

The Effect of Blended Learning on Senior Secondary School Students' Achievement in Mathematics in Private Secondary Schools in Nsukka Local Government Area

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ABSTRACT

The study was carried out to determine the effect of blended learning on Mathematics achievement of Senior Secondary School Students in Private Schools in Nsukka Local Government Area of Enugu State. The influence of gender on Mathematics achievement of students when exposed to blended learning was explored. Moreover, the interaction effect of blended learning and gender on Mathematics achievement of students was also examined. Three research questions were generated and three null hypotheses were formulated to guide the study. The study was a non-equivalent control group quasi-experimental design involving one treatment and one control group. A total of 142 Senior Secondary Class two students from two co-educational Private Senior Secondary Schools in Nsukka L.G.A made up the sample for the study. In each school, one intact class was randomly selected and assigned to experimental and control groups. An instrument named Mathematics Achievement Test was used for data collection. The experimental group was exposed to blended learning while the control group was taught using the conventional lecture method. The internal consistency reliability of the MAT was calculated using Cronbach Alpha and a reliability estimate of 0.78 was obtained. The data obtained were analyzed mean scores, standard deviation and a 2x2 Analysis of Covariance (ANCOVA). The major findings of the study were that teaching using blended learning strategy significantly improved the mathematics achievement of Senior Secondary School Students in Private Schools, gender had no significant influence on the Mathematics achievement of Students in Private Schools was not significant. It was this recommended that emphasis should be given to equipping students with the relevant skills in using blended learning strategy and that teacher education institutions should incorporated blended learning strategy in the relevant areas of the curriculum units and expose both the pre-service and in-service teachers tot this strategy of learning.

Keywords: Blended Learning, Strategy, Mathematics Achievement.

INTRODUCTION

Mathematics is this science of numbers and their properties; operations and relations with shapes in space and their structure; and measurement. It is one subject that cuts across all the sciences and pervades literally every field of human endeavour, and plays a fundamental role in the economic development of a country [1, 2, 3, 4, 5]. According to [6, 7] mathematics is a bed rock

and indisputable tool for scientific, technological and economic development of any nation. [8, 9] stated that the line of demarcation between developed and under developed nations is based on the level of mathematical attainment and ingenuity. They maintained that mathematics is an indisputable agent of national development and wealth creation [10].

[11] see mathematics as an important subject that not only give academic qualification but also prepares students for the future; irrespective of which ever career they choose to be part of, as mathematics permeates every aspect of human endeavours such as politics, economy, science and technology. [12], confirms it all by saying that mathematics permeates into everything in life from smallest to the largest.

In spite of the relative importance of mathematics in the overall economic development of a country, students' achievements in mathematics have been poor. The trend of poor achievements in Mathematics has been confirmed by the recent West African Examination Councils' (WAEC) results for the years 2014 to 2017. For instance, the WAEC result analysis revealed that only 57.2%, 47.64%, 51.50% and 58.99% of the candidates obtained credit pass and above in the years 2014, 2015, 2016 and 2017 respectively. These uninspiring achievements in Senior Secondary Certificate Examinations (SSCE) are causes for concern. A number of programmes, conferences and workshops have been organized with a view to addressing the problems of poor achievements in mathematics [13]. As a result, a number of strategies have been recommended for teaching so that students can develop interest and achieve better in mathematics. These include: establishment of the National Mathematics Centre (NMC) in Abuja in the year 1989 and the Mathematics Improvement Project in Akare in 2007 to deploy appropriate initiatives and resources of international standing to rekindle and sustain interest in the study of mathematics and mathematical sciences at all levels. Other corporate organizations such as Promasidors Nigeria Limited (Makers of Cowbell Milks) and Macmillan publishers have programmes for secondary school students' aimed at

reawakening secondary school students' interest in mathematics. Examples of such programmes include the 2008 and 2009 Cowbell National Secondary School Mathematics Competition and the 2008 Macmillan workshop on effective teaching of mathematics. Despite these efforts, mathematics achievement at all levels of education in Nigeria has not improved to a satisfactory level. Evidence emanating from Western Europe tends to suggest that blended learning strategy has the potential of helping students to improve their mathematics achievement. Blended learning is a formal education programme in which a student learns at least in part through delivery of content and instrument via digital and online media with some element of student control over time, place, path or place, while still attending a "brick-and-mortar" school structure, face-face classroom method are combined with computer mediated activities [14]. Blended learning strategy involves leveraging the internet to afford each student a more personalized learning experience with increased student control over time, place, path and/or place of his/her learning. The definition of Blended Learning was given by Coach (2012) as a formal education programme in which a student's learns: at least in a path through online learning, with some element of student control over time, place, path and/or place; at least in a path in a supervised brick-and- mortar location away from home; and the modalities along each student's learning path within a course or subjects are connected to provide an integrated learning experience. Blended Learning, online learning and e-learning are all terms which have been used to describe the use of synchronous and asynchronous method of supporting learning through technological means [15]. Blended Learning can also be seen as a form of Technology Enhanced

Learning which for the past decade acknowledges the historical need to blend an academic environment to face-face delivery of materials and which may access both new digital technology and no ICT with a revision of existing and possible new Pedagogies. The phrase "Blended Learning" has been debated extensively by its many adherent [16, 17, 18] and its occasional detractors [19] but has now settled into the e-learning language for two specific contexts. These are firstly, for commercial organisational learning programmes which provide a context for Blended Learning [20] and secondly, the area that is the focus of this study the blended learning, which includes a blending of face-to-face teaching with additional availability of materials online in a digital formation. Blended Learning is consistent with values of traditional higher education institutions and has the proven potential to enhance both the effectiveness and efficiency of meaningful learning experiences [21]. Proponents of blended learning cite the opportunity for data collection and customization of instruction and assessment as two major benefits of this approach. Blended learning was generally classified by [22] into six models which include face to face driver, where the teacher drives the instruction and augments with digital tools; Rotation, where students cycle through a schedule of independent online study and face-to-face classroom time; Flex, where most of the curriculum is delivered via a digital platform and teachers are available for

face-to-face consultation and support; Labs, in which all of the curriculum is delivered via a digital platform but in a consistent physical location. Students usually take traditional classes in this model as well' Self-Blend, which involves students choosing to augment the traditional learning with online course work; and Online Driver, where all curriculum and teaching is delivered via a digital platform and face-to-face meetings are scheduled or made available if necessary. [23] argued that majority of blended learning programmes resemble one of four models such as Rotation Model, Flex model, A La Carte model and Enriched Virtual model. Though blended learning has some research evidence in support of its potential effectiveness in some western countries [24, 25, 26], little studies seem to be available here in Nigeria. Therefore, it is important that this strategy be tried out in Enugu State Nigeria to determine the extent of its effectiveness in improving the mathematics achievements of Secondary School Students. In adopting blended learning as an instructional strategy, an observed factor that can influence the students' participation in the learning procedure such as gender needs to be addressed. While some research studies showed evidence of girls' superiority over boys in academic achievement [20, 21, 22, 23, 24], some studies reported that boys achieved better [25, 26, 27]. Following it affects Mathematics achievement. The finding of the study may reveal which gender achieves better.

Statement of the Problem

Mathematics is one subject that cuts across all the sciences and pervades literally every field of human endeavour, and plays a fundamental role in the economic development off a country. The state of science and technology is a function of the development and application of

mathematics. In spite of the relative important of mathematics in the overall economic development of a country, students' achievements in it have been poor. Teachers, parents, curriculum experts and evaluators are worried, especially when the poor achievement

has been blamed on inadequate teaching strategy. It is believed that if the mathematics achievement of students in the SSCE remains like this, it will affect both the economic and technological growth of Nigeria. Evidence emanating from Western Countries tends to suggest that blended learning has the potential for improving their mathematics achievement.

How blended learning would affect the mathematics achievement of Nigerian Students who operate in a different socio-cultural environment is yet to be determined. Therefore, the problem of this study put in a question form is: how would blended learning affect the mathematics achievement of Senior Secondary School class II students?

Purpose of the Study

This study was concerned with determining the Effect of Blended Learning on the Mathematics

achievement of Senior Secondary School (SSSII) Students in Nsukka L.G.A. of Enugu State.

Research Questions

The study sought answers to the following questions:

- 1 To what extent do the mean mathematics achievement scores of the students depend on exposure to blended learning strategy and conventional teaching method?

- 2 What is the influence of gender on the mean mathematics achievement scores of the students based on blended learning strategy?
- 3 What is the interaction effect of blended learning strategy and gender on the mean mathematics achievement scores of the students?

Hypotheses

The following hypotheses were formulated to guide the study and were tested at 0.05 levels of significance:

the students as measured by their mean scores in the Mathematics Achievement Test.

- 1 There is no significant difference in the mean mathematics achievement scores of the student who were exposed to blended learning and those taught using conventional teaching method.
- 2 Gender has no significant influence on the mathematics achievement of

- 3 There is no significant interaction effect of blended learning strategy and gender on the mean mathematics achievement of the students as measured by their scores in the Mathematics Achievement Test

Methodology

The study was a non-equivalent control group quasi-experimental design, involving one treatment and one control group. A total of 142 Senior Secondary Class two students from two co-educational Senior Secondary Schools in Enugu State Nigeria made up the sample for the study. In each school, one intact class was randomly selected and the intact classes were

also randomly assigned to experimental and control conditions. An instrument named Mathematics Achievement Test was developed by the researcher and used for data collection. The internal consistency reliability of the MAT was calculated using Cronbach Alpha Procedure and a reliability estimate of .79 was obtained. The blended learning strategy lesson plan was

used for the experimental group while the control group received training using the conventional teaching method. The data

obtained were analyzed using mean score, standard deviation and 2x2 analysis of covariance (ANCOVA)

Results

The results of the study are presented below

Research Question One

To what extent do the mean mathematics achievement scores of the students depend on

exposure to blended strategy and conventional teaching method?

Table 1: Pre-test-Pro-test Mean Mathematics Achievement Scores and Standard Deviation of Students based on exposure to Blended Learning Strategy.

		Pre-Test	Pro-Test	Mean gain
Experiment Group (Blended Learning)	Mean	40.10	64.23	24.13
	N	72	72	
	Std. Deviation	14.60	3.04	
Conventional Method (Control Group)	Mean	41.17	42.44	1.27
	N	70	70	
	Std. Deviation	15.75	16.31	

Data presented in Table 1 indicates the pre-test and pro-test mean scores in mathematics achievement of students in the treatment and control groups. The students exposed to training in blended learning strategy had a mean pre-test achievement score of 40.10 and a standard deviation of 14.60. the mean post-test achievement was 64.23, giving a mean pre-test /post-test gain score of 24.13. For the students in the control group, their mean pre-test achievement score was 41.17 and a standard deviation of 15.75 and a mean post-test achievement score of 42.44 and a standard deviation of 16.31. the mean pre-test/post-test achievement gain score was 1.27. The data

indicate that the students in the treatment group had higher mean scores in achievement than those in the control group. This implies that the students in the treatment group, who were exposed to training in blended learning strategy achieved better than those in the control group, who were exposed to instruction using the conventional teaching strategy.

A corresponding hypotheses formulated to further address the research question is:-

Ho₁: There are no significant differences in the mean mathematics achievement scores of the students who were exposed to blended learning and those taught using conventional teaching method.

Table 2: 2-Way Analysis of Covariance on Student's Post Treatment Achievement Scores on Mathematics Achievement Test.

Source	Sum of Squares	df	Mean Square	F	Sig.	Eta squared	Partial
Corrected model	51367.136a	9	5707.460	52.233	.000	.741	
Intercept	7008.632	1	7008.632	64.141	.000	.281	
Pre-achievement	23586.195	1	23586.195	215.855	.000	.561	
Experimental	18595.849	1	8595.849	170.184	.000	.509	
Gender	94.136	1	94.136	.862	.355	.005	
Experimental *Gender	45.947	1	45.947	.420	.518	.003	
Error	17920.083	164	109.269				
Total	566570.000	174					
Corrected Total	69287.218	173					

A R squared = .741 (Adjusted R squared = .727)

The results presented in Table 2 indicated that blended learning as a factor in the study had a significant effect on the mathematics achievement of students. This is because the calculated f-value of 170.18 in respect of treatment as main effect has a probability valued of .000 and therefore significant at .05

levels of significance this suggests that exposing students to blended learning strategy significantly improved their mathematics achievement. This also means that the null hypothesis of no significant difference in the mean achievement scores of the treatment and control groups is rejected.

Research Question Two

What is the influence of gender on the mean-mathematics achievement scores of

the students based on blended learning strategy?

Table 3: Pre-test/Post Test Mean Scores and Standard Deviation of the Students in Mathematics Achievement based on gender

Gender of subjects		Pre-test	Post test	Mean gain score
Males	Mean	39.35	55.36	16.01
	N	70	70	
	SD	15.50	20.82	
Females	Mean	41.72	51.84	10.12
	N	72	72	
	SD	14.83	19.26	

Data in Table 3 show the pre-test and post-test mean mathematics achievement scores and standard deviation of males and females used in the study. The males had a pre-test mean mathematics achievement score of 39.35 and a standard deviation of 15.5 with post-test mean achievement score of 55.36 and a standard

deviation of 20.82. The mean pre-test/post-test achievement gain score was 16.01. The females had a pre-test mean mathematics achievement score of 41.72 and a standard deviation of 14.83 with a post-test mean achievement score of 51.84 and a standard deviation of 19.26, resulting to a mean pre-test/post-test

mathematics achievement gain score of 10.12. These results seem to imply that the mean differ in their achievement gains from the females. Their higher mean point gains in achievement scores show that they seem to have benefited more from the treatment than the females.

A corresponding hypothesis formulated to further address the research question is:

HO₂: Gender has no significant influence on the mathematics achievement of the students as measured by their mean scores in the Mathematics Achievement Test.

Results presented in Table 2 do not show a significant difference in the mean post-test

mathematics achievement scores of male and female students exposed to training in blended learning strategy. This is indicated by the calculated f-value of .862, which has a probability value of .355 and therefore not significant at .05 levels. The null hypothesis of no significant difference in the mathematics achievement of students as measured by their scores in the mathematics achievement test is upheld. The implication is that gender had no significant influence on the mathematics achievement of student exposed to training in blended learning strategy.

Research Question Three

What is the interaction effect of blended learning strategy and gender on the mean

mathematics achievement scores of the student

Table 4: Interaction Effect of Blended Learning and Gender on Students' Mathematics Achievement

Treatment Groups	Gender Subjects	of N	Mean	Standard Deviation
Experimental Group	Males	34	71.70	12.37
	Females	38	64.92	19.40
	Total	72	64.23	17.30
Control Group	Males	36	46.13	16.38
	Females	34	38.79	13.38
	Total	70	42.44	16.31
Difference in Treatment and Control Group by Gender	Males	70	25.57	
	Females	72	26.13	

Data presented in Table 4 appear to indicate the effect of interaction between blended learning and gender on mathematics achievement scores of students exposed to blended learning strategy. The mean mathematics achievement scores across the two gender groups for the treatment and control group differ. This difference for the Males is 25.57. In this group, the males in the treatment group had a higher mean achievement score of 71.70 as against the 46.13 for the males in the control group. On the

other hand, the difference between the mean achievements scores for the treatment and control groups among the female students is 26.13. Females in the treatment group had higher mean mathematics achievement score of 64.92 as against 38.79 for those in the control group. Data in Table 2 indicate that the interaction effect of blended learning and gender on the mean mathematics achievement scores of students as measured by their scores in the mathematics achievement test was not

significant. This is shown by the calculated f-value of .420, which has a probability value of .518 and therefore not significant at .05 levels. Thus, the null hypothesis of no significant interaction effect of treatment and gender on

achievement is upheld, since there was no significant interaction effect of treatment, using blended learning strategy and gender on the mathematics achievement scores of the student on the mathematics achievement test.

Summary of Findings

The major findings of the study were that:

- 1 Teaching using blended learning strategy significantly improved the mathematics achievement of Senior Secondary School Students in Private Schools.
- 2 Gender had no significant influence on the mathematics achievement of

students based on the blended learning strategy;

- 3 The interaction effect of blended learning strategy and gender on mathematics achievement of student was not significant.

Discussion of the Results

The result of this study revealed that training in the use of blended learning strategy significantly improved the mathematics achievement of Senior Secondary School Students. The treatment group that was exposed to blended learning strategy had a significantly higher mean score in the Mathematics Achievement Test than those in the control group, who were taught using the conventional teaching method. This result is in line with the findings of some earlier research in other cultures on the effectiveness of blended learning strategy on students' learning. For instance, [13, 16, 18, 20] found significant improvement in the achievement of students after being exposed to blended learning strategy. Furthermore, [16] observed significant improvement in academic and peer interactions of students with emotional behaviour disorders. Blended learning strategy is a highly learner centred approach to problem solving, and places the responsibility of learning directly on the students. This situation therefore, enhances the students' achievement in mathematics, as the strategy is very relevant in tackling most of the learning problems they encounter in school. A situation that permitted the active involvement of

students in the process of learning as the blended learning strategy did is a possible explanation for the superior achievement recorded by the treatment group in the study.

The result of this study revealed that gender had no significant influence on the mathematics achievement of student as measured by their mean scored in the Mathematics Achievement Test. The treatment group that was exposed to blended learning strategy did not have a significantly different gender mean score in the Mathematics Achievement Test.

This result does not agree with the findings of the studies by [15, 17, 19]. These studies showed evidence of girls' superiority over boys in academic achievement. It also differs from studies conducted by, [11, 15, 17] which reported that boys achieved better than girls. The result is however, in line with a study conducted by Lietz as reported by [19], which showed that gender had no direct effect on reading achievement. The result of this study therefore, indicates that male and female students benefited equally from the treatment. He fact that the interaction effect between the treatment and gender was not significant neither

did it show that gender was not a factor in the mathematics achievement of students exposed to blended learning strategy. The inconsistencies in the findings of studies reviewed and the present study is an indication that gender factors in achievement remains an issue requiring diversified attention. Males and

females are naturally equal in achievement. Females are not dependent on males for taking initiatives and for taking initiative and for leadership if given equal opportunities with males. Therefore, the socio-cultural practices that discriminate against females need to be abolished.

Conclusion

The results of this study have obvious educational implications. The finding suggest the need for students to be equipped with relevant skills in the use of blended learning strategy in order to facilitate their leaning in content areas like humanities, social science, sciences and other related subjects. This demands that the teacher in preparing to teach does not only bother about how best to teach the content of instruction, but also about the strategy the learner can personally manipulate to

learn the content. The fact that training in blended learning strategy facilitates better mathematics achievement suggests that teachers would achieve better results if trained don low to teach using blended learning strategy. Experienced has shown that teachers during their preparatory stage are never exposed to skills required in using blended learning strategy and how best to plan blended learning strategy instruction.

Recommendation

The findings of this study imply that teachers should be taught how to help students acquire skills required in the use of blended learning strategy. As such, teacher preparation institutions should not only emphasize methods of teaching in their methodology course, but also the teaching of learning strategies. If the teachers become aware of the importance of blended leaning strategy in enhancing learning, the problem of poor mathematics achievement currently experienced in our schools may be reduced. The findings of this study also have implication for curriculum planners. The curriculum should not only specify appropriate teaching methods for a unit of study, there is also the need to specify appropriate learning

strategies that students can utilize to achieve the objectives of the unit. The results of this study indicate that training in blended learning strategy uniformly improved significantly the mathematics achievement of both males and female students. The non-significant interaction effect between the treatment and gender provide additional evidence that the enhanced mathematics achievement was as a result of training in blended learning strategy. This implies that males and females could be exposed to the skills in using blended learning without discrimination as the two levels of gender benefit equally and significantly from such strategy of instruction.

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