

# Probing the Influence of Blended Learning Approach on Student's Academic Achievement in Biology: A Moderating Role of Gender

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## Abstract

Although the implementation of the blended learning approach (BLA) in the classroom has attracted significant research attention, previous studies on their impact on students' learning outcomes such as achievement have reported contrasting findings. In this study, we extended the study of BLA's influence on students' academic achievement in biology. Two research questions and three hypotheses guided the study. The sample size involved 87 students, (36 males and 51 females), enrolled in the experimental group (42 students) and the control group (45 students) in the 2022/2023 academic session. The data for the study was collected using the Biology Achievement Test (BAT) and was analysed through descriptive analysis for the research questions, while the analysis of variance (ANCOVA) was employed to test the null hypotheses at 0.05 alpha level of significance. The findings revealed a significant difference in students' achievement in biology in favour of BLA. However, no significant influence of gender on students' achievement was observed. The findings also show that the interaction effects of teaching methods and gender do not significantly influence students' achievement. Conclusion, implications, and future directions were discussed.

**Keywords:** Academic achievement, Blended Learning Approach, Gender and Lecture method

**JEL Classification:** I20, I21

## 1. Introduction

The integration of technology in the classroom has gained wide acceptance. This acceptance was particularly accelerated by the recent COVID-19 pandemic, which forced many schools to improve their academic provisions leading to a shift in pedagogical approaches. The pedagogical shift from the conventional mode of instruction is also driven by the necessity to meet the evolving needs of the 21st-century students which requires quality learning experiences that align with the global standards. Based on this need, for instance, recent research has attempted to diversify classroom instructional delivery to improve students' learning outcomes. The attempts include the combination of face-to-face mode and e-learning, leading to flexibility in instructional delivery in the classroom. Flexible instructional approaches acknowledge students' learning styles which could enhance their achievement in any subject including biology, irrespective of gender.

Biology is the science that studies life and living organisms. It is a popular and compulsory science subject among secondary school students in Nigeria. As one of the basic science subjects, it seeks to explain the mechanisms underpinning life in its diverse forms (Ambusaidi et al., 2021). The knowledge of biology enables students to understand and interpret their environments and helps to address critical human challenges such as food scarcity, pollution, population issues, disease management, health, hygiene, and conservation of natural resources in its advanced application. The subject was introduced as a basis for human capital development. Based on this premise, Muokwe and Okeke (2021) agreed that Biology provides a platform for teaching students to apply science concepts and principles in solving everyday life problems, which underscores the importance of the subject for national growth and development. Hence, students' achievement in this subject is regularly monitored (Bietenback, 2016).

Academic achievement is a crucial metric in educational practice. It indicates the level of attainment made by students based on the achievement of instructional objectives (Ezeanyika & Okigbo, 2021; Agbasi & Okeke, 2021; Oguezie & Osuafor, 2021). Achievement is a learning outcome that reflects the skills acquired and knowledge gained in any area. The contribution of consistent academic achievement to national development is significant, as it plays a crucial role in shaping the socio-economic landscape of any nation, in the long run. When students perform well, it shows they are better equipped with essential skills and knowledge that drive innovation and national productivity (Sele & Wanjiku, 2024). Therefore, optimum performance in any

subject especially science subjects like biology contributes to national growth. Despite the cruciality of Biology to nation-building, the academic achievement of students in the subject remains below average, as evidenced by fluctuating results in their external examinations (Ezeanyika & Okigbo, 2021).

The analysis of students' achievement in Biology according to the statistics provided by the Chief examiner of the West African Examinations Council (WAEC) from 2019-2022 substantiates the fact of students' fluctuating performance and underachievement in the subject. The statistics revealed that students had 55.63%, 63.23%, 58.09%, and 62.18% between 2019 and 2022 respectively. None of these standings gives a distinction and consequently, the student's chances for a university education are threatened. This calls for urgent attention because students are expected to do more in a subject as crucial as Biology. Efforts to improve this situation have proved abortive (Agbasi & Okeke, 2021; Muokwe & Okeke 2021), which highlights the need for urgent pedagogical review to address the issue and ensure students' active engagement in classroom learning to foster desired knowledge.

Factors such as lack of teacher commitment, students' laziness to study, lack of interest in the subject, and poor teaching methods have been implicated as responsible for the fluctuating performance of students in Biology (Okigbo & Okeke, 2011; Agaba, 2013; Balaraba, 2016; Oguezue & Osuafor, 2021). Agaba specifically noted that for students to achieve optimally in the subject, another approach to teaching was necessary other than the conventional approach. Agaba's view requires urgent attention if students are to improve their academic achievement. Poor academic achievement if unaddressed, could lead to limited career opportunities, increased risk of dropping out of school, difficulty in pursuing higher education, the potential for a cycle of poverty, higher rates of crime, and reduced economic growth in the long run (Bisri et al., 2025; Rogers et al., 2025). Poor academic achievement is detrimental to national and economic growth, and an urgent pedagogical shift to innovative teaching methods like blended learning could be instrumental.

The blended learning approach (BLA), also known as hybrid teaching is an instructional approach that integrates technology and digital media with traditional instructor-led classroom activities, giving students the flexibility to customise their learning experiences (Hirumi, 2011; Nnoli & Onwudinjo, 2023). This flexibility offers some advantage to the learner to dictate the pace of their learning unlike the pure traditional mode, where the teacher is seen as the purveyor

of knowledge. According to Lalima and Dangwal (2017), BLA involves framing the teaching-learning process by incorporating face-to-face learning experience with technology-supported teaching. Operationally, BLA is a pedagogical fusion that bridges traditional face-to-face learning with innovative digital tools, thus creating a fluid and inclusive learning experience. This approach is viewed as a balanced middle ground between the potential for excessive teacher control in the classroom and the potential for excessive student freedom. BLA represents a significant shift in educational practices, offering a more dynamic and effective way of teaching that aligns with the contemporary needs of the learners. As a technology-mediated approach, BLA combines the advantages of both modes (face-to-face classroom learning and online learning activities) to improve student learning experiences and more so academic achievement while preparing them for a technology-driven world.

Previous studies have established the effectiveness of BLA in different contexts, subject areas, higher and basic education, and methodologies on several students' learning outcomes such as interest, problem-solving skills, gender and academic achievement (Ezeanyika & Okigbo, 2021; Abidoeye, 2015; Kheng, 2014; Lin, Tseng, Chiang, 2017; Demirer & Sahin, 2013; Vo, Zhu, Diep, 2017; Utami, 2018; Ceylan & Kesici, 2017). However, these studies revealed contrasting findings on the impact of BLA on students' achievement, leading to the extension of the present study. More so, no study based on available literature, has been carried out in the subject area in the study location.

## 2. Literature Review

### **Blended Learning Approach: Academic Achievement and Gender Differences**

Existing literature has examined the influence of blended learning (BLA) on students' achievement, and the interplay of gender in this relationship. For instance, Abidoeye (2015) examined the effect of BLA on secondary school students' achievement in geography in Akure, Nigeria using a sample of 110 students and a non-equivalent controlled group design. The study revealed that BLA was more effective in enhancing students' achievement in geography than the lecture method. The result also revealed no significant difference between the achievement of male and female students. Similarly, Lin, Tseng, and Chiang, (2017) examined the effect of BLA on junior high school students' attitudes in learning mathematics with a quasi-experimental design. The ANCOVA and MANCOVA analyses showed that the BLA learning experience

benefitted students in the experimental group with a positive influence on the learning outcomes and their attitudes toward studying mathematics in a blended environment.

Utami (2018) investigated the effect of BLA model on senior high school students' achievement with an experiential research design using 63 students in the first grade of SMA Negeri 1 Lintau-Buo 2012/2013 academic year. The research showed that the achievement outcomes of the experimental group were higher than those of the control group. More so, Ezeanyika and Okigbo (2021) and Ugboja and Omachonu (2022) conducted similar studies by examining the influence of BLA on secondary school students in computer studies and the English language respectively. Both studies also revealed significant influences of the BLA on the student's learning experiences in the subject areas. Oluyemo et al., 2020 conducted a study on Gender Differences in Mathematics Interest and Achievement in Junior Secondary School Students, Niger State, Nigeria. The study adopted a correlation design with 92 participants. The study revealed that male students excel in Mathematics more than their female counterparts. Based on the prevailing mixed results and paucity of literature in this area, the present study addressed a critical gap.

First, the study was conceived to assess the academic achievement of male and female secondary school students in Biology in the study location. Secondly, the study makes an original addition to the limited existing literature by substantiating the integration of BLA to explain students' academic achievement through the mechanism of gender. The findings of this study could enhance educational practices that not only improve academic achievement but also foster a supportive learning environment for all students, regardless of gender. The present study also added to knowledge through insights that could inform the development of more inclusive and effective adoption of blended learning frameworks in the classroom.

### **Research Questions**

1. What is the mean achievement score of students taught Biology using BLA and those taught using the lecture method (LM)?
2. What is the mean achievement score of male and female students taught Biology using BLA and LM?

### **Hypotheses**

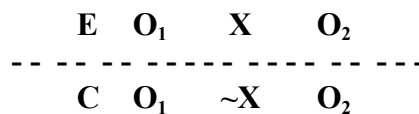
1. There is no significant difference in the mean achievement score of students taught Biology using BLA and those taught using the lecture method (LM).

2. There is no significant difference between the mean achievement scores of male and female students taught Biology using BLA and LM.
3. There is no interaction effect of teaching methods (BLA and LM) and gender on students' achievement in Biology.

### 3. Methodology

#### Research Design

The study adopted a pre-test post-test non-equivalent quasi-experimental design. This design according to Nworgu, 2015, is where random assignments of the research participants to groups are not possible. This design is appropriate for this study because the administrations of the participating schools did not allow for the alteration of their school settings, therefore the researchers did not alter the student's arrangement in the sampled schools. The study design is symbolically shown in **Figure 1**.



**Figure 1.** Design of the Study

Where **E** is the experimental group; **C** is the Control group; **O<sub>1</sub>** is the pre-test, **O<sub>2</sub>** is the Post-test; **X** is the Experimental treatment; and **~X** represents the absence of experimental treatment while the dotted lines ' - - ' show the two groups (**E** and **C**) were not equated by random assignment.

#### Participants

The study's population comprised 4,391 (1,818 males and 2,573 females) senior secondary two (SS2) Biology students from the 47 co-educational government secondary schools in Awka Education Zone of Anambra State. Participants in the 2022/2023 academic session were used for the study.

#### Sample and Sampling Techniques

A total sample size of 87 (36 males and 51 females) students offering Biology were used for the study. The sample was selected using a multistage sampling procedure. A simple random sampling technique, specifically balloting without replacement, was employed to select two out of the 16 co-educational schools in the area. Two classes were selected from the sampled schools. Out of the two selected schools, one was randomly assigned to the experimental group

(BLA) and the other to the control group (CLM) using a simple random sampling technique (flip of a coin). The sampling technique ensured that each school/class had equal and independent chances of being selected.

Variable	Dimensions	N	%
Gender	Male	36	41%
	Female	51	59%
Group	Experimental	42	48%
	Control	45	52%
<b>Total</b>		<b>87</b>	<b>100%</b>

**Table 1.** Demographic information of the research sample in the study

### Instruments for Data Collection

Biology Achievement Test (BAT) was used for data collection, and to measure students' achievement in Biology in the study. Part A of the instrument elicited the participants' demographic information, while Part B contained 50 multiple-choice questions with 4 options (A to D) against each question. The question items were adapted from Senior Secondary School Certificate (SSCE) past questions and compiled based on the topics that were taught during the period of the research using a well-planned lesson plan, and table of specifications to ensure even coverage of content.

In scoring the BAT, each correct answer attracted 2 marks while each wrong answer or unanswered question had a zero mark. Thus, the highest possible score was 100 marks while the lowest possible score was zero (0). The instrument was subjected to face and content validity by three experts in the field. Using the Kuder-Richardson formula 20, the reliability was calculated, and it yielded a coefficient value of 0.87, showing that the instrument was reliable.

Data was collected through face-to-face administration of the Biology Achievement Test (BAT) to the students with the aid of two research assistants (regular classroom teachers). The instruments were retrieved scored, coded, and analysed using SPSS v27. This approach ensured a return rate of 100% of the instruments. Using descriptive analysis, the research questions were answered. However, the null hypotheses were tested using ANCOVA, reject the hypothesis if the probability value (P-value) is less than the 0.05 alpha level; if not, do not reject the hypothesis.

### Experimental procedure

The experimental group was taught using the BLA, whereas the control group was taught using

the lecture method handled by their regular Biology teachers who doubled as research assistants in the study. The researchers provided the Biology teachers with a one-week briefing and guidelines on the implementation of BLA to teach the nutrition cycle - the concept selected for the study in Biology. Following the briefing, the researchers developed one lesson plan for the experimental group, while the teacher in the control group was requested to adopt the regular classroom lesson plan to teach the students the same topic. The experimental group adopted a lesson plan that included detailed steps on the implementation of BLA. The Biology Achievement Test (BAT) was administered to the student (pre-BAT) before the actual treatment. The actual experiment (treatment) took place during the second, third, fourth, and fifth weeks; post-BAT was administered in the fifth week after being rescheduled. The reshuffling was important to give the BAT items a distinctive look and prevent memory effects. Data on student achievement in Biology by gender and treatment groups were collated based on post-test data. The research questions posed in the study were answered using the mean (M) and standard deviation (SD), and the analysis of covariance (ANCOVA) was applied to test the hypotheses at the 0.05 level of significance.

#### 4. Results and Discussions

The findings are organised around each research question and hypothesis. We provided the details of the findings below.

Group	N	Pretest Mean	Pretest SD	Posttest Mean	Posttest SD	Gained Mean
Experimental	42	30.48	7.31	68.67	13.70	38.19
Control	45	30.49	10.52	60.84	9.72	30.35

**Table 2.** Mean Achievement Scores of Students taught Biology using Blended Learning Approach (BLA) and Conventional Lecture Method (CLM)

**Table 2** shows that students taught Biology using a BLA had a pretest mean achievement score of  $30.48 \pm 7.31$ , and a post-test mean achievement score of  $68.67 \pm 13.70$ , with a mean gain of 38.19 in Biology, while those taught using the lecture method (LM) had a pre-test mean achievement score of  $30.49 \pm 10.52$ , and a post-test mean achievement score of  $60.84 \pm 9.72$ , with



a mean gain of 30.35. Students' scores in the blended learning class were more spread in the post-test (13.70) than those in the control group (9.72).

Method	Gender	N	Pretest Mean	Pretest SD	Post-test Mean	Post-test SD	Gained Mean
Experimental	Male	16	31.00	6.97	72.50	11.97	41.50
	Female	26	30.15	7.63	66.31	14.37	36.16
Control	Male	23	32.48	10.57	60.78	8.59	28.30
	Female	22	28.41	10.29	60.91	10.98	32.50

**Table 3.** Mean Achievement Scores of Male and Female Students taught Biology using BLA and CLM

**Table 3** shows that with a higher mean gain of 41.50, BLA is more effective in enhancing the achievement of male students in Biology. However, there was a higher score variation among the female students (14.37) than among the male students (11.97), with a gained mean difference of 5.34.

Source	SS	Df	Mean Square	F	Sig.	Decision
<b>Corrected Model</b>	1719.291 <sup>a</sup>	4	429.823	3.076	.021	
<b>Intercept</b>	27727.884	1	27727.884	198.451	.000	
<b>Pretest</b>	10.078	1	10.078	.072	.789	
<b>Method</b>	1540.814	1	1540.814	11.028	.001	<i>Sig.</i>
<b>Gender</b>	178.603	1	178.603	1.278	.262	<i>Not Sig.</i>
<b>Method * Gender</b>	216.831	1	216.831	1.552	.216	<i>Not Sig.</i>
<b>Error</b>	11457.192	82	139.722			
<b>Total</b>	376474.000	87				
<b>Corrected Total</b>	13176.483	86				

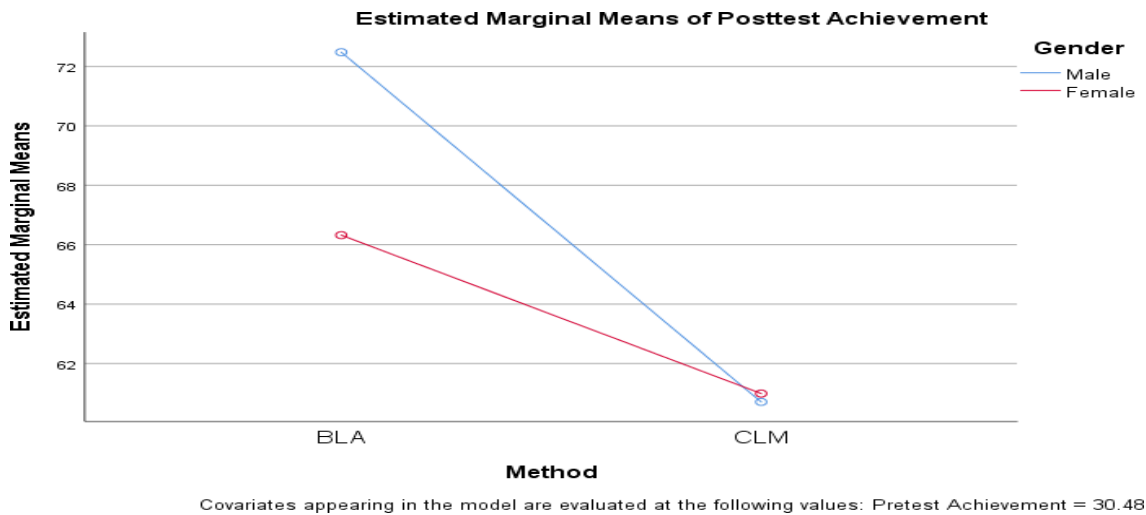
**Table 4.** Test of Hypothesis

**Table 4 (hypothesis 1)** shows that there is a significant main effect of the treatment on students' achievement in Biology,  $F(1, 82) = 11.028$ ,  $P < 0.05$ . Therefore, the null hypothesis is rejected meaning that there is a significant difference between the mean achievement scores of students taught Biology using the Blended Learning Approach (BLA) and those taught using the Lecture Method (LM).

**Table 4 (hypothesis 2)** also shows that there is no significant main influence of gender on

students' achievement in Biology,  $F(1, 82) = 1.278, P = > 0.05$ . Therefore, the null hypothesis was not rejected meaning that there is no significant difference between the mean achievement scores of male and female students taught Biology using BLA and LM.

**Table 4 (hypothesis 3)** further shows that there is no significant interaction effect of the teaching methods and gender on students' achievement in Biology,  $F(1, 82) = 1.552, P = > 0.05$ . Therefore, the null hypothesis was not rejected meaning that there is no significant interaction effect of teaching method (BLA and CLM) and gender on students' achievement in Biology.



**Figure 2.** Estimated marginal means of the post-test achievement among students in the BLA

## Discussion of Findings

The study investigated the influence of BLA on students' academic achievement in learning Biology. The findings revealed that students taught biology with BLA outperformed those taught with the Lecture Method. This is because the mean gain in students' achievement in the experimental group revealed that BLA was favoured and most preferred, unlike the Lecture Method. The difference in students' achievement was significant with the ANCOVA test of hypotheses. This finding is consistent with previous studies Abidoye (2015), Utami (2018), Ezeanyi and Okigbo (2021), and Ugboja and Omachonu (2022), who reported that BLA enhances students' engagement, learning outcomes and academic achievement paralleled to traditional teaching method (Lecture Method). The higher performance of students in the experimental group could be attributed to the flexibility of the approach, autonomy of learning,

and accommodation of the differential learning styles among students that BLA offers. This indicates that BLA is a good substitute for the conventional classroom mode of instruction.

The findings also revealed that male students performed higher than female students in the BLA classroom, while female students performed higher than male students in the lecture method group (**Table 3**). However, the test of hypothesis revealed that the difference between male and female students' academic achievement in Biology was non-significant. This implies that the effect of BLA on male and female students' achievement was even, as both gained equally. This finding is consistent with Muokwe and Okeke (2021) and Ceylan and Kesici (2017), who reported that no significant difference exists between male and female students in achievements in sciences. However, the finding is contradicted by Godpwer-Echie and Ihenko (2017) and Oluyemo et al., 2020, who maintained that a significant difference exists in male and female students' achievement when exposed to the same classroom activities. The equal achievement of male and female students in the BLA environment could be attributed to equal access to learning resources, robust collaborative activities, and effective teacher support in the classroom. More so, the study provided evidence to prove that the interaction effect of teaching methods and gender on students' academic achievement was non-significant.

## 5. Conclusions

In this study, we examined the influence of Blended Learning Approach (BLA) by comparing students' academic achievement in the experimental group with those in the conventional group (Lecture Method) through the mechanism of gender. Based on the findings, the following conclusions were made:

- a) the use of BLA had a significant influence on secondary school students' academic achievement in Biology compared with the Lecture Method; this was demonstrated by the fact that the post-test mean achievement score of the experimental group (BLA) was significantly higher than that of the control group;
- b) there was no significant gender difference in the mean academic achievement scores of SS2 students taught Biology using BLA. This suggests that the use of BLA is gender-friendly, as both male and female students benefitted from the learning experience;
- c) there is no significant interaction effect of gender and teaching method on students' achievement in Biology.

## Implications

The findings of the study revealed that students' academic achievement was significantly influenced when taught with BLA. Moreover, there is no significant difference between male and female students in their academic achievements when taught Biology with BLA. The interaction between gender and teaching method had no significant effect on students' academic achievement. These findings have several implications for students, teachers, and other stakeholders such as curriculum planners.

The effectiveness of BLA implies that teachers should adopt it for optimum student performance in Biology and other subjects at large. The use of BLA could reinforce students' collaboration, and access to learning experiences where both males and females learn equally. Although, conventional methods still have their unique effectiveness. However, teachers should not be over-dependent on them.

## Limitations/Suggestions for further studies

The sample size was limited to 87 senior secondary school students distributed across experimental and control groups; any generalisation made from this study should be regarded with a little caution. Further studies should consider expanding the sample size to include participants at other levels of education, to improve the generalisability of such a study. A Quasi-experimental research design was used in this study, with a mix ratio of 50%-50% (50% face-to-face and 50% online). Future research can consider different mixed ratios and different methodologies to further examine the effect of BLA. Other students' learning outcomes such as computational thinking, impostor syndrome and self-regulated learning efficacy should be explored from the lens of BLA, and in different contexts. More so, a longitudinal effect of BLA should be studied.

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