International Journal of Applied Research

Accra Jaja Fulfillment
Department of Science
Education, Faculty of
Education, Rivers State
University, Nigeria

Ejiofor-Chima Ngozi Ann
Government Girls Secondary
School Oromineke D/Line Port
Harcourt, Rivers State,
Nigeria

Effect of blended learning instructional strategy on senior secondary student's achievement and interest in mathematics in Rivers State

Accra Jaja Fulfillment and Ejiofor-Chima Ngozi Ann

Abstract
The study determined the effect of blended learning instructional strategy on senior secondary students' achievement and interest in mathematics in Rivers State. The study was a quasi-experimental design, guided by three research questions and hypotheses. The population of the students comprises of all the Senior Secondary 2 students in Rivers State. A sample size of 122 was drawn from selected schools using purposive sampling technique. Two instrument were used, Mathematics Achievement Test (MAT) and Mathematics Interest Inventory Questionnaire (MIIQ). The instruments were validated by experts in the field. The reliability of the instruments was determined using test retest and a reliability coefficient of 0.84 for (MAT) were obtained using Pearson Product Moment Correlation while for (MII) using Cronbach Alpha Method a coefficient of 0.89 was calculated. Mean and standard deviation were used to answer the research questions while the hypotheses were tested using ANCOVA at 0.05 significant level. The findings of the study revealed that blended learning instructional strategy improve students' performance. It also arouses interest of both male and female students in leaning mathematics than the traditional learning method. Based on the findings it was recommended that Mathematics teachers should use blended learning Instructional Strategy to teach difficult concepts in mathematics and arouse student's interest in learning.

Introduction
Mathematics is one subject that students perceived to be difficult, due to its abstract nature. This makes students to lose focus of the on the subject and divert towards selection of careers that its study requires little or no mathematics. Mathematics is the foundation of science and technology. According to Arua, (2007) [2] mathematics is the prime instrument for development, understanding and exploration of scientific, economic and social world. Mathematics is a basic rudiment for all fields of life and an indispensable tool in creating new knowledge. Usman, (2007) [15], in his study opined that mathematics is one important subject for continues existence of the world because without mathematics, there is no science, without science, there is no technology and without technology there is no modern society. Charles-Ogan and Ejiofor-Chima, (2017) [4] attested that the economic development of any nation depends on the level of their mathematics practice. This is the reason of great importance and attention accorded to mathematics education not just in Nigeria but in the whole world.
The above reasons deemed it necessary the adoption of better ways of delivering mathematics at classroom level as to achieve the objectives of learning. Teachers should use instructional designs and materials that facilitate conceptual understanding, retention, application, critical thinking, reasoning and problem solving. Despite the importance of mathematics and attention given to its study, yet the expected achievement has been an illusion. The poor performance in the subject is of great concern to educational stakeholders due its importance in our world today. Okereke, (2006) [9] opined that poor performance of students in mathematics is due to the inability of students in attaining effective teaching and learning. The cause he attributed to the use of inappropriate instructional methods and materials. This means that for the attainment of effectiveness in the teaching/learning process, it must be students centred. Onyegagbu, (2002) argue that facilitation of students conceptual understanding, knowledge acquisition and application in solving problems depends on learners' characteristics, learning environment,

Correspondence Author:
Accra Jaja Fulfillment
Department of Science
Education, Faculty of
Education, Rivers State
University, Nigeria

teachers' knowledge and instructional approaches used. This means that learning will be more effective when it is directed towards learners' interest. Thus, it is time for teachers to reimage mathematics instructions with better technological approaches and learning resources. We need teaching method/ strategies and learning tools that will provide more detailed and reliable data about our students' performance in mathematics, so that we can personalize instruction for each learner. Therefore, to bring our students to the acceptable world standard of learning, bolster assessment scores, and create a data-driven culture in our schools, we need to employ blended learning approach.

We are in a digital world where learners are keen on the manipulation of digital devices. The world activities had gone digital likewise learning. Education in the 21st century anchors more on the use of Information and Communication Technology. Information and Communication Technology (ICT) pervaded the fields of education. In recent years, the term e-learning has emerged as a result of the integration of ICT in the educational fields. Following the application of this technology in education; Calinten, (2015) [3] stated that some pitfalls have been identified and this has led to the blended learning phenomenon. ICT is seen as an enabler and an enhancer of the teaching and learning process in producing the best quality personnel who will become great leaders and manpower for the country. Thus responsible for the national economic, social and technological development (Chen and Jones, 2015) [5]. We are living in an ever changing world. Recently, the world of education has been varied by the fast and rapid revolution in computer and the internet technologies which according to Collen (2015) [6], new findings are generated and become established at break taking speed. This has revolutionized teaching and learning particularly distance education. The arrival of World Wide Web (www) has increased the demand for distance education and concepts like online learning or E-learning in educational development. The system of online learning has been largely used not only in higher education but in secondary school education.

The above statement is the reason of the paradigm shift in learning from traditional base instructional approaches to technological base instructional approaches. Learning is no longer teachers centred but student centred. Students are the focal point of today's learning. The aim of education is to equip individuals with knowledge and skills that will help them solve human problems and function effectively in our today's world. Therefore, learning should be tailored towards the attainment of learners needs. The aforementioned can be best achieved when both instructional strategies and materials are of students' interest. This will not only arouse the interest of learners but will make learning more creative, fun, flexible and understandable. Therefore, the integration of ICT in teaching/learning process will be of great interest to students. It is on this stand that the researcher deemed it necessary on blended learning instructional approach.

Fonkeng (2014) defined blended learning as a hybrid of traditional face-to-face and online learning that instruction occurs both in the Classroom and online and where the online component becomes a natural extension of traditional classroom learning. Blended learning is a formal education program in which students learn at least in part through delivery of content and instruction via digital and online media with some element of student control over time, place, path, or pace. This is combination of face-to-face classroom methods with computer-mediated activities. Gad, (2016) [8] defined blended learning as a term increasingly used to describe the way E-learning is being combined with traditional classroom methods and independent study to create a new hybrid teaching methodology. According to Flash (2015) [7], blended learning represents a much greater change in basic technique than simply adding computer to classrooms. It represents, in many cases, a fundamental change in the way teachers and students approach the learning experience. In a nut shell blended learning is the integration of ICT in a traditional class room. Blended learning provide an exciting opportunity for students to become standards-proficient, full engaged in learning process and math learners.

Statement of Problem
The WAEC chief examiners' report (2015) identified the use of inappropriate teaching method, inadequate preparation for examination by students and teachers not using appropriate instructional materials contributing to students' poor performance in mathematics. Arua, (2007) [2] attested that failure in internal and external examination in mathematics is as a result of the use of inappropriate teaching method that do not inculcate the right scientific skills and processes to the students. The use of wrong instructional method causes poor conceptual understanding resulting into inability of knowledge application in problem solving.

According to Aroh, (2005) [1] teachers centred approach causes poor understanding, resulting into rote memorization. The approach makes mathematics to be more abstract, rigid and uninterested. This is the reason of lack of students' participation in the learning process resulting into poor achievement in the subject. Therefore, to improve on students' achievement in mathematics calls for the adoption student centred approach.

Aim and Objectives of the Study
The aim of the study is to examine the effect of blended learning strategy on senior secondary students' achievement and interest in mathematics. The study is guided by the following objectives;
1. To determine the effect of blended learning instructional strategy on senior secondary students' achievement in mathematics.
2. To find out if there is a difference in the mean interest scores of senior secondary mathematics students exposed to blended learning instructional strategy and those exposed to traditional learning strategy.
3. Determine the interactive effect of blended learning instructional strategy and gender on senior secondary students mean interest scores in mathematics.

Research Questions
1. What is the achievement mean scores of mathematics students exposed to blended learning instructional strategy and those exposed to traditional learning strategy?
2. What is the difference in the mean interest scores of mathematics students exposed to blended learning instructional strategy and those exposed to traditional learning strategy?
3. What is the interactive effect of blended learning instructional strategy and gender on senior secondary students mean interest scores in mathematics?

Hypotheses

1. There is no significant difference in the achievement mean scores of mathematics students exposed to blended learning instructional strategy and those exposed to traditional learning strategy.
2. There is no significant difference in the mean interest scores of mathematics students exposed to blended learning instructional strategy and those exposed to traditional learning strategy.
3. There is no significant difference in the interactive effect of blended learning instructional strategy and gender on senior secondary students mean interest scores in mathematics.

Methodology

The design of the study was quasi experimental, non-equivalent pre and post-test design. The classes were used in their intact nature. The population of the study consist of all public senior secondary school two students in Rivers state. The sample size for the study consists of 122 students including both male and female.

Instrumentation: Two instruments were developed for data collection. They include Mathematics Achievement Test (MAT) which tested Academic Achievement and Mathematics Interest Inventory (MII). Mathematics Achievement Test (MAT) has 25 multiple choice questions drawn from mathematics concepts of SS2 syllabus. Mathematics Interest Inventory (MII) which contained 20 items modified 4-point Likert Scale; Strongly Agree (SA) = 4 points, Agree (A) = 3 points, Disagree (D) = 2 points and Strongly Disagree (DS) = 1 point, measuring the level of agreement and disagreement on the interest statements. The Mathematics Achievement Test questions were selected from West African Senior Secondary Certificate Examination past question papers and Mathematics text books for Senior Secondary Schools based on SS2 scheme of work.

The instruments were validated for content and face validities by experts in the field. The Reliability coefficient of the instruments were determined using test retest and a reliability coefficient of 0.84 was obtained using Pearson Product Moment Correlation for MAT while that of MII, Cronbach Alpha Method was used to obtain a coefficient of 0.89. A pre-test was administered to the students of both experimental and control groups. The experimental group was taught using blended learning instructional strategy while the control group were taught using the traditional method. A post-test (MAT) was administered to the students of both groups immediately after four weeks' treatment period to determine its effectiveness on students. An MII questionnaire was also given to students before and after treatment. Data collected were analysed, using mean and standard deviation to answer the research questions while the hypotheses were tested at 0.05 significant level using Analysis of Covariance (ANCOVA)

Results

Research question 1: What is the achievement mean scores of mathematics students exposed to blended learning instructional strategy and those exposed to traditional learning strategy?

Table 1: Mean and SD of pre-post Achievement scores of students on Achievement.

Group.	N	Pretest Mean (X)	SD	Posttest Mean (X)	SD	Mean. Gain.
Expt.	58	52.20	3.37	85.66	5.11	33.46
Control.	64	52.92	5.78	57.75	7.62	4.83
Total	122	-	-	-	-	-

The findings of table 1 showed that the pre-test mean score of the experimental group is (52.20) with SD of (3.37) while that of the control group was (52.92) with SD of (5.78). The post-test mean score of the experimental group is (85.66) with SD of (5.11) while that of the control group is (57.75) with SD of (7.62). The mean gain of experimental group is (33.46) which is higher than that of control group of (4.89). The result proved that blended learning instructional strategy is effective in enhancement of students' achievement in mathematics.

Research question 2: What is the difference in the mean interest scores of mathematics students exposed to blended learning instructional strategy and those exposed to traditional learning strategy?

Table 2: Mean and SD of students' mean interest scores in mathematics before and after treatment.

Group.	N	Pretest Mean (X)	SD	Posttest Mean (X)	SD	Mean. Gain.
Expt.	58	18.31	10.42	85.63	5.12	67.32
Control.	64	25.48	7.77	26.98	12.56	1.5
Total	122	-	-	-	-	-

The result of table 2 showed that the pre-test mean score of the experimental group is (18.31) with SD of (10.42) while that of the control group is (25.48) with SD of (7.77). The post-test mean score of the experimental group is (85.63) with SD of (5.12) while that of the control group is (26.98) with SD of (12.56). The mean gain of experimental group is (67.32) which is higher than that of control group of (1.5). The result proved that, at first students of both groups interest in learning of mathematics were low but after the treatment students of experimental group interest increased with insignificant change of interest of the control group.

Research question 3: What is the interactive effect of blended learning instructional strategy and gender on senior secondary students mean interest scores in mathematics?

Table 3: Mean and SD of male and female expt. group students' mean interest scores in mathematics.

Group.	N	Pretest Mean (X)	SD	Posttest Mean (X)	SD	Mean. Gain.
Male	27	17.68	1.07	79.85	9.10	62.17
Female.	31	15.21	5.02	77.48	8.19	62.27
Total	58	-	-	-	-	-

Table 3 showed that the pre-test mean score of male experimental group is (17.68) with SD of (1.07) while that of the female is (15.21) with SD of (5.02). The post-test mean score of the male experimental group is (79.85) with SD of (9.10) while that of the female is (77.48) with SD of (8.19). The mean gain of male experimental group is (62.17) while that of female is (62.27).

Hypothesis 1: There is no significant difference in the achievement mean scores of students exposed to blend learning instructional strategy and those exposed to traditional method.

Table 4: Summary of Analysis of Covariance (ANCOVA) of students' Achievement mean scores.

Tests of Between-Subjects Effects						
Dependent Variable: VAR00002						
Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	43717.183ᵃ	2	21858.592	505.044	.000	.895
Intercept	33234.210	1	33234.210	767.878	.000	.866
VAR00001	.713	1	.713	.016	.898	.000
VAR00003	43698.769	1	43698.769	1009.662	.000	.895
Error	5150.390	119	43.281			
Total	576610.000	122				
Corrected Total	48867.574	121				
a. R Squared = .895 (Adjusted R Squared = .893)						

The ANCOVA result of table 4 showed a calculated significant value of (.000) which is less than the 0.05 therefore, there is a significant difference between the achievement of students exposed to blended learning instructional strategy and those exposed to traditional method.

Hypothesis 2: There is no significant difference in the mean interest scores of students exposed to blended learning instructional strategy and those exposed to traditional method.

Table 5: Summary of Analysis of Covariance (ANCOVA) of students' interest mean scores.

Tests of Between-Subjects Effects						
Dependent Variable: VAR00002						
Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	104840.561ᵃ	2	52420.281	550.546	.000	.902
Intercept	26630.461	1	26630.461	279.687	.000	.702
VAR00001	105.493	1	105.493	1.108	.295	.009
VAR00003	104597.052	1	104597.052	1098.535	.000	.902
Error	11330.595	119	95.215			
Total	483573.000	122				
Corrected Total	116171.156	121				
a. R Squared = .902 (Adjusted R Squared = .901)						

The ANCOVA result of table 5 showed a calculated significant value of (.000) which is less than the 0.05 therefore, there is a significant difference in the mean interest scores of students exposed to blended learning instructional strategy and those exposed to traditional method.

Hypothesis 3: There is no significant difference in the interactive effect of blended learning instructional strategy and gender on senior secondary students mean interest scores in mathematics.

Table 6: Summary of Analysis of Covariance (ANCOVA) of male and female student's interest mean scores.

Tests of Between-Subjects Effects						
Dependent Variable: VAR00002						
Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	151.377ᵃ	2	75.688	1.016	.369	.036
Intercept	33368.407	1	33368.407	447.986	.000	.891
VAR00001	70.457	1	70.457	.946	.335	.017
VAR00003	74.520	1	74.520	1.000	.322	.018
Error	4096.692	55	74.485			
Total	362444.000	58				
Corrected Total	4248.069	57				
a. R Squared = .036 (Adjusted R Squared = .001)						

The ANCOVA result of table 6 showed a calculated significant value of (.369) which is greater than the 0.05 therefore, we accept the null hypothesis of no significant difference in the interactive effect of blended learning instructional strategy and gender on senior secondary students mean interest scores in mathematics.

Discussions
The findings of this study revealed that adoption of appropriate teaching method/strategy in teaching of mathematics enhances students' achievement and interest in mathematics learning. This implies that the integration ICT in the teaching/learning process have positive effect on students' achievement and interest in mathematics learning. The study specifically proved that blended learning instructional strategy improves students' achievement and interest in mathematics. This study is in agreement with the study of Agwagah, Arua and Abugu (2019) in their finding that the use of computer assisted instruction improve students' achievement in mathematics. It is also in line with

the findings of Suleman, Hussain, Din and Iqbal, (2017) [12] that computer assisted instruction enhances students' achievement in mathematics. it is also in line with the study of Ya-Wen, Chih-Lung and Po-jui finding that students are more motivated in the blended learning environment and also students gave positive feedback on the use of moodle learning platform for mathematics after experiencing blended learning. The study agrees with the study of Terry, (2016) on the effect of blended learning on math and reading achievement in a charter school context. The study determined that there is not a statistically relationship between traditional, blended, and fully online students and math scores, nor between traditional and blended learning students and reading scores.

The second findings of this study proved that students of both groups before treatment has low interest in mathematics learning. The result also proved that after treatment; the experimental group exposed to blended learning tends to have their interest increased in the learning of mathematics than those exposed to traditional learning. This confirmed that that the integration of ICT in the teaching/learning process arouses student's interest in mathematics learning. This is in agreement with the study of Owora and Chika, (2019) [1] that the use of appropriate instructional strategies and materials arouses student's interest in the study of mathematics. The study was also supported with the work of Usman and Musa (2019) [16] that the use of appropriate instructional strategies that get students engage, be creative and critically think like concept mapping arouses student's interest in learning algebra.

The third findings of this study confirmed that both male and female of the experimental group exposed to blended learning have interest in learning mathematics. Therefore, proving that blended learning arouses the interest of both male and female students to mathematics learning. This came to concur with the work of Tali and Peter, (2019) [13] that the use of appropriate instructional approach arouses the interest of both male and female students in learning geometry.

Conclusion
Based on the findings of this study it was conclude that the adoption of blended learning has a statistical significant effect on students' achievement in mathematics and also it enhances student's interest for mathematics learning both male and female.

Recommendations
1. Based on the findings of this study, the following recommendations are made.
2. Mathematics teachers should use blended learning Instructional Strategy to teach difficult concepts in mathematics.
3. Rivers State Government should build and equip functional Information and Communication Technology (ICT) Laboratories in all their schools.
4. Teachers should attend and participate in the Mathematical Association of Nigeria (MAN) and Science Teachers Association of Nigeria (STAN) workshops and conferences to improve and update their knowledge in technological teaching methods.
5. Teacher training Institutions should ensure that pre-service teachers are taught how to apply modern technological methods and materials in teaching.

References
1. Aroh GC. Effect of video-taped instruction on students' achievement and interest in mathematics. Unpublished Master's thesis, University of Nigeria, Nsukka, 2005.
2. Arua SN. Effect of interactive whiteboard instructional approach on students' achievement and interest in mathematics. Unpublished Master's thesis, University of Nigeria, Nsukka, 2007.
3. Calinten AF. Getting started with blended learning. Australia: Griffith Institute for Higher Education press, 2015.
4. Charles-Ogan G, Ejiofor-Chima NA. Entrepreneurial education and sustainable national develop: The gap between policy and implementation. International Journal of Multidiscipline Research and Development online ISSN: 2349-4182. 2017; 4(10):15-18.
5. Chen CJ, Jones OF. Flipped classroom and primary six pupils' mathematics performance in Abia State, Nigeria. Journal of Science and Technology. 2015; 3(2):23-26.
6. Collen EU. Blended learning: Uncovering its transformative potential in higher education internet. Higher Education. 2015; 7(2):95-105.
7. Flash AM. Student Review of the Science Curriculum: Major Findings. London: Planet Science, 2015.
8. Gad KO. Students and teachers' perception of the causes of poor academic performance in Ogun State secondary schools Nigeria: Implications for counselling for national development. European Journal of Social Sciences. 2016; 13:229.
9. Okereke SC. Effects of prior knowledge of implications of mathematical task/concepts to career types and gender on students' achievement, interest and retention. Paper presented at the proceedings of 47th Annual Conference Science Teachers Association of Nigeria (STAN), 2006, 253-259.
10. Onyegegbu SO. Sex, age and performance in mathematics. Unpublished Doctoral dissertation, University of Nigeria, Nsukka, 2001.
11. Owora NO, Chika CU. Strategies for arousing students' interest in mathematics. Mathematical Association of Nigeria (MAN) Journal. 2019; 44(1):201-209.
12. Suleman Q, Hussain I, Din NU, Iqbal K. Effects of computer assisted instruction (CAI) on students' academic achievement in physics at secondary level. Computer Engineering and Intelligent System. 2017; 8(7):9-17.
13. Tali DJ, Peter D. Effect of collaboration learning approach on upper basic two students' interest in geometry in Pankshin education zone. A paper presented at the proceedings of 56th of Annual Conference of Mathematical Association of Nigeria (MAN), Rivers State, and September, 2019, 444-451.
14. Terry AC. The effect of blended learning on math and reading achievement in a charter school context. Doctoral dissertation Liberty University, Lynchburg, VA. Retrieved 20th September, 2019. from www.http//pdfs.semanticscholar.org>....
15. Usman KO. Computer competences require of mathematics teachers for the use of computer in teaching mathematics. Unpublished Doctoral Dissertation, University of Nigeria, Nsukka, 2007.
16. Usman MA, Musa DC. Concept mapping instructional strategy and senior secondary student' performance and

interest in algebra in Bauchi. Mathematical Association of Nigeria (MAN) Journal. 2019; 44(1):231-236.

17. West African Examination Council (2015-2017). Chief Examiners' report (Nigeria) SSCE, May/June Examinations.

18. Ya-Wen L, Chih-Lung T, Po-Jui C. The effect of blended learning in mathematics course. Eurasia Journal of Mathematics, Science and Technology Education. 2017; 13(3):741-770.