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Impact of Blended Learning Method on Secondary School Physics Students' Achievement and Retention in Lokoja, Nigeria

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ABSTRACTS

This study determined the Impact of Blended Learning on Secondary School Physics Students' Achievement and Retention in Lokoja, Kogi State, Nigeria. Four objectives, four research questions were raised and four null hypotheses were formulated and tested at a 0.05 level of significance. A quasi-experimental design was adopted for the study using a pretest-posttest, non-randomized, non-equivalent control group. The sample size for the study comprised 100 Physics Students. The topics were taught based on the blended learning model via the website. The data were collected using Physics Achievement Test. The Kuder Richard-son 21 formula was used to determine the reliability coefficient and it was found to be 0.86. Mean scores and Analysis of Covariance (ANCOVA) were used for data analysis. The finding of the study indicates that the experimental group performs better than the control group. Gender did not affect Physics students' academic achievement when taught Physics using the blended learning method. It was recommended that; the blended learning method should be introduced into secondary schools in Lokoja to promote and encourage a student-centered approach to instruction for the enhancement of student's academic achievement and retention.

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1. INTRODUCTION

Physics is an important element in the education of scientists, engineers, chemists, medical practitioners, and other biometrical and physical scientists. To build a strong technology foundation, Physics Education needs to be given more priority in the Nigerian education system due to its significance in all fields of science and technology development. Retention, as defined by Hornby, is the ability to remember experiences and things learned. In addition, retention can also be described as the ability to reproduce the concept learned when the need arises while academic achievement is an element that shows the level of retention of the students. Therefore, the teachers must use an effective instructional technique for the learners to make knowledge to be retained for a long time by the learners.

The teachers' teaching method was consistently identified as one of the major factors responsible for the massive failure of students in science (Makinde & Yusuf, 2017; Soetan *et al.,* 2017; Kasmana *et al.,* 2021; Yapici & Akbayin, 2012). Blended learning is a teaching method that involves instructional delivery through online (Internet) and face-to-face interaction. The learning involves a combination of distance (distributed) learning technologies and face-to-face (FTF) instruction. For example, the creation of the printing press in the 15th century enabled teachers to blend FTF instruction with reading homework. Likewise, online text-based databases, audio recordings, television transmissions, and discussion boards, just to mention a few, were developed in the 20th century, and teachers use them for pedagogical purposes; such development enhances the teaching and learning strategy (Ekamilasari & Pursitasari, 2021).

The blended learning method of instruction can combine both conventional methods and modern technology for more effective dissemination of concrete information and critical evaluation of learners to enhance good achievement and retention (Abdulwaheed *et al.,* 2017). This is one of the features that Blended Learning has and thus makes it distinct from other methods of teaching such as video conferencing, computer-based teaching (CBT), and mobile learning to mention but a few, which do not require a direct class interactive session. For example, the recorded videos on subjects/topics for primary/secondary school students on Compact Disc/Digital Videos Disc (CD/DVD) that are sold all over the place in Nigeria are only going to assist a few good students. This is because these videos give no feedback, and nobody is available to assess students' understanding and explain the difficult concepts of the topics/lessons recorded. Unlike in blended learning, students are not opportune to have one-on-one interaction with the teachers.

The analysis of the achievement of Physics students in the West Africa Examination Council (WAEC) from 2015 to 2021 revealed that the percentage of Physics students that passed Physics at credit level and above (A1 – C6) was consistently less than average percent (50%), this low achievement of Physics students has some serious implications on the admission of students into Nigeria higher institutions particularly in courses like Engineering, Medicine, Pharmacy, Chemist and applied sciences to mention but a few. Consequently, secondary schools may produce an inadequate number of qualified candidates for science-based courses for university admission.

This may be a result of the only conventional method of teaching employed by most teachers in secondary schools has not been very successful in effective learning to take place. This problem has become worrisome to the government, educational policymakers, school administrators, and parents (Abdulwaheed *et al.,* 2017). Consequently, this prompted many researchers to work on different instructional strategies that would enhance effective teaching and learning to improve students' achievement more than the use of conventional

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methods only. Therefore, this call for more research that will explore more suitable teaching methods and instructional strategies that will improve students' achievement in Physics. The strategy considered by the researchers which may salvage this problem is the blended learning method/strategy.

The quality of online education depends on the proper use of digital technologies following modern educational theories which are behaviorism, cognitivism, and social constructivism. Behaviorism examines how students behave while learning (Abdulwaheed *et al.,* 2017). It focuses on how learners respond to certain stimuli. When the teacher repeats the stimuli, they can observe, control, and modify the learner's behavior. Learners do what they are instructed to do and are only prepared to reproduce basic facts and automatically perform tasks. Behaviorism does not examine the mind or cognitive processes. In blended learning, behaviorism can be applied through step-by-step video tutorials, game-based activities, regular and constructive feedback, quizzes, gamification, etc. Cognitivism focuses on the role of the mind and cognitive processes in learning (Nasution & Nandiyanto, 2021). It explains how the brain is functioning and the levels of cognitive development that form the foundation of learning. Studies of cognitivism help educators understand how people learn and how to teach more effectively. In blended learning, cognitivism can be applied through customizable learning environments, adaptive and personalized learning applications, etc. Social constructivism finds perfect application in group discussions, brainstorming, problem-based learning, and small group activities. A great environment for these types of activities is the blended learning classroom for live online teaching with interactive tools like collaborative web-conferencing, an online whiteboard, breakout rooms, screen sharing, etc.

The main objective of this study is to determine the impact of blended learning on secondary school Physics students' achievement and retention in Lokoja, Specifically, the study seeks to determine the following objective.

(i) The impact of the blended learning method and conventional method on Physics students' achievement in secondary schools.
(ii) The impact of the blended learning method and conventional method on Physics students' retention in secondary schools.
(iii) The impact of blended learning method on Physics students' achievement in secondary schools based on gender.
(iv) The impact of blended learning method on Physics students' retention in secondary schools based on gender.

Four research questions were raised to guide the study,

(i) what is the impact of the blended learning method and conventional method on Physics students' achievement in secondary schools?
(ii) what is the impact of the blended learning method and conventional method on Physics students' retention in secondary schools?
(iii) what is the impact of the blended learning method on Physics students' achievement in secondary schools based on gender?
(iv) what is the impact of the blended learning method on Physics students' retention in secondary schools based on gender?

Based on research questions, four null hypotheses were formulated and tested at a 0.05 level of significance.

(i) HO1: There is no significant difference in the mean achievement scores of secondary school students taught Physics using the blended learning method and those taught using the conventional method.

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(ii) HO2: There is no significant difference in the mean retention scores of secondary school students taught Physics using the blended learning method and those taught using the conventional method.
(iii) HO3: There is no significant difference in the mean achievement scores of male and female secondary school students taught Physics using the blended learning method.
(iv) HO4: There is no significant difference in the mean retention scores of male and female secondary school students taught Physics using the blended learning method.

2. METHODS

The research design adopted for this study was quasi-experimental. A non-equivalent pretest-posttest and control group design was used. This design was adopted because it was not possible to randomize the subject of the study without disrupting the academic programs of the schools. The population of the study comprised all secondary school Physics students in Kogi State. The targeted population for the study was secondary school II Physics Students in Kogi State. Multi-stage sampling technique was used for the study. Firstly, the purposive sampling technique was used to select one senatorial zone (Kogi Central) out of three senatorial zones in Kogi State and the purposive sampling technique was also used to select one Local Government Area (LOKOJA) out of five Local Government Area in Kogi Central based on easily assessable internet connectivity. Secondly, a purposive sampling technique was also used to select four secondary schools from the Local Government Area based on gender composition (co-educational schools) and having a functioning Computer laboratory. Thirdly, a random sampling technique was used to assign two schools to the Experimental Group and the two schools to the Control Group (conventional method). To avoid the interruption of the school program the intact class was used but the sample size was determined using the table of sample size by Krejcie and Morgan (1970). Fifty (50) multiple choice objective items with five options per item were developed on the mechanics' aspect of Physics topics selected from SSS II unified schemes of work in Kogi State, extracted from the National Curriculum for Secondary Schools. After four weeks retention test was administered. Each question carried two marks.

Face and content validity were conducted on Physics Achievement Test. The instrument and the table of the specification were given to two Physics Education experts, two Physics teachers from secondary schools, and two Measurement and Evaluation experts from WAEC. The validators were requested to carefully examine all the items in the instrument concerning the content of the items, appropriateness of the contents, and the extent to which the contents cover the selected topics. More so, they were asked to carefully examine the content of the items concerning the clarity of terms and language used, grammar ambiguity, and spelling errors among others for face validity. The feedback obtained from the experts was used to make necessary amendments to the final draft of the instrument.

To ascertain the reliability of the instruments, Physics Achievement Test was administered to two Secondary schools in Lokoja, Kogi State, within the targeted population but outside the sampled population. The test was administered in two weeks (using the test-retest method) to obtain two sets of scores used for calculating the reliability coefficient of the test items. The Kuder Richard son 21 formula was used to analyze the scores and the reliability coefficient score of 0.86 at 0.05 level of significance was obtained. The research questions raised were answered using mean and standard deviation. The null hypotheses formulated in the study were tested using Analysis of Covariance (ANCOVA) at a 0.05 level of significance.

The Blended Learning Package (BLP) was developed with the help of a Computer Programmer for use as an intervention for the experimental groups. The package was on a

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platform termed blended learning classroom and was in three sections. These sections are (i) textual, (ii) podcast (audio), and (iii) vodcast (video). BLP is an instructional package that was designed and validated, covering five broad topics in Physics. It was a stimulus instrument that was used for the experimental groups. For the Blended Learning Method, students were given access to the Blended Learning Package online via the hosted platform created and designed using "www.oabdulwaheedblp.sch.ng". Individual students were having access to this platform with the student username and password. To complete the given task at a specified time, students were given a text to read, audio to listen to, videos to watch, and quizzes through the hosted platform, called Blended Learning Classroom. The students watched the videos, solve problems, and take quizzes, and the teacher had access to the solutions to the quizzes and gave corrections where necessary. The students arrived at class with questions from the lesson for the teacher to assist in solving them during the face-to-face interactive section in the class. These students were those who know computers and the internet and had access to these facilities at home and school, and they were called the Experimental Group.

3. RESULTS AND DISCUSSION

3.1. Research question one: what is the impact of the blended learning method and conventional method on physics students' achievement in secondary schools?

Table 1 revealed that the two groups comprised a total of 100 Physics Students, 48 students were exposed to online blended learning (Experimental Group) while 52 students were used for the control group. Similarly, the mean of the pretest and posttest scores of the blended learning group was 37.34 for the pretest and 76.88 for the posttest respectively. This gives a pretest; the posttest means a gain of 40.54 for the blended learning group. The mean of the pretest and posttest scores of the conventional group was 37.24 for the pretest and 58.97 for the posttest; this result gives a pretest, and the posttest means a gain of 21.73 respectively. This implies that blended learning methods may have a more positive impact on students' achievement than conventional methods.

Table 1. Pretest and Posttest Mean Achievement Scores and Standard Deviation of the Experimental and Control Groups.

Group	N	Pretest		Posttest		Mean Gain
		Mean	SD	Mean	SD	
Blended learning	48	37.34	3.53	77.88	7.48	40.54
Conventional method	52	37.24	3.22	58.97	3.73	21.73

3.2. Research Question Two: What is the impact of the blended learning method and conventional method on Physics students' retention in secondary schools?

Table 2 shows the mean of the post-test and retention-test scores of the blended learning group was 76.88 for the post-test and 70.37 for the retention test respectively; this result gives a post-test, retention test mean difference of 6.51 for the blended learning. While the mean of the post-test and retention-test scores of the conventional group was 58.97 for the post-test and 50.49 for the retention test respectively, this gives a post-test, retention test mean difference of 8.48. From this result, it can be seen that blended learning groups have the lowest mean difference in the conventional method.

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Table 2. Posttest and retention-test mean scores and standard deviation of experimental and control groups.

Group	N	Posttest		Retention test		Mean diff.
		Mean	SD	Mean	SD	
Online blended learning	48	76.88	7.48	70.37	7.06	6.51
Conventional method	52	58.97	3.68	50.49	3.46	8.48

3.3. Research question one: what is the impact of the blended learning method and conventional method on physics students' achievement in secondary schools?

Table 3 shows the mean of the male and females Physics Students for the pretest and posttest scores of the experimental groups were 34.12 and 34.42 for the pretest and 76.14 and 77.62 for the posttest; this gives a pretest; posttest means a gain of 42.02 and 43.20 for males and females in the blended learning group respectively. This implies that blended learning methods have a closely positive impact on students' achievement irrespective of gender.

Table 3. Mean and standard deviation of achievement scores of male and female physics students in experimental groups.

Group	Gender	N	Pretest		Posttest		Mean gain
			Mean	SD	Mean	SD	
Online blended learning	Male	22	34.12	3.24	76.14	6.49	42.02
	Female	26	34.42	3.32	77.62	6.16	43.20

3.4. Research question four: what is the impact of blended learning on physics students' retention in secondary schools based on gender?

Table 4 reveals that the mean of the male and female Physics Students' test scores in the BL group was 76.84 and 70.41 for the post-test and 76.76 and 70.34 for the retention test; this result gives a post-test, retention test mean difference of 6.43, and 6.42 for males and females in the blended learning group respectively. From this result, blended learning groups have close mean scores for retention tests. This implies that blended learning methods have a closely positive impact on students' retention irrespective of gender.

Table 4. Mean and standard deviation of retention scores of male and female physics students in experimental groups.

Group	Gender	N	Posttest		Retention test		Mean diff.
			Mean	SD	Mean	SD	
Blended Learning	Male	22	76.84	6.49	70.41	6.16	6.43
	Female	26	76.76	6.36	70.34	6.17	6.42

3.5. HO1: There is no significant difference in the mean achievement scores of secondary school students taught Physics using the blended learning method and those taught using the conventional method.

Table 5 reveals an F-value = 21.347 with p = 0.00. Hypothesis one (HO1) was not accepted, because the p-value is less than 0.05. This implies that there was a significant difference between the mean achievement scores of secondary school students taught Physics using flipped classrooms and those taught using the conventional method.

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Table 5. ANCOVA on achievement scores of the experimental and control group.

Source	Type III Sum of Squares	Df	Mean Square	F-Cal.	Sig	Decision
Correctional Model	1057.637	4	164.409	19.246	0.000	
Intercept	908.345	1	908.345	91.548	0.000	
Pretest	465.345	1	465.345	52.533	0.000	
Group	162.665	1	162.665	21.347	0.000	S
Gender	0.616	1	0.616	0.068	0.795	
Group	243.413	1	1143.13	21.877	0.000	S
Error	939.688	95	9.041			
Total	35903.000	100				
Corrected Total	1897.325	99				

*: Significant at p <0.05 level

3.6. HO2: There is no significant difference in the mean retention scores of secondary school students taught Physics using the blended learning method and those taught using the conventional method.

From **Table 5** above, the analysis revealed F (1, 100) = 21.877 with p = 0.000. Hypothesis two (HO2) was not accepted, because the p-value is less than 0.05. This implied that there was a significant difference between the mean retention scores of secondary school students taught Physics using the blended learning method and those taught using the conventional method.

3.7. HO3: There is no significant difference in the mean achievement scores of male and female secondary school students taught Physics using the blended learning method.

In **Table 6**, the calculated F- value for gender was 0.911 with p = 0.063. Hypothesis two was accepted because p- the value is greater than 0.05. this implies that There was no significant difference in the mean achievement scores of male and female secondary school students taught Physics using the blended learning method.

3.8. HO4: There is no significant difference in the mean achievement scores of male and female secondary school students taught Physics using the blended learning method

Table 6 indicates that F (1, 48) = 0.914 with p = 0.06. Hypothesis two (HO_4) was accepted because the p-value is greater than 0.05. This implied that there was no significant difference between the mean achievement scores of male and female secondary school students taught Physics using the blended learning method.

Table 6. ANCOVA on achievement scores of males and females in the Experimental Group.

Source	Type III Sum of Squares	Df	Mean Square	F-Cal.	Sig	Decision
Correctional Model	5057.637	4	64.409	10.246	0.000	
Intercept	508.182	1	508.182	51.548	0.000	
Pretest	245,145	1	245.145	22.533	0.000	
Group	74.309	1	74.309	0.911	0.063	NS
Gender	0.616	1	0.616	0.068	0.795	
Group	74.309	1	74.309	0.914	0.006	NS
Error	939.688	43	9.041			
Total	35903.000	48				
Corrected Total	1897.325	47				

*: Significant at p <0.05 level

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The outcome of testing the corresponding hypothesis one using Analysis of covariance on the achievement of students who received instruction using blended learning methods further revealed that there is a significant difference in the achievement scores of secondary school students taught Physics using blended learning method and those taught using conventional teaching method. Hence, Hypotheses one and two were not accepted as manifested in **Table 5.**

This finding collaborates with that of Yapici and Akbayin (2012) who researched the effect of the blended learning model on high school students' Biology achievement and their attitudes towards the Internet. The result revealed that the blended learning model contributed more to the students' Biology achievement than the traditional teaching method. Similarly, Makinde and Yusuf (2017) observed that there was a significant difference in the performance of students taught Mathematics in flipped classrooms and those taught with lesson notes.

The outcome of testing the corresponding hypothesis three and four using Analysis of covariance on the achievement of male and female secondary school Physics students who received instruction blended learning methods further revealed that there was no significant difference in the achievement scores of male and female secondary school students taught Physics using the blended learning method. Hence, Hypothesis two was accepted. This finding corroborates that of Mabawonku who determined the effects of multimedia-assisted instruction on academic achievement and retention of senior secondary school Biology students. The result revealed that there was no significant difference in the achievement scores of male and female students taught Genetics using the Multimedia Instructional package. Similarly, Soetan *et al.,* (2017) observed that there was no significant difference between male and female students in utilizing mobile technology devices. This is supported by the findings of Obielodan *et al.,* (2017) who submitted that there was no significant difference between the perception of male and female lecturers regarding the usefulness of blended learning for instruction.

This finding is also in line with that of Mabawonku who determined the effects of multimedia-assisted instruction on academic achievement and retention of senior secondary school Biology students. The result revealed that there was a significant difference in retention of students taught Genetics using the Multimedia Instructional Package and those taught with the conventional method. Similarly, Makinde and Yusuf (2017) observed that there was a significant difference in the retention of students taught Mathematics in Flipped Classrooms and those taught with lesson notes. It could therefore be emphatically said here that the use of the blended learning method enhanced the retention of students. Based on this, the use of blended learning methods for teaching and learning becomes imperative for Nigeria secondary school Physics Students.

The outcome of testing the corresponding hypothesis four using Analysis of Variance on the retention of students who received instruction using blended learning methods further revealed that there was no significant difference in the retention scores of male and female secondary school students taught Physics using the blended learning method. Hence, hypothesis four was accepted.

4. CONCLUSION

Based on the findings of the study, the following conclusions were made. The blended learning method improved students' achievement in Physics better than the use of the Conventional Method. Also, the male and female students exposed to Blended Learning

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Method achieved equally in Physics Achievement Test. The blended learning method improved students' retention in Physics than more the use of the conventional method and also the male and female students exposed to online and offline Blended Learning methods were equal in terms of retaining concepts taught in Physics. Based on the major findings of the study, it was recommended that teacher education should be geared towards the training of teachers to acquire appropriate knowledge on blended learning instruction strategy and its application in teaching as it strongly enhanced students' achievement and retention in Physics. Also, blended learning methods should be introduced into secondary schools to promote and encourage a student-centered approach to instruction for the enhancement of academic achievement and retention of students.

5. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. Authors confirmed that the paper was free of plagiarism.

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