EFFECTS OF BLENDED LEARNING STRATEGY ON SENIOR SECONDARY SCHOOLS STUDENTS' PERFORMANCE IN GEOMETRY IN KOGI STATE, NIGERIA
BY

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Abstract
This study examined the effects of blended learning strategy on senior secondary schools' students' performance in Kogi state, Nigeria. The research adopted the non-randomized, pre-test – post-test control group quasi experimental design. Data were collected from a sample of 60 students comprising 31 boys and 29 girls from two randomly selected schools in Kogi state. The schools were grouped into one experimental group and one control group. Blended learning approach was used for the experimental group while the control group was taught using the conventional method. The instruments used for data collection was Mathematics Performance Test (MPT). MPT contained twenty (20) items with a reliability coefficient of 0.79 using Cronbach Alpha (σ). Data collected were analysed 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. The results showed a significant difference in the performance of students exposed to blended learning approach and those in the control group. There was no significant difference in the level of performance of male and female students taught mathematics using the blended learning approach. Based on these findings, it was recommended that teachers in training should be equipped with knowledge vast enough to implement blended learning approach in teaching mathematics.
Keywords: Blended, learning, performance, geometry, gender

Introduction
The knowledge of mathematics is a basic pre-requisite in the quest for present day scientific and technological advancement. The idea of numbers, structures and relationship which mathematics connotes stand out in medicine, business, education, agriculture, and every field of human endeavor. In the 21st century in particular, sound mathematical background is needed for life sustenance and workplace competence. Mathematics is the study of numbers, counting and

measurement, but that is only the beginning. Mathematics is the queen of science and a tool for scientific and technological advancement, an indispensable tool for effective use of electronic resources for national development. It is also a way to communicate ideas, and perhaps more than anything, it is a way of reasoning that is unique to human beings. According to Yusuf (2011), mathematics is divided into applied mathematics and pure or theoretical mathematics, applied mathematics tries to model, predict and explain things in the real world: for example, one area of applied mathematics is fluid mechanics, which analyses how fluids are affected by forces. Other examples of applied mathematics might be statistics or probability theory pure mathematics, on the other hand, is separate from the physical world. It solves problems, finds facts and answers questions that don't depend on the world around us, but on the rules of mathematics itself. Olutosin (2007) described mathematics as an instrument to ease or facilitate the learning of other subjects and that, the importance of mathematics permeates all aspects of human endeavour.

Literatures have consistently reported low performance of students in mathematics. The problems identified in the teaching and learning of mathematics at the secondary school level include the following: weak teachers' background, weak students' foundation, poor teachers' preparation due to high workload, low students' interest and poor understanding of mathematics concepts. Other problems are poor problem-solving skills, lack of proper guidance to construction and proof of geometric figures, anxiety for mathematical figures and poor teaching methodology (Chiason, Kurumeh & Obida, 2010; Adolphus, 2011, Ali, Bhagawati & Sarmah 2014). Despite numerous methods used in teaching mathematics, reports show that in 2017, 2018, 2019 and 2020 the total number of students who could not get the university requirements in mathematics is 2,192,682. This figure is a serious concern to every stakeholder because of mathematics.

The major issue that faces mathematics educators anywhere is how they can provide a better and interactive educational environment and which method can lead them to this aim. The traditional "talk and chalk" method, do not provide students with a wide range of learning modalities and students are not able to learn at their own pace. It cannot be compared with the use of computer technology which uses pictures, stored information, simulation and immediate evaluation. Moreover, using computer as an educational tool provides an interactive environment. The use of computers as a teaching method or necessary tool started since 1977 due to the development of the computers and digital multimedia (Vaughan, 2007). Computer provides students with opportunities to educate themselves and assist those who have learning difficulties in attractive ways. Bonk & Graham (2006) defined Blended learning as learning systems that combine face-to-face instruction with computer mediated instruction. Currently, the use of the term blended learning mostly involves combining Internet and digital media with established classroom forms that require the physical co-presence of teacher and students (Friesen, 2012).

Generally, blended learning aims to employ multi-educational methods to achieve the final goal behind education (Tsoi, 2009). The uniqueness of the blended learning is represented by its ability to use the refined techniques from both e-learning and traditional method; thus, the output is a version of the best from each method.

Interest as viewed by Nekang (2004) is an emotionally oriented behaviour trait, which determines students' energy and enthusiasm in tackling educational programmes or other activities. Harbor-Peters (2002) also defined interest as a subjective feeling of intentness or curiosity over something. The interest in a particular thing is a feeling manifested in an activity. Interest is a tendency to become absorbed in an experience and to continue in it. It is the zeal or willingness to participate in an activity from which one derives some pleasure.

Interest is therefore a necessary ingredient before learning can take place; for a child is bound to pay attention as a lesson goes on if such a child is interested in the particular subject. However, studies carried out in Nigeria have revealed high failure rate and relatively small proportion of students' interest in mathematics (Ezugwu & Agwagah 2000; Harbor-Peters 2002). The issue of gender inequality in mathematics has been an ongoing topic of discussion both in industry and academic. It seems ironic that this field, where objectivity is more often sought over subjectivity, apparently suffers from a gender biased culture. Girl-child education is the education geared towards the development of the total personality of the female gender in any society. Such education promotes the development of the whole nature of women physically, intellectually, morally, socially, economically and politically which makes them active participating mem bers of economic development.

Thorough studies such as Else-Quest, Hyde and Linn (2010) and Linderberg, Hyde, Petersen and Linn (2010) reported that gender differences among male and female is closing and both male and female perform similarly. In the study of mathematics, the same situation and result hold in terms of gender achievement and performance. Atebe (2008), Yang and Chen (2010) submitted that male students performed better than their female counterpart by exhibiting better spatial abilities while other studies like Etukudo (2002) and Iji (2014) found no significant difference in the performance of students based on gender.

Statement of the Problem

The lack of interest and poor performance among students in mathematics in secondary schools has continued to persist despite the importance of the subject to nation building and development. Studies such as Iji (2014) and Charles-Ogan (2017) asserted that secondary school students' performance is less than 50 percent in mathematics for the past decades. Also, the Chief Examiners report for WAEC (2009 - 2017) and NECO (2017) expressed worries over the low achievement of

students in mathematics which they attributed to weakness and difficulty in understanding mathematical concepts, lack of confidence, poor teaching methods, poor retention and interest in mathematics. The low performance among students in mathematics was also observed by Kurumeh, Onah and Mohammed (2012) who asserted that it is a function of the instructional method adopted by the teacher. The instructional method employed by the teacher plays an important role in the acquisition of instructional content for meaningful learning and development of necessary skills. Nigerian junior secondary school classrooms are predominantly dominated by the conventional method of instruction, which does not encourage students' interaction. It is teacher-centred instructional methods that make students passive with less interaction. The lack of active participation of students in their learning was also indicted for students' poor performances in mathematics (Gambari & Olumorin, 2013).

Research Questions

 The following research questions were posed to guide the study:

1. What is the extent at which students taught geometry using blended learning strategy in senior secondary differ in performance with those taught with conventional teaching method?

2. What is the difference in the performance of male and female students taught geometry with blended learning strategy?

Hypotheses

The following null hypotheses were tested at 0.05 level of significance.

Ho$_1$: There is no significant difference in the level of performance of students taught geometry with blended learning strategy and those taught with conventional method.

Ho$_2$: There is no significant difference in the performance of male and female students taught geometry using the blended learning strategy.

Literature Review

Kazu and Demirkol (2014) performed a six-week long study with 54 twelfth grade biology students in Turkey using blended learning approach. The students in the blended learning group, which had access to a class blog that allowed them to answer questions, interact, and take notes collaboratively, scored statistically significantly higher on the post-test than students in the control group, which was a traditional, face-to-face classroom. Curious, Kazu and Demirkol looked at whether or not gender played a role in this outcome, but they found that while females did score higher in both groups, there was no significant evidence that one method worked better for one gender over the other.

Turki (2014) investigated the impact of teaching science using blended learning strategy in the development of achievement skills among students in United Arab

Emirate. The results and showed that using blended learning strategy to teach science, has a positive impact in achievement skills and attitudes. The study also showed a high level of performance on achievement test as a whole after applying blended learning strategy. Feras (2015) investigated Blended Learning approach compared to the traditional learning approach on fifth grade students' achievement in language textbook and the development of their verbal creative thinking in Saudi Arabia. The experimental group which was taught using the blended approach of learning outperformed the Control Group in both tests.

Huang and Hong (2016) carried out research on whether or not blended learning increased English reading comprehension and Information and Communication Technology (ICT) skills using Taiwanese tenth grade English students. At the end of the twelve-week experiment, they found that students in the experimental group, who had participated in blended learning, had shown a significantly larger increase in their ICT and English reading comprehension skills than those in the control group.

Gideon (2016) investigated the effects of constructivist instructional methods on learner achievement in biology in secondary schools in Homabay County, Kenya. Findings of the study were as follows: 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 but there was no significant difference in their performance.

Ya-Wen, Chih-Lung and Po-Jui (2016) explored the influences of blended learning pedagogy on high school students' learning achievement and students' attitudes toward physics in Taiwan. 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. Terry (2016) studied the effect of blended learning on mathematics and reading achievement in a charter school context in Lynchburg. The result showed no statistically significant relationship between the mathematics achievement of students taught with traditional and those taught with blended learning approach and there was no significant relationship between traditional and blended learning students on reading scores. Based on this finding it was recommend that blended learning should be used in teaching and reading. Alajana (2016) carried out a study titled blended learning and improved biology teaching in Nigerian secondary schools. Results showed that all students

and teachers can boot, operate and type but specialized skills were found to be very low. The t-test analysis of the posttest revealed that there is a significant difference in the performance of learners. The use of blended learning can make a significant difference in the performance of learners compared to the traditional chalk and talk approach. Omar (2017) conducted research titled 'effect of using the blended learning method on students' academic achievement and satisfaction level in a university course for female student teachers who follow the General Teaching Method Course (304) at the College of Basic Education in Kuwait'. The study found a significant difference in the instructor's support dimension of the satisfaction questionnaire between the first experimental group and the control group, but no significant difference was found between the second experimental group and the control group. There was also no significant difference in the course content dimension of the satisfaction questionnaire between the two experimental groups (each separately) and the control group. Gambari, Shittu and Osunlade (2017) carried out a study on the effectiveness of blended learning and E-learning modes of instruction on the performance of undergraduates in Kwara State, Nigeria. Findings of this study showed that: (i) there was significant difference in the performance of the three groups in favor of Experimental group 1 (Blended learning), (ii) there was no significant difference in the performance of male and female undergraduates taught with blended learning, (iii) similarly, no significant difference was found in the performance of male and female undergraduates exposed to e-learning mode of instruction. Ojalaye and Awofala (2018) examined the effects of blended learning (BL) and problem-based learning (PBL) instructional strategies on senior secondary school students' achievement in algebra. Results showed that there was a statistically significant main effect of treatment on students' achievement in algebra. There was a statistically significant main effect of gender on students' achievement in algebra.

Methodology
The research design Adopted for this study is quasi-experimental non-equivalent control group design, which made use of pre-test and post-test. The reason for the adoption of this design is based on the fact that students in the class were taught with either blended learning approach or conventional teaching method. The population of the study comprised all the 7,319 junior secondary two (JSS 2) students in the 72 junior secondary schools in Yagba-East as at the 2021/2022 Academic session. Purposive sampling technique was used to select two schools that were involved in the study. The sample size for this study consisted of 60 students. This comprised 31 male and 29 female junior secondary two students selected from two schools in Yagba-East. Simple random sampling technique was used to select one intact class from each of the two sampled schools. The instrument used to collect data for this study is the Mathematics Interest Inventory (MII). The

Mathematics Interest Inventory (MII) is a structured inventory made up of two sections viz: Section A which contains bio data of the respondents and section B which comprise structured statements on Interest of students toward mathematics. MII consist of 20-items in which respondents were requested to indicate their interest by ticking (√) the most appropriate response to show the extent to which they agree or disagree with the statement. The 4-point modified Likert rating scale having responses of Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD) was used. These items were scored 4,3,2 and 1 respectively and it was administered before and after the experiment. MII was pilot tested in the same school, the rating score for the MII was used to determine the reliability coefficient of the instrument using Cronbach Alpha (σ) which gave 0.75. This indicated that the items were reliable within the acceptable limits. Descriptive statistics of mean and standard deviations were used to answer all the research questions. Inferential statistics of ANCOVA was used to test all the hypotheses, as the case may be, at significant level of 0.05. For the MII scale built on a four-point likert scale, a grand mean score of 2.50 was termed as having interest while a grand mean score below 2.50 was termed as having no interest.

Research Question One: What is the extent at which students taught geometry using constructivism based blended learning strategy in senior secondary differ in interest level with those taught with conventional teaching method?

Table 1

Descriptive Statistics Showing the Difference in Interest Score of Students who were Taught Geometry using CCBL Strategy and Conventional Method

Method	N	$\bar{X}$ (Pre-test)	S.D (Pre-test)	$\bar{X}$ (Post test)	S.D (Post test)
CBBL	31	1.94	0.68	3.03	0.48
Conventional	29	2.17	0.54	2.27	0.45
Mean Difference			0.23		0.76

Table 1 reveals that at pre-test, the mean interest scores of both experimental (CBBL) and control group were 1.94 and 2.17 while the standard deviations were 0.68 and 0.54 respectively. The mean difference in the interest scores of both groups was 0.23. This means that the students in the experimental and control groups had similar interest (negligible difference) before the commencement of the experiment.

At the post test the mean score of students in experimental group (CBBL) was 3.03 and standard deviation was 0.48 while the control group had a mean score of 2.27 and standard deviation of 0.45 The mean difference was found to be 0.76 in favor of experimental group which is an indication that the students in the experimental group showed more interest than the students in the control group.

Research Question Two: What is the difference in the interest level of male and female students taught geometry with blended learning strategy?
To answer this research question, frequency count (N), means ($\bar{X}$) and standard deviations (S.D) reported in Table 2 were used.

Table 2

Pre-test and Post-test Geometry Interest Inventory (GII) mean Score of Students in CBBL on Gender

Gender	N	$\bar{X}$	Pre-test S.D	$\bar{X}$	Post test S.D
Male	18	1.83	0.71	3.06	0.54
Female	13	2.08	0.64	3.00	0.41
Mean Difference			0.25		0.06

Table 2 shows that the mean interest score of male students taught Mathematics using CCBL method of instruction was 1.83 and 3.06 in the pre and post-test respectively that of female students taught using same method was 2.08 and 3.00 in the pre and post-test respectively. The mean difference between the groups was 0.25 in the pre-test and 0.06 in the post test. This means that the interest score of male and female students taught mathematics using CBBL approach showed much less difference after the experiment. Therefore, there is no meaningful difference in interest between male and female students taught mathematics using CBBL approach.

Ho1: There is no significant difference in the level of interest of students taught geometry with blended learning strategy and those taught with conventional method.

Table 3
Analysis of Covariance (ANCOVA) of students' interest scores in GII

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	8.900[a]	2	4.450	20.401	.000	.417
Intercept	27.723	1	27.723	127.098	.000	.690
PRESCORE	.328	1	.328	1.502	.225	.026
GROUP	8.900	1	8.900	40.802	.000	.417
Error	12.433	57	.218			
Total	448.000	60				
Corrected Total	21.333	59				

a. R Squared = .417 (Adjusted R Squared = .397)

In Table 3, the obtained F-value is significant at p=0.000, so at a higher confidence level (0.05), it is also significant. Thus, the null hypothesis was rejected. This result shows that there is a significant difference in the interest scores of students taught with blended learning approach and those taught with conventional method.

Ho$_2$: There is no significant difference in the level of interest of male and female students taught geometry using the blended learning strategy.

Table 4
Analysis of Covariance (ANCOVA) of male and female Experimental groups' interest scores in MII

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	.373[a]	2	.187	.792	.463	.054
Intercept	23.140	1	23.140	98.248	.000	.778
PRESCORE	.350	1	.350	1.485	.233	.050
GENDER	.066	1	.066	.279	.601	.010
Error	6.595	28	.236			
Total	292.000	31				
Corrected Total	6.968	30				

a. R Squared = .054 (Adjusted R Squared = -.014)

In Table 4, the obtained F value is significant at 0.601, which is greater than the level of significance of 0.05. Thus, the null hypothesis is not rejected. This result shows that there is no significant difference between male and female students' interest in mathematics as a result of blended learning approach. This implies that both male and female students in experimental group indicated a similar level of interest in mathematics after being taught with blended learning approach.

Discussion

The data presented in Table 1 provide answer to research question two; finding revealed that the mean score in MII for experimental group is 3.03 while the control group has a mean score of 2.27. The mean difference is 0.76 in favor of experimental group. This indicates that students in the experimental group had a higher mean score than their counterpart in the control group in mathematics interest inventory. The ANCOVA result as reported in Table 2 showed that there was a statistically significant difference between the mean interests scores of students exposed to blended learning and those exposed to the conventional method. The finding confirms that of Ya-Wen, Chih-Lung and Po-Jui (2016) who saw 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 attitude toward studying mathematics in a blended environment. Students gave positive feedback on the use of the Moodle learning platform for mathematics after experiencing blended learning.

The data presented in Table 3 provide answer to research question two; finding revealed that the mean score of MII for experimental group male students is 3.06 while the female students have the mean score of 3.00. The mean difference is 0.06 in favor of male students. This indicates that male students in the experimental group had a higher mean score than their female counterparts in the mathematics interest inventory. The ANCOVA result as reported in Table 3 showed that there was no statistically significant difference in the mean interests of male and female students exposed to blended learning. This implies that both male and female students in experimental group indicated a similar level of interest in mathematics using blended learning approach. This finding contradicts that of Gideon (2016) that girls have a more positive attitude towards constructivist instruction than boys.

Conclusion

From the findings of the study, the following conclusions could be drawn: Students learn and develop interest in mathematics better when taught with blended learning approach than conventional teaching method. Blended learning approach enhanced students' interest level in mathematics. it was found that blended learning approach is gender-friendly. Also, both male and female students in experimental group indicated a similar level of interest in mathematics using constructivism based blended learning approach.

Recommendations

Based on the results and findings of this study, the following recommendations were made:

1. Mathematics teachers should be encouraged to use blended learning approach to teach mathematics at junior secondary level.
2. Teachers in training should be equipped with knowledge vast enough to implement blended learning approach in teaching mathematics.
3. Seminars, workshops and conferences should be organized to train teachers on the use of the blended learning approach

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