



Effect of Constructivism Based Blended Learning Approach on Senior Secondary School Student Mathematics Academic Performance in Katsina Educational Zone of Katsina State Nigeria

OLAOYE, Abiodun Emmanuel.

Teaching Mathematics Methods in the Department of Curriculum and Instructional Technology,
Federal College of Education Katsina.

abiodune.emmanuel@fcekatsina.edu.ng

Dr. Onoge Honmane

Department of Science Education, Federal University Wukari, Taraba State, Nigeria; Onoge666@gmail.com

AUDU, Hauwa

Teaching Mathematics Methods in the Department of Primary Education,
Federal College of Education Katsina.

hauwaauduedoh@gmail.com

Correspondence: abiodune.emmanuel@fcekatsina.edu.ng

DOI: <https://doi.org/10.xxxxx/xxxxx>

*Correspondence: OLAOYE, Abiodun Emmanuel

Email: abiodune.emmanuel@fcekatsina.edu.ng

Received: Feb-18, 2024

Accepted: March-12, 2024

Published: April-10, 2024



Copyright: © 2024 by the authors. Submitted for possible open access publication under the terms and conditions of the Creative Commons Attribution (CC BY) license (<http://creativecommons.org/licenses/by/4.0/>).

Abstract: This study investigated the effect of constructivism based blended learning approach on senior secondary school students' mathematics academic performance. The research adopted quasi- experimental non-equivalent control group design. Data were collected from a sample of 120 tudents comprising 59 boys and 61girls from two randomly selected public schools in Katsina educational zone of Katsina state. The schools were grouped into experimental and control group Mathematics Performance Test (MPT) was used to gather data. The MPT as a researcher made instrument consisting of forty multiple choices (40) items based on SSII mathematics second term topics. The MPT was administered twice, before experiment (Pre) and after experiment (Post). The reliability coefficient of MPT was found to be 0.85. Data collected were analyzed using descriptive statistics of mean and standard deviation for answering the research questions and ANCOVA at coefficient alpha level of 0.05 for testing the hypotheses. Major findings of this study are: there was a significant difference between the mean academic performance scores of students' taught mathematics with constructivism based blended learning approach and those in the control group. There is no significant difference between the mean achievement score of male and female students' taught mathematics with constructivism based blended learning approach. It was recommended that Mathematics teachers should be encouraged to use constructivism based blended learning approach to teach mathematics at senior secondary level.

Keywords: Academic performance, Blended learning and Constructivism.

INTRODUCTION

Mathematics is a key to unlock the hidden human talent and resources of nation that would lead to national growth and development. Mathematics provides opportunity to inculcate permanent literacy and numeracy in an individual as well as laying a sound basis for scientific and reflective thinking. Mathematics is relevant to everyday life and can be seen as the pivot on which all other subject revolve. Its study is generally considered as pre-requisite for the preparation of every informed citizen and serves as a gateway into numerous career choices in life. Mathematics has contributed more to the objectives of the general education of man than any other subject. It is for this reason that almost all nations of the world make the study of Mathematics compulsory both in primary and secondary levels of education. Mathematics is a way of thinking; this implies that; Mathematics affects every area of human life. For example, in buying and selling, simple arithmetic is needed; construction of bridges, roads and houses, geometry is involving; in cooking, measurement and estimation is needed (Lassa, 2012).

The National Policy on Education of the Federal Republic of Nigeria (FRN, 2013) stated that Mathematics is a core subject that all students regardless of discipline, gender or ability must study and pass it at credit level especially at secondary school level before gaining admission to study any course at higher institution of learning. To achieve the desired goal of teaching Mathematics, Nigeria as a developing country needs scientific innovation in teaching and learning process and as such requires mathematics teachers that would enable the early and proper realization of these goals. In Nigeria in spite the enormous role that Mathematics stands for, Researchers such as Mabula (2012) and Esan (2015) evidences revealed poor academic performance of students in Mathematics is attributed to lack of teaching materials, Mathematics phobia, teaching method, poor teaching facilities that include equipment and instructional materials for effective teaching. Ale (2009) have attributed the cause of the poor performance on the conventional method of teaching. According to Ale the conventional method of teaching does not allow students to accomplish learning and its lack meaningful and authentic learning activities to enable students construct their understanding and knowledge. He emphasized that conventional methods are teacher-centered where the teacher often talks at the students instead of encouraging them to interact, ask questions or make them understand the lesson thoroughly.

There is need to advance a variety of teaching methods having to with activity- based or students' centered approaches to secondary school mathematics in order to promote positive attitude towards problem-solving in the Senior School Certificate Mathematics Examinations. Methods such as Guided Inquiry, Problem-solving, Concept map, Vee mapping, Constructivism based blended learning, Process oriented guided inquiry learning, Context-based learning and Flipped classroom, among others need to be encouraged. It is on this note that this study aimed to find out the effect of constructivism based blended learning on academic performance.

The Blended Learning is an alternative for e-learning. In blended learning, it is easy for the teacher to blend traditional classroom with computer based virtual classroom. According to Milheim (2006), Blended learning combines traditional learning with e-learning. Poon (2013) opines that Blended learning comingles teachers with students, and audio visual illustration or internet to improve the educational process. The Blended Learning environment is a learning environment that combines electronic and traditional learning. It enables student-teacher interaction, or student-content interaction, or student-student interaction through direct dialogue or discussion in order to overcome the obstacles of electronic and traditional learning environments and develops students' knowledge and skills effectively.

Blended learning allows the instructor to select from diverse online learning tools as well as traditional face-to-face pedagogical methods to create a learning environment that best meets the needs of each learner in the class. Because each instructor has different learning goals and learners have different learning needs, different blended learning environments will have a different balance between online and face-to-face components. One of the harshest criticisms of Blended Learning is that it focuses on the teacher for creating the knowledge, rather than on the student. To overcome this drawback, Constructivism theory may be applied in Blended Learning environment, increasing students' interactivity and focusing on the student to construct new knowledge based on his/her previous experience.

Constructivists put their emphasis on learning rather than instruction implying the need for rich learning environments for students to actively engage with the teacher as well as their peers and construct knowledge. Besides, constructivism requires the learning environment to be learner-centred. Student centered learning environment is seen as a major enabling element in constructivism. People learn best when they can contextualize what they learn for immediate application and personal meaning. In constructivism the primary responsibility of the teacher is to create a collaborative problem-solving environment where students become active participants in their own learning.

Some researchers explored the effect of constructivism based blended learning approach on learning outcomes from different dimensions as it concerns teachers and educators from different field of study: Turki (2014) investigated the

impact of teaching science using blended learning strategy in the development of achievement skill among students in United Arab Emirate. The study finding out that using blended learning strategy to teach science, has a positive impact in achievement skill and attitudes. The study also showed high level of performance on achievement test as a whole after applying blended learning strategy. Feras (2015) investigated the effect of Blended Learning approach compared to the traditional learning approach on fifth grade students' achievement in My Beautiful Language Textbook and the development of their verbal creative thinking. The study consisted of 49 students among which 25 are males in the Experimental Group and 24 females in the Control Group. The study found a statistical significant difference ($\alpha \leq 0.05$) between the mean scores of the two study groups in achievement posttest and verbal creative thinking post application test. The experiment group which was taught using the blended approach of learning outperformed the Control Group in both tests. Thus, learning My Beautiful Language Textbook using the blended approach is more effective than the traditional method in terms of achievement and the development of verbal creative thinking skills. In light of this, the study recommends the adoption of blended approach in learning My Beautiful Language Textbook, the curriculum computerization, holding series of training courses, and workshops for teachers in school districts on how to effectively implement the blended approach.

Gideon (2016) investigated the effects of constructivist instructional methods on learner achievement in biology in secondary schools in Homabay County, Kenya. The findings of the study shown that constructivist instruction is more effective in learning biology compared to conventional instruction. When taught through the constructivist instruction, girls learn and perform better in biology than boys. When learning achievement was compared along classroom category, girls performed better than students in mixed sex classrooms and students in boys' classrooms. The study also revealed that girls have a more positive attitude towards constructivist instruction than boys.

Ya-Wen, Chih-Ling and Po-Jui (2017) explored the influences of blended learning pedagogy on junior high school student learning achievement and the students' attitudes toward mathematics. To investigate the outcomes of the combination of Moodle online teaching platform and traditional instruction, a quasi-experiment was conducted using a pre-test-post-test control group design. ANCOVA and MANCOVA analyses showed that the blended learning experience benefitted students in the experimental group by having a positive effect not only on the learning outcomes, but also on their attitudes toward studying mathematics in a blended environment. Preliminary results indicated that male students and high-ability students were more motivated in the blended learning environment. Students gave positive feedback on the use of the Moodle learning platform for mathematics after experiencing blended learning.

In adopting constructivism based blended learning as an instructional method of teaching, other observed factors that can influence the students' participation in the instructional delivery process such as academic performance and gender need to be addressed. Academic performance is the quality of students' scores in a test or examination when compare with that of other students of the same level. Popoola (2010), defined academic achievement as an expression used to present students scholastic standing and which is a function of a various factors such as method of teaching, teacher's qualification, child's home background, school environment, attitude, interest among others. Musa (2010) viewed academic performance as the quality of result produced by student as reflected in the quality of their examination score. James, (2015) maintained that academic performance really involved knowing how much students has learned.

Gender is another variable in this study which is defined as a set of characteristics distinguishing between male and female. Depending on the context, the discriminating characteristics vary from sex to social role to gender identity. Okeke (2017), viewed gender to be the social or cultural construct, characteristics, behaviors and role which society ascribes to males and females. Gender is a social or cultural determinant that varies from place to place or culture to culture. For example, Babajide (2010) opined that science subjects are given masculine outlook by educational practitioners. Also, influence of gender on students' conceptual change has been equally investigated. Here, the researcher wants to check whether Constructivism Based Blended Learning is gender friendly or gender bias. This study investigated the effect of constructivism based blended learning approach on senior secondary school student Mathematics academic performance in Katsina state Nigeria.

Statement of the Problem

Nigerians students phobic for mathematics have been a persistent phenomenon. Most of the students in Nigeria secondary schools are ignorant of the relevance of Mathematics to human existence. Despite the importance of Mathematics, the performance of students in the subject has not been encouraging and their retention ability is very low. To worsen the matter people, abandon the study of the subject and those that were endure it chosen as a profession were no longer interested to practice it due to the fact that government inability to finance research and remunerate those that

are in teaching profession accordingly. Not only these students see mathematics teachers as their enemy these has adversely reduced their ability of creativity and critical thinking in them. Also the approaches that most Mathematics teacher employed during classroom teaching are mostly teacher based centered method which lack students' activities and without class activities students tends to hate the subject even dislike teachers. The research in many areas of education has shown that the methods of teaching utilized by the teacher are an important factor in students' learning outcomes and subsequent performance in examinations. Hence there is need to try out other methods to rescue the poor performance of students in Mathematics as a result of teacher centered approaches mostly used by mathematics teachers. Based on the above, this study is set to investigate the effects of constructivism based blended learning approach on mathematics academic achievement.

Objectives of the Study

The study was set to achieve the following objectives

1. Find out if there is any difference between the mathematics academic performance of senior secondary school students taught with constructivism based blended learning approach and those taught with the conventional method.
2. Investigate if there is any difference between the mathematics academic performance of male and female senior secondary school students taught with constructivism based blended learning approach

Research Questions

The following research questions were posed to guide the study:

1. What is the difference between the mathematics academic performances of senior secondary school students taught with constructivism based blended learning approach and those taught with the conventional method?
2. What is the difference between the mathematics academic performance of male and female senior secondary school students taught with constructivism based blended learning approach?

Research Hypotheses

The following Hypotheses were tested at 0.05 significant level

Ho1: There is no significant difference between the mathematics academic performance of senior secondary school students taught with constructivism based blended learning approach and those taught with the conventional method.

Ho2: There is no significant difference between the mathematics academic performance of male and female senior secondary school students taught with constructivism based blended learning approach

Methodology

Design of the Study: This study adopted quasi-experimental control group design, which makes use of pre-test, treatment and post-test. The reason for adoption of this design is based on the fact that students in the class were taught with constructivism based blended learning approach or conventional teaching method, in other words, there was no randomization of the students for the treatment. The study used one experimental group and a control group.

Population of the Study: The population for this study comprised all the secondary school students in Educational zone of Katsina state. The target population of the study consists of all SSII students in Public Secondary Schools in Katsina educational zones numbering 19,572 (Katsina state Ministry of Education 2023).

Sample and Sampling Technique: The total number of Secondary Schools in Katsina Educational Zone is sixty-eight (68) of which twenty-five (25) are public schools and forty-three (43) are private schools. Simple random sampling technique was used to select two Government senior secondary school from Katsina Educational zone for this study. The schools sampled for the study are: Government Day Senior Secondary School Kofar Yandaka and Government Day Secondary School Nasinta. Public schools were chosen for the study because they have many arms of the same class and many students in each class, this make it easy for school authority to release two arms each from the selected schools. Unlike private schools that have small population which may not allow the school authority to easily released two arms for researchers. Simple random sampling technique was used to randomly assigned to either experimental or control group. The experimental group comprised 37 male and 35 female students and the control group comprised 22 male and 26 female students, making a total of 120 students. Intact class of SSII was used in each of the two schools to avoid distortion in their normal school schedules and classroom settings.

Instrumentation: The instrument for the study was Mathematics Performance Test (MPT which consisted of 40 multiple-choice objective questions with four options (A-D). It was developed by the researchers drawn from the topics

on Mathematics in the SSII scheme of work for a whole term, which were taught during the study. The MPT was used for both pre-testing, post testing and retention testing of students' cognitive achievement.

Validity and Reliability

Mathematics Performance Test (MPT) was content validated with the use of a Table of Specification (Test Blueprint) in constructing the test items. Having completed the construction of the MPT, it was face-validated by three experts from Mathematics Education Department of Federal College of Education Katsina. The experts' pieces of advice were adhered to in terms of content relevance of the test items. Corrections and suggestions made by the experts were used to review the MPT. Kuder-Richardson (KR- 21) formula was used to ascertain the internal consistency of the instrument which gave 0.85. The decision to use KR-21 for testing the reliability of MPT was borne out of the fact that the items were not of equal difficulty but of the same level and that one single test scores was used for the reliability. This confirmed a high reliability of the instrument as the correlation coefficient was close to 1.

Administration of the Instrument: Before the commencement of the teaching, each class were given a pre-test (first version of MPT) to determine the level of homogeneity of students' knowledge. The researchers later organize a day training for teachers of the experimental group to be familiar with guides and procedures describe in the lesson plan and how to use the constructivism based blended learning approach lesson plan prepared by the researchers while the control group would use the conventional method this group used teacher's typical method; where chalk and talk instructional technique usually dominate. For the period of the study, the teachers would meticulously use the lesson plans prepared by the researcher for both experimental and control groups to cover the mathematics contents for the whole term. The post-test (that is, the second version of the MPT) was administered at the end of the term when the two groups might have cover the expected contents and two weeks after, delayed post-test of MPT was administered. The MPT was scored 100 percent in all versions.

Method of Data Analysis: The data collected were analyzed using descriptive statistics of mean and standard deviation to answer the research questions while t-test at coefficient alpha level of 0.05 was used to test the hypotheses.

Analysis and Results

Research Question One: What is the difference between the mathematics academic performances of senior secondary school students taught with constructivism based blended learning approach and those taught with the conventional method?

Table 1: Descriptive Statistics Showing Experimental Group (Constructivism Based Blended Learning) and Control Group Academic Performance in the Pre-test and Post test

Groups	No. of Students	Pre-Test		Post-Test		Mean Gain
		\bar{X}	S.D	\bar{X}	S.D	
Experimental	72	15.00	6.77	57.78	9.34	42.78
Control	48	15.10	6.15	46.67	7.02	31.57
Mean Difference				11.11		
		0.10				11.21
Total	120					

Results on table 1 indicated that the mean gain of the students taught with constructivism based blended learning approach (Experimental Group) was 42.78 and that of the control group who were taught using conventional method 31.57. The overall mean difference between the groups was 11.21 and these favored students' in Experimental group. The mean performance scores of students who were taught mathematics with constructivism based blended learning approach was higher than those taught using conventional method with a mean gain of 11.11 which favored the experimental group. Therefore, a difference in performance existed between the group taught mathematics with constructivism based

blended learning approach and those taught using conventional method. The students who were taught with constructivism based blended learning approach higher than the other students who were taught in the control group.

Research Question Two: What is the difference between the mathematics academic performance of male and female senior secondary school students taught with constructivism based blended learning approach?

Table 2: Descriptive Statistics Showing Experimental Group (Constructivism Based Blended Learning) on Gender Academic Performance in the Pre-test and Posttest.

Groups	No. of Students	Pre-Test		Post-Test		Mean Gain
		\bar{X}	S.D	\bar{X}	S.D	
Male	37	13.78	6.50	58.11	9.53	44.33
Female	35		5.57	57.43	9.27	43.57
Mean Difference		13.86		0.68		0.76
Total	72	0.10				

Result of table 2 indicated that the mean gain of the male students taught mathematics with constructivism based blended learning approach (Experimental Group) was 58.11 and that of the female students who were also taught mathematics with constructivism based blended learning approach (Experimental Group) was 57.43. The overall mean difference between the performance scores of male and female students was 0.76 which favored the male students. The mean performance score of the male was higher than that of the female students with a mean gain of 0.68 which favored the male students. Therefore, the effect of constructivism based blended learning approach of the male students was higher than that of the female students.

Test of Hypotheses

Table 3: Table 6: ANCOVA of the Difference in Mean Scores of Students Taught with Constructivism Based Blended Learning Approach and those Taught with Conventional method

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	3569.686a	2	1784.843	24.577	.000
Pretest	.114	1	.114	.002	.969
Intercept	33248.873	1	33248.873	457.824	.000
Gender	14.130	1	14.130	.195	.660
Method	3520.691	1	3520.691	48.478	.000
Error	8496.981	117	72.624		
Total	353400.00	120			
Corrected Total	12066.667	119			

a. R Squared = .296 (Adjusted R Squared = .284)

Ho1: There is no significant difference between the mathematics academic performance of senior secondary school students taught with constructivism based blended learning approach and those taught with the conventional method.

Table 6 shows that teaching method as a main factor has significant effect on students' academic performance in mathematics. This is because, from the table, method is significant at p-value of 0.000 and therefore at a higher p-value of 0.05, teaching method is also significant. This leads to the rejection of the null hypothesis of no significant difference in the mean mathematics academic performance scores of students taught with constructivism based blended learning approach and those taught with conventional method.

Ho2: There is no significant difference between the mathematics academic performance of male and female senior secondary school students taught with constructivism based blended learning approach.

Table 6 shows that the computed F - ratio for the effect of gender on academic performance of students in the Mathematics Achievement Test was 0.198 which was not significant at P-value of 0.05. Thus, the null hypothesis of no significant effect of gender on the performance of students in MPT was accepted

Discussion of Findings

Results presented in table 1 showed that experimental group that were taught with constructivism based blended learning approach performed significantly better than the control group who were taught with the same contents with the conventional method. The students in both groups were found to be relatively homogeneous before the start of the experiment, judging from the result of the pre-test where they had a difference in mean of 0.10. The result of ANCOVA as reported in Table 3 showed that there was a statistically significant difference between mean academic performance of students taught mathematics through constructivism based blended learning and those taught with conventional method. The finding agreed with the work of Turki (2014) who found that using blended learning strategy to teach science, has a positive impact in achievement skill and attitudes. The study showed high level of performance on achievement test as a whole after applying blended learning strategy than traditional teaching method.

Table 2 and 3 show that the teaching method of constructivism based blended learning approach is not biased as male and female students taught mathematics with the approach achieved almost at the same high level in the post-test, with male students doing even slightly better than female. This finding contradicts that of Gideon (2016) who find that when taught through the constructivist instruction, girls learn and perform better in biology than boys. When learning achievement was compared along classroom category, girls performed better than students in mixed sex classrooms and students in boys' classrooms. Also, the reasons for the insignificant gender difference in achievement recorded students exposed to constructivism based blended learning approach could be due to the fact that both genders collaborated very well in the process of learning and no gender dominated the class activities. Another reason could be that all the members of the group worked together as teams to achieve the common goal which had reflected in their achievement in the posttest.

Conclusion

Constructivism Based Blended learning approach represents an effective method of teaching and learning mathematics as student's performance reflects positively as students taught with constructivism based blended learning approach performed better than those taught with conventional method of teaching. This method takes it's important due to the use of both, the e-learning and traditional method and as a result of this, the student's achievement in mathematics were improved. In the same vein, there was no significant gender difference between male and female students' performance in mathematics when constructivism based blended learning approach is used. The use of Constructivism Based blended learning strategy plays a major role of turning the mathematically environment to a creative and interactive. In addition, the interaction between the learner and the learning materials in the electronic environment without the need for the presence of the teacher develop the skill of self-learning thereby improve the quality of the learning mathematics as a whole.

Recommendation

The following recommendations were made:

1. Government at all level should provide online learning that is blended to enhance students' active learning and to construct knowledge with peers.
2. Teachers should be trained and equipped with knowledge vast enough to implement constructivism based blended learning approach in teaching mathematics.
3. Mathematics teachers should use different learning strategies to teach their students to create successful learning experiences.

References

- Ale, S. O. (2009). Primary school mathematics: A foundation for secondary level and tertiary level mathematics. Training manual for capacity building workshop for secondary and primary school's Mathematical Science Teachers. Abuja: National Mathematical Centre.
- Babajide, V. F. T. (2010). Generative and predictive-observe-explain instructional strategies as determinants of senior secondary school students' achievement and practical skills in Physics. Unpublished Ph.D. Thesis, University of Nigeria, Nsukka.
- Esan, F. (2015). Cooperative Problem-Solving Strategy and Students' Learning Outcomes in Algebraic Word Problems: A Nigerian Case. *International Journal for Infonomics (IJI)*, 8(1),123-135.
- Federal Ministry of Education. (2013). National Policy on Education. Lagos: Nigeria Educational Research Council NERDC 4th Edition.
- Feras, M. A. (2015). The effect of blended learning approach on fifth grade students' academic achievement in my beautiful language textbook and the development of their verbal creative thinking in Saudi Arabia. *Journal of International Education Research*, 11(4), 253-260.
- Gideon, M. M. (2016). Effect of constructivist instructional methods on learner achievement in biology in secondary schools in Homabay county, Kenya. Unpublished PhD Thesis, University of Nairobi, Kenya.
- James, T. (2015). Effect of Combining Reflective Writing with Concepts Mapping and Lecture Method on Pre-Service Teachers Attitude Achievement in Biology. Unpublished PhD Thesis, A.B.U. Zaria.
- Lassa, P. N. (2012). The Teacher of Mathematics for Nigerian Secondary School: Jos, Nigeria; Fab Anieh Nig. Ltd. National Examination Council (NECO) (2012). Mathematics Chief Examiner's Report.
- Mabula, N. (2012). Promoting Science Subjects Choices for Secondary School Students in Tanzania: Challenges and Opportunities. Dar es Salaam University College of Education: Dar es Salaam.
- Milheim, W. D. (2006). Strategies for the Design and Delivery of Blended Learning Courses. *Journal of Educational Technology*, 18(3), 99-105.
- Musa, M. (2010). The Relative Effect of Teaching Method for Enhancing Academic Performance In Chemistry Among Senior Secondary Schools Students. Unpublished Master's Thesis, A.B.U. Zaria.
- Okeke, E. A. C. (2017). Towards gender equity in the 21st century. In C. V. Nnaka and M. C. Anaekwe (Eds.), *Towards gender equality in Nigeria in the 21st century*. Enugu: Podik.
- Poon, J. (2013). An examination of a blended learning approach in the teaching of economics to property and construction students. *Property Management*, 31(1), 39-54.
- Popoola, A. A. (2010). Effect of teaching qualification on mathematics academic achievement. *Journal of Science Teachers Education*, 5(2), 12-15.
- Turki, F. A. (2014). The effect of using blended learning strategy achievement and attitudes in teaching science among 9th grade students. *European Scientific Journal*, 31(10), 134-139.
- Ya-Wen, L., Chih-Lung, T., & Po-Jui, C. (2017). The effect of blended learning in mathematics course. *EURASIA Journal of Mathematics Science and Technology Education*, 13(3), 741-770.