

EFFECTS OF BLENDED LEARNING STRATEGY ON SENIOR SCHOOL STUDENTS' ACHIEVEMENT IN CELL BIOLOGY IN ILORIN, NIGERIA

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Abstract

This study investigated the effects of blended learning strategy (BLS) on senior school students' achievement in Cell Biology (CB) in Ilorin Nigeria. The design used was quasi experimental design of pretest, post-test, non-equivalent control group. The population involved all senior school students in Ilorin town. The sample consisted of 127 (67 male and 60 female) senior school II students from three schools offering Biology, selected using purposive sampling techniques. Intact science class of SS2 in each of the chosen schools were selected for the study. Students in the experimental group I were taught using BLS, and the experimental group II was taught using online learning mode (a custom built web-based learning management system) and the control group were taught using the conventional method. The research instrument was researcher's designed Cell Achievement Test which was validated by three experts. The reliability was carried out using Kuder Richardson Formula 20 and its value was 0.81 at 0.05 level of significance. The data collected were analyzed using Analysis of covariance. Findings revealed that; there existed a significant difference in the achievement of students taught CB using BLS. There was no significant difference in the achievement of male and female when taught with BLS. The study concluded that BLS improved students' achievement regardless of gender by providing equal access to learning opportunities and interaction. The study recommended that Biology teachers should incorporate BLS to foster students' academic performance in other topics in Biology because of its flexibility.

Keywords: Blended learning strategy, performance, cell, gender

Introduction

The study of living things in terms of their distribution, structure, taxonomy, behavior, and origin as a division of life science is called biology (Adewunmi & Adeoye 2023). Onu, Anyaegbuman and Uzoigwe, (2020) defined biology as a natural science concerned with living organisms and their characteristics as well as their interactions with non-living components of the earth. Biology is crucial for mankind, yet students' performance in the external examination has been unsatisfactory. Performance of Students in Biology examinations are increasingly depreciating and worrisome, hence there is need for constant researches in improving on it (Sheldon & Turner, 2019).

Thus, the desire to find out the factors responsible for poor performance in biology has been the focus of researchers for some time now. In Nigerian secondary schools, some foundational topics that are pre-requisites in students' career aspirations include, cell biology, ecology, genetics, environmental pollution, respiration, reproduction and so on. Oyarole, (2023) reported that Biology concepts can sometimes be difficult particularly when describing ideas that are abstract and cannot be fully comprehended by students for the first time. WAEC Chief Examiners Report of 2022 revealed that a number of topics in Biology with Cell Biology inclusive, contain concepts which pose difficulty for students to comprehend. Etobro and Fabinu, (2017) affirmed that students consider cell biology as abstract in nature and difficult to understand, resulting in their poor performance.

Cell Biology as a topic in the biology curriculum comes under the theme of organization of life. A cell is the smallest unit of life that can replicate independently, and cells are often called building blocks of life. Michael, (2020) defined cell as the basic structural, functional, and biological unit of all known living organisms. The knowledge of cell is a prerequisite for understanding Biology at any level and sub disciplines of biology as it lays the foundation on which other topics build on. Cell is an important topic that everybody needs to understand because of its invaluable roles in human life.

Integrating technology tools into the teaching and learning process (usually known as e-learning) could help to close the gap created by conventional classroom approach. The concept of e-learning, as described by Sarigoz, (2019), involves utilizing digital electronic devices in the educational process, encompassing various tools such as audio and video devices, synchronous and asynchronous processes, and social media. This innovative practice, highlighted by Tucker et al., (2017), facilitates effective learning in the classroom and can take the form of fully online or hybrid learning experiences. E-learning involves a wide range of technology based learning through learning management systems, websites, learning portals, video conferencing, YouTube, mobile apps, and many other free available websites for blended learning. Learning Management Systems (LMS) is one of the tools in technology that is commonly used to enhance knowledge and skills acquisition by students, academic staff, and other professionals, through the Internet (Adams, Sumintono, Mohammed & Noor 2018; Chopra, Mandan, Jaisingh & Bhaskar., 2019). Brush, (2019) defined Learning Management System (LMS) as a software application or web-based technology used to plan, implement and assess a specific learning process. It is an e-learning-based platform built on two major elements - a server that performs the base functionality and a user interface that is operated by an instructor, learners and administrators.

In this study, the LMS that was employed as the e-learning environment for the blended learning is Moodle. Moodle (Modular Object-oriented Dynamic Learning Environment) is an open-source learning management system that enables teachers to arrange their materials in a student-friendly manner. Moodle is a free open source LMS built on a sound educational philosophy through collaboration from members. Blended learning strategy is a student-centered learning method (Vasileva-Stojanovska, 2015) that combines traditional face-to-face classrooms (synchronous learning activities) with e-learning activities (asynchronous learning activities) (Attard & Holmes, 2020). Blended learning strategy allows learners to visualize, listen, feel, and interact with the learning material. It moves learning from theory into practice. It help students' gain deeper understanding for all the abstractions they get through. They can learn according to their pace, which creates the opportunity for more individualized education.

There is no significance difference in the mean achievement of male and female students exposed to a blended learning environment. Shea, Richardson, Swan. (2022) study compared the academic achievement of male and female students that studied biology through blended learning strategy. The findings indicated that gender did not significantly differ, indicating that the students' academic achievement was determined by their own study habits, the environment in which they studied, the qualities of their teachers and the teaching approach employed. However, Panetta, (2017) studied the academic performance of male and female students taught using blended learning strategy. The findings showed that male students performed better than female students, which the author attributed to the male students greater access to technology. Therefore, students' performance in biology may differ when the course is taught with innovative approaches such as blended learning strategy

Thus, the importance of the current research stems from its topic, blended learning strategy which provides a new method of teaching where the information communication and technology is used without the need for a radical change in the conventional method; the reason is that the blended learning strategy does not rely on the conventional methods but it works to improve it. It is against this background that this study determined the effect of harmonizing face-to-face with online instruction towards improving students' performance and engagement in Biology.

Statement of the Problem

Biology is a fundamental science subject in the Nigerian school curriculum. Its significance cannot be stressed enough because of its potential to enhance the study and acquisition of relevant knowledge in science and technology necessary for sustainable healthy living and environmental management. However, with all the immense benefits of Biology, the analysis of students' results in the West African Senior School Certificate Examination (WASSCE) over the past five years (2020 – 2024) shows dwindling and unsatisfactory performance. This problem could be traceable to teaching strategies; students' attitude, inadequate learning resources and students' learning habits. In view of these, teaching of biology at the senior secondary school requires the right instructional strategies. One popular strategy that involves the harmonization of face-to-face with e-learning instruction in order to improve teaching and learning is the Blended learning strategy. Integrating technology tools into teaching and learning helps teachers utilize online learning as a powerful educational tool which increase students engagement, help teachers improve lesson plans and facilitate personalized learning. It also helps students build essential 21st century skills. Anachuna and Okigbo (2021) investigated the effect of blended learning approach on secondary school students' attitude and performance in basic science not Biology in Anambra State. Attitude was examined as the variable. Michael et al., (2025), investigated the effect of blended learning instructional strategy on academic achievement of senior secondary school students' in genetics and the study was carried out in secondary schools in Makurdi metropolis in Benue State and the concept genetics was taught and not cell biology. From the literature reviewed, it could be deduced that these previous studies differ from the present study in terms of: subject area, variable, concept taught and location. Therefore, this study examined the effects of blended learning strategy on senior school students' performance in Cell Biology in Ilorin, Nigeria, where gender serves as the moderating variables.

Purpose of the Study

The main purpose of the study was to determine the effects of blended learning strategy on Senior School students' academic achievement in Cell Biology in Ilorin, Nigeria. Specifically, the study sought to:

1. investigate the means academic achievement scores of students taught Cell Biology using blended learning strategy, those taught using online learning mode and those taught with conventional method.
2. examine the mean academic achievement scores of male and female students taught Cell Biology using blended learning strategy

Research Questions

The following research questions guided the study;

1. What is the significant mean difference in the academic achievement of students taught of Cell Biology using blended learning strategy, those taught using online learning mode and those taught with conventional method?
2. Does any difference exist in the achievement of male and female students taught cell using Blended learning strategy?

Hypotheses

H₀₁: There is no significant difference in the mean academic achievement scores of students' taught Cell Biology using blended learning strategy, those taught using online learning mode and those taught using conventional teaching method.

H₀₂: There is no significant difference in mean academic achievement scores of male and female students taught Cell Biology using blended learning strategy.

Methods

The study adopted quasi- experimental research, specifically, pretest, and posttest non-equivalent control group design. The population consisted of all senior secondary students offering biology in Ilorin, Kwara State, Nigeria. The sample consisted of 127 (67 male and 60 Female) selected from senior secondary school II students in three coeducational school. The researchers employed purposively sampling technique to select three coeducational secondary schools within the Ilorin town. The schools selected for the two experimental groups had functional computer laboratory, internet facilities, alternative power supply and all other accessories like projector readily available. Hence the students have been exposed to receiving instruction through information communication technology. Two Research instruments were used in this study. The stimulating instrument is the custom built web based learning management system instructional package on cell Biology developed by the researcher, The LMSIP was an interactive based application which covered lesson on Cell Biology as contained in the Nigeria Senior School Curriculum. It is an open source rational database learning management system. The website name is learningportal.wuaze.com. The students Log in with their username and password after which the various subjects were displayed on the dashboard. The students then selected from the dashboard from the various options Home, profile, set assessment, view result, delete assessment, YouTube classes, view subject content .The package developed was presented to experts in educational technology for rating. Feedback and comments on the technical quality of the package was used for improvement .It was blended with conventional teaching method for students in experimental group I and the online learning mode where LMS application was used in experimental group II. Also, the content of the LMS application included diagrams and notes on the topic Cell. Objectives and constructive feedback in form of assignments were made available in the application for further guidelines.

Cell achievement Test which was a multiple choice questions consisting of forty items. The research instruments were given to experts for validation. Three experts validated the instrument. One from science education department, one from educational technology department and one experienced biology teacher in secondary school. Thereafter, reliability coefficient value of 0.84 which was considered to be reliable and then used for the research. The experiment lasted for five weeks; the first week was used for training the research assistant and administration of the pretest. Thereafter, the treatment was carried out in the experimental group I, group II and the control group for three weeks by the trained research assistant at the same time. The post-test was reshuffled and administered to the respondent. In this study, there were two research questions with

corresponding hypotheses. The hypotheses were tested with analysis of covariance at 0.05 level of significance. The analysis was done using statistical package for social science (SPSS) version 25. ANCOVA was used in analyzing differences between three or more groups means order to eliminate the effect of covariate

Results

Research Question one: What is the significant mean difference in the academic achievement of students taught of Cell Biology using blended learning strategy, those taught using online learning mode and those taught with conventional method?

Table 1: Descriptive statistics of achievement of students taught cell using blended learning strategy, online learning mode and those taught with conventional method alone

Groups		Min	Max	Mean	S.D.	Remark
Blended Learning strategy (<i>Exp. I</i>)	Pre-test	10.0	27.0	17.42	4.30	Low
	Post-test	28.0	37.0	33.20	2.83	High
Online Learning mode (<i>Exp. II</i>)	Pre-test	12.0	28.0	16.30	3.50	Low
	Post-test	24.0	34.0	29.76	3.04	High
Conventional Method (<i>Control Group</i>)	Pre-test	12.0	28.0	16.50	3.84	Low
	Post-test	18.0	31.0	23.85	3.09	Moderate

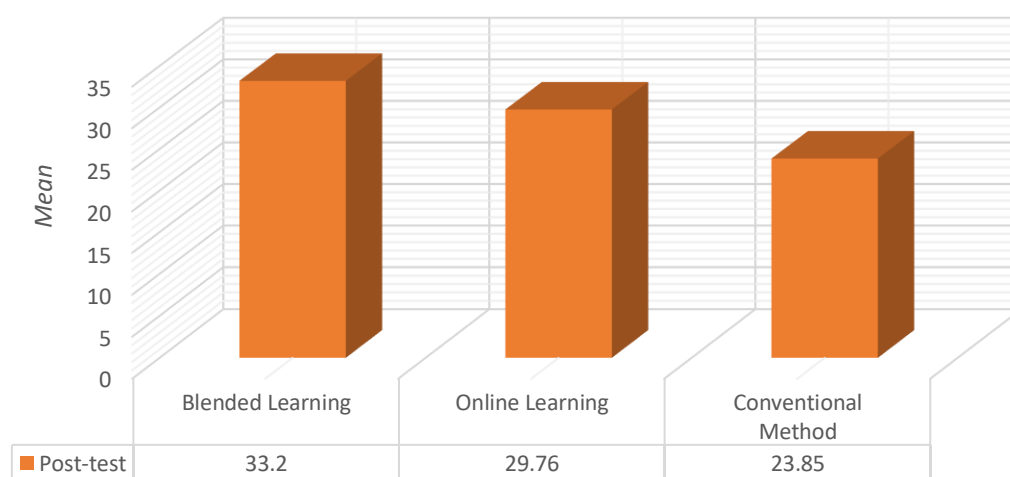


Figure 1: achievement of students taught cell using blended learning Strategy, online learning and those taught with conventional method .

As indicated from Table 1, students in the experimental Group I, Group II, and the control group demonstrated improved performances in the post-test compared to their pre-test results. Students taught Cell Biology using the blended learning strategy (experimental Group I) achieved the highest performance, with a mean score of 33.20, followed by those who learned through the online learning mode (experimental Group II), with a mean score of 29.76. In contrast, students instructed using the conventional method (control group) recorded the lowest mean score of 23.85. This outcome suggests that students exposed to blended learning strategy outperformed those taught through online learning alone and the conventional method.

After examining the achievement of students taught cell biology using blended learning strategy, online-learning mode, and conventional methods, the researcher

proceeded to determine the mean gain difference between the pre-test and post-test achievement of each group, as shown in Table 2.

Table 2: Mean gain difference in the pre-test and post-test achievement of each of the groups

Package	Pre-test	Post-test	Mean Gain
Blended Learning (<i>Exp. I</i>)	17.42	33.20	15.78
Online Learning (<i>Exp. II</i>)	16.30	29.76	13.46
Conventional Method (<i>Control Group</i>)	16.50	23.85	7.35

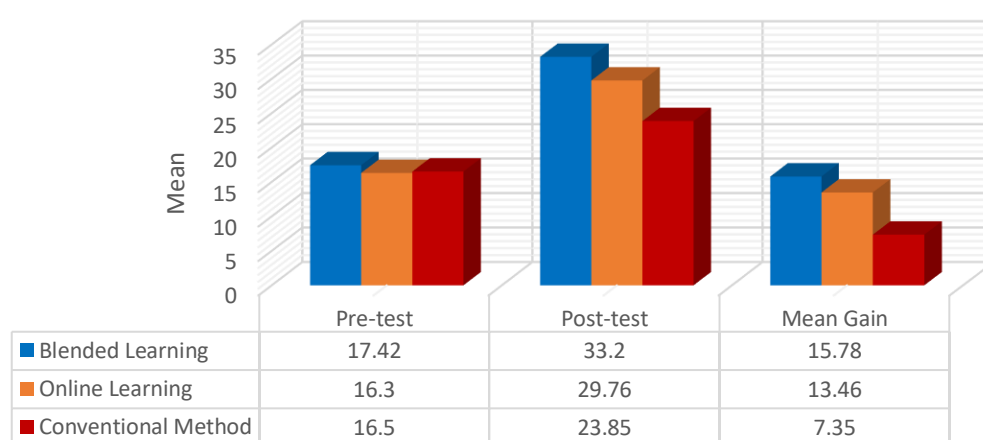


Figure 2: Mean gain difference in the pre-test and post-test achievement of each of the groups

Table 2 showed that students exposed to blended learning had a mean gain score of 15.78, while those taught using the online-learning and the conventional method had mean gain scores of 13.46 and 7.35, respectively. Therefore, students taught using blended learning strategy achieved the highest mean gain, followed by those taught with the online-learning mode while those taught using the conventional method had the lowest mean gain.

Hypotheses

Hypothesis One: There is no significant difference in the mean academic achievement scores of students' taught Cell Biology using blended learning strategy, those taught using online learning mode and those taught using conventional teaching method.

Table 3: Analysis of covariance showing the difference in the achievement of students taught cell using blended learning strategy, online learning mode and those taught with conventional method alone

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	2046.733 ^a	3	682.244	78.972	.000
Intercept	6028.307	1	6028.307	697.796	.000
Pre-test	37.958	1	37.958	4.394	.038

Groups	2044.350	2	1022.175	118.320	.000
Error	1062.606	123	8.639		
Total	107265.000	127			
Corrected Total	3109.339	126			
<i>a. R Squared = .658 (Adjusted R Squared = .650)</i>					

A multiple comparison analysis is presented in Table 3 to identify the specific differences between the three groups (i.e., experimental group I, experimental group II, and the control group).

The result in Table 3 shows an F-value of 118.320 with a p-value of 0.000, calculated at a 0.05 alpha level. Since the p-value (0.000) is less than the alpha level (0.05), the null hypothesis one is rejected. This indicates that there is a statistically significant difference in the performance of students taught cell biology using blended learning strategy, online-learning mode, and conventional methods ($F_{(2, 123)} = 118.320$, $p < 0.05$). The actual effects of these treatments are further demonstrated by the mean differences (I-J) shown in Table 4

Table 4: Pairwise comparison analysis of the actual effects of the treatments on students' performance

(I) groups	(J) groups	Means	Mean Diff. (I-J)	Std. Error	Sig. ^b	95% Confidence Interval for Difference ^b	
						Lower Bound	Upper Bound
Blended Learning	Online Learning	33.301 ^a	3.694	.668	.000	2.073	5.316
	Conventional		9.490	.625	.000	7.972	11.009
Online Learning	Blended Learning	29.606 ^a	-3.694	.668	.000	-5.316	-2.073
	Conventional		5.795	.643	.000	4.234	7.356
Conventional Method	Blended Learning	23.811 ^a	-9.490	.625	.000	-11.008	-7.972
	Online Learning		-5.795	.643	.000	-7.356	-4.234
Grand mean		28.906					

Based on estimated marginal means

** The mean difference is significant at 0.05 level*

b. Adjustment for Multiple Comparisons: Bonferroni

The pairwise comparison of online learning mode and conventional method was carried out, Blended learning strategy and conventional method was carried out and Blended learning and online learning was carried out their mean differences were significant at 0.05 level of significance.

Hypothesis Two:

There is no significant mean difference in the achievement of male and female students taught cell using blended learning strategy.

Table 5: Analysis of covariance showing the difference in the performance of male and female students taught cell using blended learning strategy

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	30.236 ^a	2	15.118	1.980	.152
Intercept	2824.033	1	2824.033	369.786	.000
Pre-test	26.067	1	26.067	3.413	.072
Gender	11.266	1	11.266	1.475	.232
Error	290.203	38	7.637		
Total	45499.000	41			
Corrected Total	320.439	40			

a. R Squared = .094 (Adjusted R Squared = .047)

The result in Table 5 showed an F-value of 1.475 with a p-value of 0.232, computed at a 0.05 alpha level. Since the p-value (0.232) is greater than the alpha level (0.05), the null hypothesis two is not rejected. This indicates that there is no statistically significant difference in the achievement of male and female students taught cell biology using blended learning strategy ($F_{(1, 38)} = 1.475$; $p > 0.05$).

Discussion

This study investigated the effects of blended learning strategy on senior school students' achievement in Cell Biology in Ilorin. Based on hypothesis one, the findings of this study showed that there was a significant difference in the achievement of students taught cell Biology using blended learning strategy and those taught using conventional method of teaching. The students' achievement was enhanced significantly better when taught using blended learning strategy than their counterparts taught using conventional method. The high performance of students in Blended learning strategy might be attributed classroom environment provided by this instructional strategy which encourage collaboration and active learning and leverages the strength of both traditional and online instructional methods, providing students with the flexibility of online learning while retaining the interpersonal benefits of in-person teaching. The findings shown in this outcome supports the findings of Adaihe, Nwanekezi and Ndioho (2020), who found a statistically significant difference in the academic achievement of students taught cell division in a blended learning environment compared to students taught in a regular classroom. The results are consistent with Njoku, (2024) assertion that blended learning strategy raises students' academic achievement. In addition finding of this study showed there was no statistically significant difference in the performance of male and female students taught Cell Biology using Blended learning strategy. This result is consistent with the findings of Umeana (2020), who found no discernible difference in the academic achievement of male and female students taught in a mixed learning setting. In contrast, previous research (Panetta, 2017) found that when blended learning was used in the classroom, male students fared better than female students. Panetta, (2017) explained this achievement gap by pointing out that male pupils are more digitally inclined than female students. The results of recent research show that blended learning strategy is gender

friendly and can be used to teach all students, regardless of gender, suggesting that female students have clearly closed the technological knowledge gap.

Conclusion

Based on the findings of this study, it could be concluded that students performed better when taught with blended learning strategy than when taught using online learning mode or conventional method. It could also be concluded that no discrepancy was found in the achievement of male and female students taught with the blended learning strategy. This lack of significant differences in achievement between male and female students, signifies that blended learning strategy platform provides equitable opportunities for all students to perform better in Biology by ensuring that all students from different gender can be actively involved in their learning and master Biology content in meaningful ways

The Way Forward

With respect to the findings obtained from this study, the following recommendations were proffered;

1. Since the blended learning strategy produces highest performance amidst students, Biology teachers should incorporate this teaching approach to foster students' academic performance and learning in Biology with the flexibility of online learning while retaining the interpersonal benefits of in-person teaching.
2. Since the success of blended learning strategy and online learning depends heavily on effective course design and teaching methods, it is recommended that educators should receive regular training and professional development in online pedagogy. This will equip them with the necessary skills to design, implement, and manage engaging and effective blended learning strategy experiences. Training should focus on how to use technology tools, develop interactive content, and create an inclusive learning environment that supports all students.

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