IMPROVING SECONDARY SCHOOL STUDENTS' MOTIVATION AND ACHIEVEMENT IN SKELETAL SYSTEM IN POST COVID 21ST CENTURY THROUGH BLENDED-LEARNING STRATEGY

Dauda, Daniel Suyibam
School of Postgraduate Studies
University of Jos, Jos, Plateau State, Nigeria
&
Ozoji, Bernadette Ebele
Department of Science and Technology Education
University of Jos, Jos, Plateau State, Nigeria
&
Imo, Georgina Chinyere
Department of Educational Foundations
University of Jos, Jos, Plateau State, Nigeria

Abstract
The study investigated the possibility of enhancing secondary school students' motivation and achievement in skeletal system in post COVID-19 Twenty first century through the use of blended learning strategy. The quasi-experimental design was employed in the study. Population of the study comprised 2,615 senior secondary two students in 20 public secondary schools in Bauchi metropolis in 2020/2021 academic session while the sample consisted of 92 students in two in-tact classes from two randomly selected secondary schools in Bauchi metropolis. Two research questions and two null hypotheses guided the study. The two schools used as sample were randomly assigned to an experimental group and a control group, respectively. A 20-item Students' Motivation to Skeletal System Scale (SMSSS) and a 30-item Biology Achievement Test in Skeletal System (BATSS) were used to collect data from the students. The SMSSS and BATSS were validated by two experts in Biology Education and Tests and Measurement, respectively. The reliability indices of SMSSS and BATSS were established using Kuder-Richardson formula 20 as 0.85 and 0.92, respectively. The experimental group was taught with blended learning strategy while the control group was taught with lecture method. Mean and standard deviation were used to answer research questions while Analysis of Covariance was used to test hypotheses at 0.05 level of significance. Findings revealed that blended learning strategy significantly improved the motivation and achievement of students in skeletal system. It was therefore, recommended that the blended learning strategy should be

incorporated into methods of teaching biology concepts for improved motivation and achievement, particularly in post COVID 19 twenty-first century.

Keywords: *Achievement, Blended Learning Strategy, Motivation and Skeletal System.*

Introduction

Biology is the study of living things and a subject that provides part of literacy needed for national growth and development. It is one of the pre-requisite courses for many fields of learning including botany, anatomy and physiology, microbiology, medicine, agriculture, pharmacy and biotechnology. Biology contributes immensely to the technological growth and development of any nation. It plays a vital role in understanding of complex forms of life involving humans, animals and plants. Biology helps individuals understand the interaction between humanity and the world. Biology pervades literally every field of human endeavour and plays a fundamental role in the educational system.

In Nigeria, the study of Biology starts from the senior secondary education level and continues to tertiary education level. At that level, the objectives of biology education as stated by the National Policy on Education (FRN, 2014) are to prepare students to acquire: adequate laboratory and field skills in biology, meaningful and relevant knowledge in biology, ability to apply scientific knowledge to everyday life in matters of personal and community health and agriculture, reasonable and functional scientific attitudes. The Ministry of education also stated that, in pursuance of the fore-stated objectives, the contents and context of the curriculum places emphasis on field studies, guided discovery, laboratory techniques and skills along with conceptual thinking.

The Federal Government of Nigeria has made a lot of efforts towards improving teaching and learning of sciences including biology in secondary schools on account of the fore-going significant roles to human and national development. The efforts include establishment of special science schools in different States of the federation, training of biology and other science teachers in the technical aid and other programmes abroad, establishment of more federal universities of technology, engaging in Science and Technology Education Projects (STEPB) in secondary schools. Despite these efforts by the government in boosting science education, literature evidence shows that students' achievement in biology in public examinations, such as, the West

African Examinations Council (WAEC) and National Examinations Council (NECO) examinations is on the decline. The results of students in WAEC from 2016 to 2018, for instance, show that students achieved poorly in biology and other science subjects. Researchers have advanced the factors of poor and ineffective methods of teaching as being responsible for the unimpressive and poor achievement outcomes of students in biology (Nwagbo & Okoro, 2012; Suyibam, 2022). Other factors bedeviling students' achievement in biology are the abstract nature of some biology concepts, students' characteristics such as poor attitudes to the subject, poor study habits adopted by students and poor motivation. the use of poor teaching and stereotyped methods of teaching that do not provide opportunities for creative thinking and critical reflection by students; skills that do not promote meaningful learning and in-depth understanding of biology concepts and principles.

Even though some aspects of the curriculum specify hands-on and minds-on processes and skills acquisition, most students are not exposed to those processes in real classroom situations. Teachers more often than not, use the traditional teaching approach which is teacher-centered and hardly gives students opportunity to actively participate in the teaching-learning process, as well as, engage in critical thinking and other 21st century skills which are known to improve motivation and achievement in school subjects. The implication is that opportunities which abound in innovative teaching strategies such as, jigsaw, process-oriented and blended learning strategies which may help teachers and students to be creative and innovative in and outside the classroom are not utilized.

Blended learning strategy has emerged as a way of addressing the ineffectiveness of conventional teaching methods by combining the advantages of autonomous e-learning with the benefits of in-person instruction in order to keep learners motivated and engaged throughout the entirety of a course or lesson. The concept of blended learning broadly refers to the combination of two or more learning methods. According to Jee and O'conor (2014), blended learning is the blending of On-line instruction with access to teacher. In a blended course students may view lectures, access readings, ask questions, and complete assignments online in virtual learning environments (VLE) like Module and through on-*line* classrooms, freeing up in-person class periods for discussions, activities and traditional lectures. Other terms, such as mixed, hybrids, or integrative learning, all describe the same method of teaching. In a recent definition, Ju and Mei (2018) posited that Blended learning is any formal education programme in which student learns at least in

part through online learning, with some elements of student control over time, place, path, and/or pace. Students do some of their learning via the internet. Blended learning is a bigger instructional shift from a face-to-face teacher to web-based content and instruction.

Blended learning strategy employs the combination of technology-based resources and traditional print materials, group or individual study; or even structured pace study and self -paced study (Nair & Bindu 2016). The blended learning approach is expected to reduce the limitation of each instructional environment and increase learning, and by mixing the advantages of face-to-face instructional technologies. Blended learning (BL) is a modern educational strategy that has replaced e-learning gradually in most educational institutions. According to Salama (2014) as cited in Suyibam (2022), BL is a logical scientifically acceptable alternative to e-learning, has higher yields, is less expensive, and incorporates more sophisticated types of learning. Blended Learning (BL) strategy aims at interactive learning, resulting in the blending or mixing of a teacher's role in a traditional classroom with that in the virtual one. This strategy provides flexibility in presenting content, it is efficient, cost-effective, it provides personalized learning; meaning that participants can study at their own pace and join face-to-face classes; it covers all learning styles and has proved to be more engaging than traditional learning for most participants (Almaseid, 2014; Alkhalee, 2019).

Blended learning strategy also has its disadvantages which include being more time-consuming in providing feedback and being expensive. Another critical issue is access to network infrastructure, many students do not have pervasive and ubiquitous access to the internet even in their classrooms. Furthermore, there are difficulties in managing group work in an online setting. Despite these challenges, blended learning strategy has some research evidences to be more effective, efficient and flexible than the traditional classroom method of teaching and learning. Again, Blended learning is relatively a new innovation that can motivate students to learn biology.

Motivation is regarded as a force that energizes, directs, and sustains behaviour (Mubeen & Reid, 2014). Learners' motivation ranges from extrinsic to intrinsic motivation in which the learner is motivated due to the challenges or the fun whenever he is doing the task. Students' changes in academic achievement are related to their learning motivation. Omrod (2011) in his study shows that students' learning motivation level is influenced by specific subjects and that they express different motivational traits in different subjects.

Students behave differently towards a particular subject or topic thus influencing their academic achievement in that subject or topic. When students are motivated in a subject, they are more likely to exhibit persevering behaviours that make them likely to succeed academically. One of the ways of maintaining students' motivation is by using active learning strategy which emphasizes active participation and learners' responsibility for discovering knowledge that is new to them. This form of learning leads to improved students' motivation and improved achievement outcomes among students.

The topic skeletal system has been featured consistently in the senior secondary certificate examinations over the years. The chief examiners' reports of 2016 and 2017 revealed that students achieved poorly in questions regarding the skeletal system in the examinations. In some instances, the students avoided answering questions on the topic. The West African Chief Examiner's report showed that most of the students had difficulties in understanding the subject matter. Ogbonna (2016) also opined that poor teaching methods, lack of instructional materials, as well as, lack of teaching skills by science teachers, were among the reasons for these poor results. Biology students find it difficult to engage in tasks that require high cognitive thinking, therefore, they find it difficult to achieve well in tasks that require them to apply, analyze, synthesize and evaluate within the context of Bloom's taxonomy of educational objectives.

The causes of failure in Biology include amongst others, difficult biology concepts and teachers' use of inappropriate teaching strategies, such as, the traditional teaching method which is a teacher-centered instructional strategy where learners are more often than not, passive listeners as posited by Suyibam (2022). This method of teaching involves repetition and memorization of previously taught materials by filling the students' minds with the knowledge of biological concepts without explaining in detail the processes of analyzing, evaluating and arriving at a conclusion. This obviously leads to underachievement in the subject.

The problem of this study was to find out if blended learning strategy as an identified teaching strategy could improve the motivation and achievement of secondary school students in skeletal system in the post-COVID-19 twenty-first century. Specifically, the objectives were to:

1. Determine the difference between the mean achievement scores of students taught Biology using blended learning strategy and those taught using lecture method.

2. Investigate the difference between the mean motivation scores of students taught Biology using blended learning strategy and those taught with the lecture method.

To realize the objectives, the following research questions were answered and hypotheses tested, respectively.

1. What is the difference between the post-test mean achievement scores of students taught skeletal system using blended learning strategy and those taught using the lecture method?
2. What is the difference between the post-test mean motivation scores of students taught with blended learning strategy and those taught with the lecture method?

Two research questions and two hypotheses guided the study.

1. There is no significant difference between the post-test mean achievement scores of students taught biology using blended learning strategy and those taught using lecture method.
2. There is no significant difference between the post-test mean motivation scores of students taught with blended learning strategy and those taught with the lecture method.

Method

The study adopted the pre-test, post-test quasi-experimental research design. The population of the study comprised 2,615 senior secondary two students during 2020/2021 session in 20 public (co-educational) senior secondary schools in Bauchi metropolis, Bauchi State, Nigeria. The sample for the study was made up of 92 SS two students in two intact classes from two public secondary schools in the area of study. The intact classes were randomly assigned to an experimental group and a control group, respectively.

Biology Achievement Test in Skeletal System (BATSS) structured by the researchers was used to collect data from students. The BATSS items based on the sub topic on skeletal system were adapted from the West African Examinations Council Senior Secondary Certificate past Examinations questions. The BATSS comprised three sections, namely, sections, A, B and C. Section A solicited students' bio-data; section B comprised 30 multiple choice questions with options A-D while section C had 10 fill in-the-blank items. The BATSS was administered as pre-test to the experimental and control groups before exposing them to the blended learning strategy and lecture method, respectively.

Two regular senior secondary two (SSII) biology teachers in each of the sampled schools for the research were trained by the researchers on the blended learning strategy for three days. One of the teachers taught the experimental group the concept of skeletal system, parts of the skeletal system, location and arrangement of the skeletal system, the vertebral column, a typical vertebra, examples and features of each vertebra from different parts of the skeletal system and functions of the skeletal system, using blended learning strategy for four weeks, while the second teacher was on standby. In using the blended learning strategy, the teachers for experimental group, directed students in the experimental group on how to search information on-line on the skeletal system, in addition, the teacher sent videos and slides on-line to the students on the fore-going aspects of the skeletal system which they downloaded and studied individually, ahead of class discussions, questioning and answering sessions, and, face-to face teaching/lecture method of the said concepts in the classroom. One of the regular teachers in each of the sampled school who was not trained in the use of blended learning strategy taught the control group the same concept (skeletal system) for the same number of weeks with the lecture method (in combination with questioning and answering technique and discussion method). At the end of the teaching period the BATSS was re-administered to both the experimental and control groups as post-test.

The 40 questions in the BATSS were allotted one mark each bringing the total score to 40. The BATSS was validated by three experts, two in Biology education and one in Research, Measurement and Evaluation Unit of the Faculty of Education, University of Jos. The reliability of each of the instruments (SMSSS and BATSS) was established using Kuder-Richardson formula 20 with internal consistencies of 0.85 and 0.92, respectively. The scores from both groups of students were collated after scoring their scripts and analyzing the data using SPSS version 25.0. Research questions were answered using mean and standard deviation while hypotheses were tested using Analysis of Covariance at 0.05 level of significance.

Results

Table1: Mean Achievement Scores of Students taught Biology using Blended Learning Strategy and Lecture Method

Group	N	$\overline{X}_1$	SD_1	$\overline{X}_2$	SD_2
Experimental	50	20.00	1.42	68.96	3.16
Control	42	19.83	1.59	36.36	12.37
Mean Difference		**0.17**		**32.60**	

From the data on Table 1, students in the experimental group had a pre-test mean achievement score of 20.00 with SD 1.42 and a post-test mean achievement score of 68.96 with SD 3.16, while their counterparts in the control group had a pre-test mean achievement score of 19.83 with SD 1.59 and a post-test mean achievement score of 36.36 with SD 12.37. The post-test mean difference between the experimental and control group is 32.60.

Table 2: Mean Motivation Scores of Students taught Biology using Blended Learning Strategy and Lecture Method

Group	N	$\overline{X}_1$	SD_1	$\overline{X}_2$	SD_2
Experimental	50	33.78	6.35	86.68	9.56
Control	42	26.31	7.03	33.67	11.00
Mean Difference		**7.47**		**53.01**	

Table 2 reveals the mean motivation scores and standard deviations of students taught Biology using blended learning strategy (experimental group) and those taught using lecture method (control group). Students in the experimental group had a pre-test mean motivation score of 33.78 with SD 6.35, and post-test mean motivation score of 86.68 with SD 9.56. The control group had a Pre-test mean motivation score of 26.31 with SD 7.03 and a post-test mean motivation score of 33.67, with SD 11.00. The post-test mean difference between the experimental and control groups is 53.01. The findings show that students in the experimental group exposed to blended learning strategy had higher motivation towards skeletal system than their counterparts in the control group who were taught skeletal system using lecture method.

Table 3: Summary of ANCOVA Results of Post-test Achievement in the Experimental and Control Groups

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	24403.854[a]	2	12201.927	164.029	.000	.787
Intercept	2448.354	1	2448.354	32.913	.000	.270
Pretest	140.950	1	140.950	1.895	.172	.021
Group	24393.744	1	24393.744	327.922	.000	.787
Error	6620.613	89	74.389			
Total	300053.000	92				
Corrected Total	31024.467	91				

a. R Squared = .787 (Adjusted R Squared = .782) b. Computed using alpha = .05

Data on Table 3 show that $F(1,89) = 327.92$, $p < 0.05$, partial $\eta 2 = .787$. Since the p-value of 0.000 is less than 0.05 level of significance with a high effect size (79%), the null hypothesis was rejected, indicating that there was a significant effect of blended learning strategy on students' achievement in Biology. Also, the pre-test (covariate) yielded $F(1, 89) = 1.89$, $p = .172$, which was not significant, indicate no significant difference in the achievement mean score between the experimental and control groups before treatment. The result further reveals an adjusted R squared value of .782 which means that 78.2 percent of the variation in the dependent variable which is achievement is explained by variation in the treatment, while the remaining is due to other factors not included in this study.

Table 4: Result of Sidak Post hoc Comparison of Difference between the mean Achievement Score in the Experimental and Control Groups

I Experimental	J Control	X-diff. (I – J)	Std. Error	p- value
69.02	36.28	32.74	.81	0.000

P<0.05

The Sidak post hoc test in Table 4 confirms that the corrected difference between experimental group and control group was statistically significant, (I-J) = 32.74. Hence, it could be said that blended learning strategy increased students' achievement in skeletal system.

Table 5: Summary of ANCOVA Results of Post-Test Motivation in the Experimental and Control Groups

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	64668.202[a]	2	32334.101	322.444	.000	.879
Intercept	10267.935	1	10267.935	102.395	.000	.535
Pretest	517.459	1	517.459	5.160	.026	.055
Group	43814.508	1	43814.508	436.930	.000	.831
Error	8924.754	89	100.278			
Total	432718.000	92				
Corrected Total	73592.957	91				

a. R Squared = .882 (Adjusted R Squared = .876)
b. Computed using alpha = .05

Table 6: Result of Sidak Post hoc Comparison of Difference between the Motivation Mean score in the Experimental and Control Groups

I Experimental	J Control	X-diff. (I – J)	Std. Error	p- value
85.45	36.13	50.32	2.41	0.000

P<0.05

Data on Table 6 show that F (1,89) = 436.93, p < 0.05, partial η2 = .831. Since the p-value of 0.000 is less than 0.05 level of significance with a high effect size (83%), the null hypothesis was rejected, indicating that there was a significant effect of blended learning strategy on students' motivation towards skeletal system. On the contrary, the pre-test (covariate) yielded F (1, 89) =5.16 , P = .026, which was significant, indicating a significant difference in motivation mean score between the experimental and control groups before treatment, although both levels of motivation were low. The result further reveals an adjusted R squared value of .876 which means that 87.6 percent of the variation in the dependent variable which was motivation was explained by variation in the treatment, while the remaining was due to other factors not included in this study. The Sidak post hoc test in Table 4.9 confirms that the corrected difference between experimental group and control group was statistically significant, (I - J) = 50.32. Hence, it could be said that blended learning strategy increased students' motivation towards skeletal system.

Discussion

The findings of this research indicated that there was a significant difference between the post-test mean achievement scores of students taught skeletal system using blended learning strategy and those taught using lecture method in favour of the former. The result is in line with the finding of Martins (2019) who investigated the effect of blended and lecture method on cognitive achievement of 9th grade science students. The result of this study showed that the students taught using the blended method had better mean score as compared to those who were taught using the lecture method.

Findings from the study also revealed a significant difference between the post-test mean motivation scores of students taught biology using blended learning strategy and those taught using the lecture method. The finding agrees with that of Gimba and Agwagha (2013) on effects of computer assisted instruction package on students' motivation and achievement in Mathematics set theory, where the experimental group achieved better than the control group.

Improvement in motivation and achievement of students exposed to blended learning strategy was not surprising because the strategy was interactive and engaged students in critical reflection, creative thinking and collaborative activities, as well as, in-depth understanding of the concepts taught.

The implication of the findings of this study is that blended learning takes advantage of both face- to-face and online teaching methods which are commendable for 21st century science teaching and learning in post COVID-19 era. Moreover, the emergence of COVID-19 crisis has made it mandatory for education systems globally to use virtual or alternative strategies of teaching and learning to face-to face instruction. There is therefore, a need for structural change in the ways of science instructional delivery to guard against such setbacks in the post COVID-19 twenty first century and beyond, to ensure that they do not grow into larger and long-lasting problems that could disrupt science instructional delivery. One effective way of achieving this is through the application of blended learning strategy, particularly, in teaching abstract and perceived difficult science concepts, such as the skeletal system.

Conclusion

From the findings of the study, it is shown that the blended learning strategy has the capacity to improve students' motivation and achievement in skeletal system.

Recommendations

Based on the findings of the study, it was recommended that:

1. Blended learning strategy should be used to teach the skeletal system and other abstract biology concepts in post Covid 21st century for improved achievement.
2. Biology teachers should use the blended learning strategy to motivate students for the study of skeletal system and other perceived abstract concepts in biology.
3. There should be training and re-training of teachers on the use of blended learning strategy at professional conferences, such as those of the Science Teachers Association of Nigeria (STAN) and the Curriculum Organisation of Nigeria (CON).
4. The biology curriculum should be reviewed to include the use of blended learning strategy and technologies in biology instruction.

References

Alkhalee, A. (2019). The Advantages of using blended learning in studying English as a foreign language at the University of Tabuk. *Modern Journal* of *Language Teaching Methods (Mjltm) 2* (5) 78-86.

Almasaeid, T. F. (2014). The effect of using blended learning strategy on achievement and attitudes in teaching science among 9th grade students. *European Scientific Journal November* 10 (3) 54-59.

Federal Republic Nigeria (2014). *National policy on education*. Yaba Lagos Nigeria: NERDC Press.

Gimba, R.W & Agwagah, N.V. (2013) Effect of computer assisted instructional package on students' achievement in mathematics set theory. *Institute of Educational Evaluation and Policy Analysis 22* (2), 120-145.

Jee, R. Y., & O'Connor, G. (2014). Evaluating the impact of blended learning on performance and engagement of second language learners. *International Journal of Advanced Corporate Learning, 7* (3), 12. DOI. 10.3991/ijac. v713.3986.

Ju, S. Y, & Mei, S. Y. (2018). Perceptions and practices of blended learning in foreign language teaching at USIM. *European Journal of Social Sciences Education and Research (*12)1.

Lee, R.M. (2019). Effects of blended learning and lecture strategy; *Out of field teaching and the limits of teachers' policy: A Research report.* Washington DC: Centre for the study of Teaching and policy, University of Washington.

Martins, K. (2019). Effects of blended learning and lecture methods on the cognitive achievement of integrated science students. *Journal of Science Education, London,* 35 (2), 31-42.

Mubeen, S., & Reid, N. (2014). The measurement of motivation with science students. *European Journal of Educational Research, 3* (3), 129-144.

Nair, T. S. & Bindu, R.L. (2016). Effect of blended learning strategy on achievement in biology and social and environmental attitude of students at secondary level. *Journal on School Educational Technology, 11,* 39-52.

Nwagbo, C.R., & Okoro, A.U. (2012). Effect of interaction patterns on achievement in biology among secondary school students. *Journal of Science teachers Association of Nigeria, 47* (1), 22-32.

Omar, M., Syed-Abdullah, S., & Hussin, N. M. (2011). eTiPs: A rule-based team performance prediction model prototype. *Procedia Technology, 1*, 390 – 394.

Omrod, J.E. (2011). *Educational Psychology: Developing learners*. Colorado: Pearson.

Sarabadani, Z. & Berenjian, A. (2017). The role of blended learning on student performance in biotechnology course. *American Journal of biochemistry and* Biotechnology, 13 (3), 111-113.

Suyibam, D.D. (2022). *Effects of blended learning strategy on senior secondary two students' motivation and achievement in skeletal system in Bauchi metropolis, Bauchi State, Nigeria*. Unpublished M.Sc. (Ed.) Thesis, University of Jos, Nigeria.

West African Examinations Council (WAEC (2016-2018). *Chief examiners report*. Yaba, Lagos.