achievement in the subject to an appreciable extent. It is therefore, pertinent at this critical time when high premium is placed on science and technology as the bedrock of national development and advancement to search for an approach for teaching mathematics in order to enhance maximum outcome. Supporting this, Mstem (2010) reported that teaching method affects the response of students and determines whether they are interested, motivated and involved in a lesson in such a way as to engage in learning. Lassa and Paulins (1995) as cited by Kurumeh (2010) observed that a way of making mathematics less abstract and interesting is to try as much as possible to concretize the teaching-learning process and make it more interesting and realistic. Eze (2006), contend that teaching and learning mathematics need a more practical approach in order to reduce the abstraction associated with mathematics.

The critics of contemporary education have claimed that students do not mastered basic concepts and principles, and cannot apply what they learn to everyday life Finn (1991). Although it is difficult to prescribe a "one-size-fits-all" approach, research shows that there are practices that will generally encourage students to be more engaged. In recent years, mathematics education has aimed to move away

from rote learning and memorization toward providing more challenging, complex work with an emphasis on deeper thinking; and having an interdisciplinary, rather than a departmentalized focus. One way to approach this goal is to use project-based learning. 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 Mitchealson, 2002). The benefits of learning by practice have long been touted; the roots of the idea go back to John Dewe. Most teachers happen to know the value of challenging projects that student can engage in and of interdisciplinary activities that enrich and extend the curriculum. It is basically an attempt to create new instructional practices that reflect the environment in which children live and learn. Project-based learning is still in the developmental stage. Based on evidence gathered over the past years, project-based learning appears to be effective model for producing gains in academic achievement and attitudes (Meyer, 1997).

Traditional instruction, such as the typical lecture based session that developed before textbooks were mass-produced, often involves delivering as much information as possible. Mathematics educators and researchers, seeing shortages of traditional lecture approach to the teaching of mathematics, involved in new research directions.

According to Moore (2006) lecture can be used to effectively survey the structure of knowledge in a particular area as well as suggest the connection between cases and real decision-making, reaches students at an emotional level, and provides necessary motivation for learning difficult material. He further elaborated that one aspect of the lecture method, which causes some concern is that its effectiveness is dependent on the skills of the individual lecturer.

School geometry is the study of spatial objects, relationships, transformations that have been formalized, and the axiomatic mathematical system that have been constructed to represent them. The National Council of Teachers of Mathematics (NCTM, 2000) has emphasized the importance of geometry in school mathematics by stating, "Geometry and spatial sense are fundamental components of mathematics learning. They offer ways to interpret and reflect on our physical environment." (p.41). Geometry allows students to develop insight to understand other mathematical concepts and connect ideas across different areas of mathematics (Mammana & Villiani, 1998; Muschla & Muschla 2000; NCTM, 2000). Furthermore, many ideas like symmetry or generalization can help students increase insights into the nature and beauty of mathematics (NCTM, 2000). Even if one does not plan to become a mathematician, he or she needs to develop visualization and reasoning abilities, and appreciation of nature. Every human being needs some geometry intuition to understand and interpret the world and our physical environment. The importance of geometry is best stated by an inscription above the door of Plato's school, "Let no one destitute of geometry enter my doors (Burton, 1999; p.79)."

Review of Related Studies

Meyer (1997) studied fourteen, fifth and sixth grade students' challenge seeking during project-based mathematics instruction in one classroom. They drew on five areas of research: academic risk taking, achievement goals, self-efficacy and effect. Data included students' responses to a tolerance for failure survey, an adaptive learning pattern survey, and three individual interviews about their actions during a math project. They reported on the effects of fifth and sixth grade students' motivation and that although the surveys were useful in characterizing general patterns of challenge seeking, more individual and contextualized information was necessary for understanding how to support students engaged in challenging academic work, such as project- based learning. According to the results, project-based learning increased the students' achievement level. Koirala (2002) studied the effects of PBL approach in science on 7th grade students' academic risk taking, problem solving ability, and creative thinking ability. In this research, experimental method was used. It is reported that PBL affected the academic success positively.

Chard (2001) searched the effectiveness of the project-based learning model on computer courses and multiple intelligence theory. The results displayed that PBL had increased students' achievement. Gültekin (2005) aimed to investigate the effects of project- based learning in mathematics on fifth grade students' learning outcomes. In the study, both qualitative and quantitative research methods were used.

According to the findings, the project-based learning approach affected the academic success of students in primary education. These studies did not investigate the effects of project-based learning on geometry while studies on mathematics in general focused on 5th and 6th grade students. In this study, the effects of project-based learning on junior secondary school students' achievement in geometry is to be investigated.

Statement of the Problem

Many students in primary and secondary schools experience difficulties with the learning of some aspects of the mathematics curriculum. Just as students find difficulties in learning mathematics, teachers equally find difficulties in achieving effective teaching in Nigerian secondary school system. This has created challenges for parents, students, teachers and educationists. Teachers are now faced with the problem of achieving effective teaching that would result to better performances of students in both internal and external examinations. It has been observed that among the factors that influence the achievement of learners in school Mathematics, is teachers' effectiveness as measured through the acquisition and use of good instructional skills and methodologies appear very prominent (Max, 1988). The method used in teaching by a teacher is very important as this affects the interest in the subject by the students. This is what necessitates the research to investigate the effectiveness of project-based learning strategy on students' performance among junior secondary school students in geometry.

Objectives of the Study

The study is designed to achieve the following objectives:

1. To investigate the effects of project-based learning strategy on students' performance in geometry.
2. To investigate the difference in performance between day and boarding students when taught geometry using project-based learning strategy.

Research Questions

What are the influences of project-based learning on the academic performance of junior Secondary school students in geometry?

What is difference in the performance between day and boarding students exposed with project-based learning strategy?

Research Hypotheses

Ho_1: There is no significant difference between the mean performance scores of those taught geometry using project-based learning strategy and those taught with the conventional lecture method.

Ho_2: There is no significant difference between the mean performance scores of boarding and day students taught geometry using project-based learning strategy.

RESEARCH METHODOLOGY

Research Design

The design of this study is quasi-experimental design. The experimental group would be subjected to the treatment (teaching using project-based learning method) while the control group would be subjected to conventional lecture method. Pretest will be administer at the beginning of the research to determine the level of group equivalence while after the treatment process posttest will be administer to determine the effectiveness of the treatment.

Population and Sample of the Study

The population of this study covered all public junior secondary school two students (JSSII) in Katsina state. There are 234 public junior secondary schools with the enrollment of 44,581 students in the study area. The state has twelve education zones, namely: Baure, Dutsin-ma, Daura, Funtua, Faskari, Katsina, Kankia, Mani and Malumfashi, Musawa, Rimi and Safana.

Out of the twelve education zones, three education zones were selected purposively as the sample for the study, one from each senatorial zone of the state. The selected education zones are Katsina, Kankia and Musawa which have total number of 58 junior secondary schools and a population of 10,776 students. One junior secondary school was selected from each of the three education zone using simple random sampling technique with the aid of Random Table of Numbers (Kerlinger, 1975). The selected school

were GSSS Batagarawa (Katsina Education Zone), GSSS Musawa (Musawa education zone) and GPDSS Kankia (Kankia education zone). A total of one hundred and eighty 180 students formed the sample of the study. Out of 180 student Sixty 60 were selected from each school, thirty 30 as experimental and control group. One day secondary school was participated out of the three secondary schools.

Research Instrument

The Geometry Performance Test (GPT) was designed and used as pretest and posttest. This is an instrument developed by the researcher to examine students' knowledge on geometrical concepts before and after the treatment between control and experimental group. The test consisted of 30 multiple choice items with options A-D which was based on the topics to be covered during the treatment, one correct answer and three distracters which were all drawn from 2005-2012 JSCE past question papers to ensure that the questions meet the required standard. The instrument was validated by experts in Mathematics Education and Test and Measurement in the Department of Mathematics and Educational Psychology of Isa Kaita College of Education Dutsin-Ma respectively. After the validation exercise, their useful and constructive suggestions led to the re-framing and eliminations of some questions which were found to be either sub-standard or ambiguous. The reliability coefficient of the instrument was 0.82, this was established using Peason Product Moment Correlation Coefficient.

Administration of the Instrument

Geometry Performance Test (GPT) was administered as pretest and posttest respectively with an interval of approximately six weeks between them. The pretest was administered before the commencement of teaching using project-based learning strategy in order to determine the equivalence in students' achievement. After engaging the students with activities, then GPT was re-arranged and administered with the aimed to measure the effectiveness of project based learning strategy.

Procedure for Data Analysis

The data gathered through the achievement tests and attitude scales would be analyzed by using Statistical Package for Social Sciences 17.0 The descriptive statistics; mean, and standard deviation were used for answering the research questions while t-test was used in testing the null hypotheses.

Results Analysis

In answering the research questions, the data collected were analysed using descriptive statistics of means and standard deviations. While in analysing the null hypotheses, the data collected were analysed using inferential statistics of t-test at p-value ≤ 0.05. The details of the analyses were in tables;

Research Question One

What are the differences between the mean academic performance scores of students taught geometry using project-based teaching method those taught using conventional teaching method among junior secondary schools in Katsina State? To answer this question, a descriptive statistics using means and standard deviations were carried out. The result is presented in Table 1.

Table 1: Mean And Standard Deviation Between The Project-Based Learning Strategy And Conventional Teaching Method.

		Pretest			posttest		
Group	**N**	**Mean**	**SD**	**Mean difference**	**Mean**	**SD**	**Mean difference**
Experimental	90	9.68	30.23		14.19	24.04	
Control	90	9.71	29.11	-0.03	9.89	11.88	4.30
Total	180						

The result in table 1 revealed that the mean performance score of the experimental group was 14.19 (SD = 24.04) and that of the control group was 9.89 (SD = 11.88). The mean performance score difference between the groups was 4.30 in favour of the experimental group. The pretest performance scores were 9.68 (SD = 30.23) and 9.71 (SD = 29.11) for the experimental and control groups respectively. The mean difference of the scores was -0.03 in favour of the control group. This showed that there was a difference

between the mean performance scores of those taught using project-based teaching strategy and those taught with conventional teaching method after treatment in favour of project-based teaching method.

Null Hypothesis One

There is no significant difference between the mean performance scores of those taught geometry using project-based learning strategy and those taught using conventional teaching method among junior secondary school students in Katsina State. To test this hypothesis t-test statistics was employed and the result is presented in table 2;

Table 2: T-test Analysis of Mean Performance Scores of Experimental and Control Groups

Group	N	Mean	S.D	Df	t-cal.	P-val.
Experimental	90	14.19	24.04	178	6.81	0.0001
Control	90	9.89	11.88			

$p \leq 0.05$

The result in Table 2 shows that t-cal is 6.81and p-value is 0.0001which is significant at $p \leq 0.05$. This indicated that the null hypothesis one is rejected. Hence, there is significant difference in the mean performance scores of those taught geometry using project-based teaching strategy and those taught using conventional teaching method among junior secondary school students in Katsina State in favour of the experimental group.

Research Question two

What is difference in the performance between day and boarding students exposed with project-based learning strategy?

Table 3: Mean And Standard Deviation of Scores for Day and Boarding Students Exposed to Project-Based Learning Strategy.

		Pretest			posttest		
Group	**N**	**Mean**	**SD**	**Mean difference**	**Mean**	**SD**	**Mean difference**
Boarding	30	6.68	18.23		11.10	16.04	
Day	30	5.71	19.05	0.97	7.89	11.28	3.21
Total	60						

The result in table 3 revealed that the mean performance scores of boarding students was 11.10 (SD = 16.04) and that of day students was 7.89 (SD = 11.28). The mean performance scores difference between the groups was 3.21 in favour of the experimental group. The pretest performance scores were 6.68 (SD = 18.23) and 5.71 (SD = 19.05) for the experimental and control groups respectively. The mean difference of the scores was 0.97 in favour of the boarding students. This showed that there was a difference between the mean performance scores of those taught using project-based learning strategy and those taught with conventional teaching method after treatment in favour of project-based learning method.

Null Hypothesis Two

Ho_2: There is no significant difference between the mean performance scores of boarding and day students taught geometry using project-based learning strategy.

Table 4: T-Test Analysis of Mean Performance Scores of Boarding and Day Students

Group	N	Mean	S.D	Df	t-cal.	P-val.
Boarding	30	11.10	16.04	58	4.13	0.0001
Day	30	7.89	11.28			

Table 4 showed that t-calculated is 4.13 and p-value is 0.0011 at 5% level of significant. Since p-value is less than 0.05, then the null hypothesis is rejected, which means there is a significant difference between the mean scores of boarding and day students in favour of boarding students.

DISCUSSION OF THE RESULTS

The aim of this study was to examine the effects of projects-based learning strategy on performance in geometry among junior secondary school students in Katsina State, Nigeria.

Result from the study in table 2 revealed that students taught geometry using project-based learning strategy performed better than those taught using lecture method. The result is in line with that for Gültekin (2005) who investigated the effects of project-based learning in mathematics on fifth grade students' learning outcomes. In the study, both the qualitative and quantitative research methods were used. According to the findings, the project-based learning approach affected the academic success of students in primary education.

Result in table 4 revealed that students taught geometry using project-based learning strategy have positive attitude towards geometry better than those taught using lecture method. This result is corresponds with the finding of Meyer et.al. (1997) whose study on the effects of students' attitude and strategies on geometry in project-based learning. In the study, they surveyed students about their preferences for challenge, their individual academic goals, their self-efficacy about maths, and their mathematics strategies. Then they interviewed students about their ongoing decisions related to the challenges inherent in their maths project. It was observed that project-based learning had on positive effect on students' attitudes and self-efficacy.

In other hand, the finding of this study is contrary with the finding of Adetunde A.I and Asare. B.(2009) in their study on the comparative performance of day and boarding students in secondary school mathematics examination in Ghana. In the research, experimental method was used. It was found that there was no significant difference between day students and boarding students.

RECOMMENDATION

The research offered the following recommendations;

1. Secondary school teachers should be encouraged to use project-based learning strategy in the teaching of mathematics.
2. Parent teachers association and non-governmental organizations should be assisting secondary schools with facilities that to be used in project-based learning.
3. School managers should allocate enough time /period for mathematics teaching in their schools in order to have good opportunity to carry out activities related to project-based method.
4. The Federal and State Ministries of education in collaboration with other bodies such as Mathematical Association of Nigeria (MAN) and National Mathematics Society (NMS) should organize seminar/workshop for teachers so as to update their knowledge on the use of project-based learning strategy to improve teaching and learning in Nigeria.
5. Parent should encourage their wards to be study in the boarding school as well as government to build more boarding schools.

CONCLUSION

This study has established that project-based learning strategy is an effective instructional strategy that can be used to improve students' performance in mathematics at secondary school level.

REFERENCES

Adetunde, A.I & Asare, B.(2009) Comparative Performance of Day and Boarding Students in Secondary School Certificate Mathematics Examinations. Academia Arena journal; 2009, 1(4). Retrieve https://wwwsciencepub.org.aarenajgmail.com.

Burton, D. M. (1999). The History of Mathematics: An Introduction.4th ed. Boston. WCB McGraw-Hill. (p.79).

Chard, S.C. (2001). The Project Approach: Taking a Closer Look CD. Retrieved from the Web June 5, 2004. http://www.project-approach.com

Eze, A.O. (2006). Training of NCE Mathematics teachers: The issues of instructional materials. *Journal of vocational education, federal college of education,Eha-Amufu 2(1)22-26*.

Finn, H. P. (1991). Teaching Mathematics Using Everyday Contexts: What if Academic Mathematics is Lost? In the Proceedings of the 23rd Conference of the International Group for the Psychology of Mathematics Education.

Gültekin, M. (2005). The Effects of Project-Based Learning on Learning Outcomes in the 5th Grade Social Studies Course in Primary Education. Educational Sciences: Theory and Practice. 5(2), 548-556.

Kurumeh, M.S. & Obida, M.F. (2010). Innovative Teaching Approaches of Mathematics Education in the 21st century.Makurdi: Azaben Publishers.

Koirala, H. P. (1999). Teaching Mathematics Using Everyday Contexts: What if Academic Mathematics is Lost? In the Proceedings of the 23rd Conference of the International Group for the Psychology of Mathematics Education.

Lassa, D.N. & Paulins, P. (1995). *Teaching Mathematics in Nigerian primary* schools University press Ltd.

Mammana, C. &Villiani, V. (1998). Geometry and Geometry- Teaching Through Ages. In Carmela Mammana and Vinicio Villiani (Ed.,) Perspectives on the Teaching of Geometry for the 21st Century, London. Kluwer Academic Publishers.

Marx, R.W., Krajcik, J.S., Guzdial, M. &Palincsar, A.S. (1991). Motivating project-based learning: Sustaining the doing, supporting the learning. Educational Psychologist, 26, 369-398.

Meyer D.K. (1997). Challenge in a Mathematics Classroom: Students' Motivation and Strategies in Project Based Learning. The Elemantary School Journal, 97 (5), 501- 521.

Mitchelmore, M. C. (1997). Children's Informal Knowledge of Physical Angle Situations. Cognition and Instruction, 7 (1) 1- 19.

Moore, S. (2006). Cases Vs lectures: A Comparison of learning, outcomes in undergraduate principles of finance. Journal of Financial Education. Retrieved April 2006 from http:\\www.journal/financialeducation.

Mstem, J. (2010). Project Based Learning with Multimedia. Retrieved from the Web June 20, 2004. http://pblmm.k12.ca.us/

Moursund, D. (1991). Project-Based Learning Using Information Technology. International Society for Technology in Education.,

NCTM. (2000). Principles and Standard for School Mathematics. National Council of Teachers of Mathematics VA, Reston.