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# Enhancing Students' Achievement in Basic Science Using Blended Learning Strategy

**Stephen Chinedu Nwafor[1], Theophilus Sunday Chima[2], Destiny Onyebuchi Ekoyo[3], Anthony Chikwado Odo[4]**

[1,3]Department of Science Education, Nnamdi Azikiwe University, Awka, Anambra State, Nigeria
[2,4]Department of Science Education, University of Nigeria, Nsukka, Enugu State, Nigeria

**E-mail:** sc.nwafor@unizik.edu.ng

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## Abstract

The investigation explored the effect of blended learning on basic science students' performance. Additionally, the study determined how gender affects students' learning outcomes when utilizing a blended learning strategy. This study took place in Aguata Education Zone of Anambra State. Across the 50 public secondary schools that composed the Zone, 2,950 Upper Basic VIII students comprised the population. For the study, a sample size of 97 students (39 males & 58 females) was employed. Two of the Zone's three Local Government Areas (LGAs) were sampled using a simple random sampling technique. Additionally, one coeducational school was chosen from the two sampled LGAs and assigned to the experimental and control groups using a purposive sampling technique. The data collection tool was the Basic Science Achievement Test. BSAT was discovered to have a dependability index of 0.81 using Kuder-Richardson 20 (K-R20). The mean and standard deviation were used to answer the study questions, and the covariance (ANCOVA) analysis was used to evaluate the hypotheses at the 0.05 significance level. The study's findings showed that students' achievement in basic science is significantly improved when a blended learning strategy is used instead of a traditional lecture format. Furthermore, when teaching basic science using a blended learning approach, there is no appreciable difference in the mean achievement scores of male and female students. The researchers made several recommendations, such as that basic science and other courses should be taught by teachers using the BLS. The pre-service and in-service teacher should be provided with basic ICT training through conferences and seminars.

## Introduction

The field of fundamental (basic) science encompasses cells, inheritance, molecules, microorganisms, viruses, tissues, organs, and the examination of ecosystems. The pedagogical approach to teaching and learning basic science integrates various scientific disciplines by articulating and presenting scientific concepts and principles as foundational components of scientific methodology. Basic science encompasses the exploration of fundamental physics, biology, chemistry, ecology, the earth/solar system, genetics, and physics as an entirety (Omiko, 2016). Okebukola and Okebukola (2018) characterize basic science as the essential concepts, theories, and practices of science that are imperative for nurturing scientific literacy, critical thinking, and problem-solving skills, as well as for establishing the groundwork for future scientific inquiry and progress.

Basic science is taught at the lower level of education in Nigeria, which consists of junior secondary school (1-3) and primary school (1-6). As such, it is the core component of scientific education that concentrates on imparting the basic knowledge needed to understand science. It is anticipated that all children will gain a fundamental knowledge and comprehension of science, along with an awareness of some of the innovations occurring in their environment, by receiving instruction in the subject at the lower education level. This aforementioned statement aligns with the purpose of science learning at that Level, as articulated by FRN (2014). These goals include developing people who can function well in the current scientific and technological era and support national development. Specific science process skills like observation, information organization, generalization, prediction, and experiment design for inference are among the skills that students can learn. In a similar vein, the themes covered in the curriculum are rich, appropriate, and connected. At the JSS level, the curriculum aims to help students become interested in scientific aspects of life, develop basic science and technology skills, apply specific as well as technical knowledge, and prepare them for science and technology-related future studies (Federal Republic of Nigeria, 2007). The right teaching of basic science is necessary to meet these goals.

Basic science is important, but students' achievement in it has been inconsistent and low over time. Academic achievement, according to Annie (2021), is the outcome of instruction and based on the achieved learning objectives. It is typically assessed through exams or ongoing evaluation. Academic achievement is the measure to which an individual's intelligence is demonstrated. It serves as a gauge of how much or what level of knowledge a particular learner has in a particular subject. This suggests that learning and teaching processes result in academic achievement. According to the students' achievement report in basic science kept by the Examination Development Center (EDC) Awka, Anambra State (2017–2022), only an average of (2.71%) students passed with distinction during the period under review in this study. This indicates that in the subject student’s achievement has been declining in Anambra State. However, only 45.9% of students on average passed with credit—that is, less than half.

Numerous factors that influence students' achievement in basic science have been identified by researchers. For example, low study habits, poor teaching methods, parents' low educational attainment, parents' low monthly income status, stress, students' negative attitudes toward science subjects, the mode of instruction, the lack of instructional materials, poor classroom management, and a shortage of qualified basic science teachers are some of the factors contributing to the decline in science student achievement, according to Jetu and Wariso (2019) and Agbidye (2015). Furthermore, Odukwe and Nwafor's (2022) research revealed that, in spite of calls for the integration of online learning tools, secondary school teachers continue to employ the lecture method exclusively, which discourages students from actively participating in the instruction

processes. To enhance students' learning outcome, Olatunde-Aiyedun and Adams (2022) recommended that teachers employ teaching strategies that combine the utilization of online and face-to-face approaches to instruction. The blended learning strategy is one of these tactics.

A BLS is a way of teaching that uses technology in addition to conventional teaching techniques to improve student learning outcomes. The value of technology in accomplishing various educational objectives has been demonstrated in literature (Boe, 2018). As a result, blended learning combines traditional teaching methods with technology (such as the internet, video, and audio devices). In a similar vein, Mahrlamova and Chabanovych (2022) said that blended learning is a tactic that combines traditional methods with online learning to accomplish various educational objectives. It makes learning adaptable by promoting student-centered learning and improving appropriate instructor supervision (Singh et al., 2021). A blended learning approach encourages student participation, motivation, feedback (Kumar et al., 2021), simple access to learning materials (Mustafa, 2023; Lalima & Lata Dangwal, 2017), and communication between students and their teachers (Warner, 2016; Boelens, De Wever & Voet, 2017). Students will study within the time range of the objectives because of this. By combining technology and multimedia with traditional classroom instruction, students will be forced to improve their areas of weakness through productive interactions with both their teacher and they. Students' ability to retain information will inevitably improve as a result. Singh et al. (2021) noted the swift shift in educational practices toward blended learning on a global scale. However, adequate planning and a sufficient number of digital tools and facilities are necessary for its use in developing nations, particularly Nigeria. According to studies, Nigerian public schools face numerous challenges in implementing the blended learning strategy (Olusola & Akinwumi, 2020), including inadequate internet access, a shortage of computers, tablets, and iPads, and a lack of electricity (Nwafor, Ibe & Muoneke, 2022; Afolabi & Afolabi, 2016). Notwithstanding these difficulties, research has also shown that the blended learning approach may improve students' learning outcomes.

For instance, the academic achievement of undergraduate students is significantly impacted by blended learning, according to Gambar, Shittu, Ogunlade, and Osunlade (2017). From Saadu (2022), students' academic performance in social studies is significantly impacted by the blended learning approach. In order to ascertain the impact of the blended learning approach on student accomplishment, Utami (2018) employed a pretest and posttest randomized design with a 35-question objective test. To analyze the data, the t-test, mean, and SD were used. The outcome demonstrated that students' accomplishment levels were higher with the BLS compared to the CLM. The effectiveness of blended learning in improving comprehension, commitment, critical thinking skills and performance was emphasized by Garrison and Vaughan (2018) and Picciano (2019). Nonetheless, the significant impact of demographic variables, such as gender and place of residence, on opinions of the efficacy of blended learning must be considered in educational design (Karsenti et al. 2017). BLS is a digital learning era teaching style that, according to Hubackova and Semradova (2016), supports both online and physical BL modes that combine online resources for self-directed preparation and in-person instruction from teachers. Also, Zrekal's (2021) experiment study conducted at Arab Open University in Saudi Arabia, blended learning both improves student learning outcomes and helps students acquire foreign languages more casually. According to Saba, Odediji, and Chiroma's (2022) findings, students exposed to blended learning outperformed those taught conventionally, and no discernible gender disparity in the achievement of these students. Each group achievement varies statistically significantly, and students' contentment with the e-learning system is unaffected by gender or the educational system, claim Lee and Hung (2015). An investigation titled "the impact of BLS on students' achievement in physics" was carried out by Onyenma and Abraham (2020) at Federal Colleges of Education in South-East Nigeria. Blended

learning improved the performance of the study's Physics participants, and the results showed that student performance was independent of gender.

A cultural role known as gender serves to differentiate between men and women. According to Ifelunni (2018), gender refers to a person's identity as a man or a woman as well as the roles and behaviors that are expected of them. Among other places, our homes, workplaces, and other spaces are affected by it. Gender, as defined by Tolland and Evans (2019), is a social construct that encompasses traits and actions associated with both masculine and feminine traits. Teachers and researchers are still interested in the sway of gender on learning outcome, particularly in the scientific fields. This is due to the fact that, in Nigeria, science subjects are gender stereotyped by educational stakeholders to favor men, which has an adverse effect on girls' negative attitudes toward science, according to Ifelunni (2018). Similar to this, Okorie and Ezeh (2016) pointed out that because gender issues have persisted in several research findings, gender is now a crucial topic in every academic discourse aimed at raising student achievement. This is because gender issues are a concern for researchers, educationists, and psychologists. For example, research by Onyi, Njoku, and Nwafor (2022) and Makarova, Aeschlimann, and Herzog (2019) discovered that males significantly achieve more in science subjects the females, while research by Eze, Egbo, and Omeje (2018) revealed that girls performed significantly better than boys. Ezeudu et al. (2019), on the other hand, found no discernible difference between male and female achievement. Hanan, Maie-Anne, and Lori (2015) also found that a student's performance in both in-person and online college algebra courses is not significantly impacted by their age or gender. From the aforementioned, it is clear that gender has had a variable impact on students' science achievement and has not skewed any one way, as evidenced by the conflicting findings of researchers. However, the present study fills this literature gap because none of the previous research has looked into how gender affects basic science students' achievement when taught using a BLS.

## Objectives of the Study

1. Mean achievement scores of students in basic Science when taught blended learning strategy and conventional lecture method.
2. Mean achievement scores of male and female students' achievements in basic science when taught using blended learning strategy.

## Research Questions

1. What are the mean achievement scores of students taught basic science using blended learning strategy and those taught with conventional lecture method?
2. What are the mean achievement scores of male and female students' achievements in basic science when taught using blended learning strategy?

## Hypotheses

1. There is no significant difference in the mean achievement scores of students taught basic science using blended learning strategy and those taught with conventional lecture method.
2. There is no significant difference between the mean achievement scores of male and female students' achievements in basic science when taught using blended learning strategy.

## Methods

A Quasi-experimental research design was utilized. In particular, the non-equivalent control group design with pre- and post-tests was applied. Intact classes were utilized because it is not feasible to assign participants at random to the experimental and control groups., which made

this design appropriate, according to Nworgu (2018). This study took place in Anambra State's Aguata education zone. 2,950 upper basic VIII students from the 50 public secondary schools in the zone comprised the population (1,300 males and 1,650 females). 97 upper basic VIII students offering basic science (39 males and 58 females) made up the study's sample. Two local government areas (LGA) were chosen using the sample random sampling technique; one co-educational school was chosen from each of the two sampled LGAs using purposive sampling, as gender was a variable in the research. At random, one school was placed in the experimental group and the other in the control group.

The Basic Science Achievement Test (BSAT), which comprises 25 objective questions derived from previous Basic Education Certificate Examination (BECE) questions, was the tool used to collect the data. Along with the lesson plan, research questions, table of specifications, study purpose, and hypotheses, the instrument was validated by a pair of specialists from the Department of Science Education (Integrated Science Unit) and one from the Department of Educational Foundation (Measurement and Evaluation Unit) at Nnamdi Azikiwe University in Awka, Anambra State. The BSAT yielded a reliability index of 0.81 when Kuder-Richardson 20 (K-R20) was used.

Two teachers of upper basic science served as research assistants during the experiment. While the experimental group was instructed using a BLS, students in the control group used the CLM. Seven weeks were allotted to the study. The purpose of the researchers' first week-long visitation to the schools was to acquaint themselves with the research assistants and participants and to begin training them. A BSAT pre-test was given in the second week, and treatment continued through the 6$^{th}$ week, with the post-test administered in the 7$^{th}$ week. The lesson plan served as the guide for the teacher in the experimental group that received training on the fundamentals of the BLS. In this study, the blended learning strategy is implemented by the teacher who divides the students into groups, assigns leaders, and creates a WhatsApp group for each group. Then the instructor admonished the students using the online resource by first using a face-to-face approach. And so, through the WhatApp page made specifically for this study, the class group received links to YouTube videos covering each lesson. As they engage with one another, the students pose the appropriate queries. When the class reconvenes in person, the group leaders are permitted to summarize the online session's conversation. Additionally, in both the physical and online learning, the instructor engages with the students. Afterwards, the teacher uses the same method to go over the material for the following lesson while answering any questions the students may have. For this reason, the teachers facilitate the activities and provide a summary at the conclusion of each lesson. Data from the pretest and posttest were gathered, and analysis was done. Utilizing the mean and standard deviation, the questions were addressed, and the analysis of covariance (ANCOVA) was employed for the hypotheses at 0.05 level of significance.

## Results

The study's findings are arranged in accordance with the hypotheses and research questions:

**Research Question One:** What are the mean achievement scores of students taught basic science using blended learning strategy and those taught with conventional lecture method?

**Table 1: Pre-test and post-test mean, and standard deviation achievement scores of students taught basic science using BLS and those taught with CLM**

| Methods | Pre-test | | | Post-test | | |
|---|---|---|---|---|---|---|
| | N | Mean | SD | Mean | SD | Mean Gain |
| BLS | 42 | 39.83 | 9.81 | 75.24 | 5.52 | 35.41 |
| CLM | 55 | 36.05 | 7.51 | 59.13 | 4.42 | 23.08 |

According to Table 1, the students who received basic science instruction using BLS had mean achievement scores of 39.83 with an SD of 9.81 for the pre-test and 75.24 with a SD of 5.52 for the post-test. The mean gain for students who get instruction utilizing BLS is 35.41. On the other hand, the mean achievement score of students who received basic scientific instruction through CLM was 36.05 with a standard deviation of 7.51 prior to the exam, and 59.13 with a standard deviation of 4.42 following the test. The mean gain for students taught with CLM was 23.04. Students in the two groups have mean achievement scores that are 12.33 different, with BLS having the advantage. The outcome suggests that students who received basic science instruction using BLS performed better than those who received instruction using CLM. As a result, BLS outperforms CLM in raising students' achievement in basic science.

**Hypothesis One:** There is no significant difference in the mean achievement scores of students taught basic science using blended learning strategy and those taught with conventional lecture method.

**Table 2: Analysis of covariance (ANCOVA) of the significant difference in the mean achievement scores of students taught basic science using strategies**

| Source | Type III Sum of Squares | Df | Mean Square | F | Sig. | Partial Eta Squared | Dec. |
|---|---|---|---|---|---|---|---|
| Corrected Model | 6246.491[a] | 2 | 3123.245 | 131.271 | .000 | .736 | |
| Intercept | 18633.532 | 1 | 18633.532 | 783.174 | .000 | .893 | |
| Pretest | 65.250 | 1 | 65.250 | 2.742 | .101 | .028 | |
| Strategies | 5630.282 | 1 | 5630.282 | 236.643 | .000 | .716 | Sig. |
| Error | 2236.478 | 94 | 23.792 | | | | |
| Total | 432336.000 | 97 | | | | | |
| Corrected Total | 8482.969 | 96 | | | | | |

Table 2 indicates that F (1, 94) = 236.643, P = 0.000 < 0.05 alpha level, thereby leading to the rejection of hypothesis 1. The conclusion drawn is that a statistically significant disparity exists between the mean achievement scores of students instructed in basic science utilizing the BLS and those instructed via the CLM, favoring the BLS cohort. Regarding effect size, Table 2 also shows that the instructional treatment accounts for Partial Eta Squared =.716 (71.6%) of the variance in the students' performance scores in Chemistry, which is significant enough to be considered effective.

**Research Question Two:** What are the mean achievement scores of male and female students' achievements in basic science when taught using blended learning strategy?

**Table 3: Mean and standard deviation of the pre-test and post-test achievement scores of male and female students in basic science when taught using BLS**

| BLS | Pre-test | | | Post-test | | |
|---|---|---|---|---|---|---|
| | N | Mean | SD | Mean | SD | Mean Gain |
| Male | 17 | 38.29 | 8.49 | 76.00 | 5.70 | 37.71 |
| Female | 25 | 40.88 | 10.65 | 74.72 | 5.44 | 33.84 |

According to the data in Table 3, male students who received basic science instruction using the BLS had a pre-test mean achievement score of 38.29 with a standard deviation of 8.49 and a post-test mean achievement score of 76.00 with a standard deviation of 5.70, whereas female students had a pre-test mean score of 40.88 with a standard deviation of 10.65 and a post-test mean score of 74.72 with a standard deviation of 5.44. The mean gain between the pre-test and post-test for male and female Chemistry students was 37.71 and 33.84, respectively, indicating that male students performed slightly better than their female counterparts when given basic science instruction using the BLS.

**Hypothesis Two:** There is no significant difference between the mean achievement scores of male and female students' achievements in basic science when taught using blended learning strategy.

**Table 4: Analysis of covariance (ANCOVA) of the significant difference in the mean achievement scores of male and female students taught basic science using BLS and gender**

| Source | Type III Sum of Squares | Df | Mean Square | F | Sig. | Partial Eta Squared |
|---|---|---|---|---|---|---|
| Corrected Model | 17.038[a] | 2 | 8.519 | .270 | .765 | .014 |
| Intercept | 13080.602 | 1 | 13080.602 | 414.555 | .000 | .914 |
| Pretest | .459 | 1 | .459 | .015 | .905 | .000 |
| Gender | 17.019 | 1 | 17.019 | .539 | .467 | .014 |
| Error | 1230.581 | 39 | 31.553 | | | |
| Total | 239000.000 | 42 | | | | |
| Corrected Total | 1247.619 | 41 | | | | |

Table 4 shows that when BLS is used to teach basic science, the probability associated with the calculated F value (.539) for the mean achievement scores of male and female students is.467. The null hypothesis is not disproved because the probability value of.467 is greater than the 0.05 significance level ($p > .05$). Therefore, it can be said that students' mean achievement scores in basic science are not significantly impacted by gender. The effect size shown in Table 4, which shows that the effects of gender account for Partial Eta Squared =.014 (1.4%) of the variance in students' success scores, supports this conclusion even more.

## Discussion

The results of the study showed that students who received basic science instruction using BLS did better than those who received instruction using CLM. Further research showed that the mean achievement scores of students who received basic science instruction utilizing BLS versus

CLM differed statistically significantly, with the BLS group outperforming the CLM group. Furthermore, an effect size determined using the Partial Eta squared method indicates that the treatment was responsible for 71.9% of the students' basic science achievement scores. This may be the case because BLS creates the circumstances for student engagement with the curriculum, interaction, and active learning—all of which improve academic achievement—by combining in-person instruction with virtual learning activities. These findings support the theory of cognitive development put forth by Vygotsky in 1978 that stressed the importance of social (communications) interactions in the process of cognitive development. It states unequivocally that individuals build their own knowledge and perceptive of the society through actively exploring, relating with others, and reflecting on their learning experiences. Alsalhi, Eltahir, and Al-Qatawneh (2019), López-Pérez et al (2017) and Khader (2016), concur with the study's conclusions that when comparing students in blended learning groups to those in traditional learning groups, the former group's students performed better in the sciences. The study's results are consistent with those of Cifti (2020), who found that, when compared to traditional classroom settings, blended learning significantly affects students' attitudes and academic performance in social studies courses. Additionally, in line with the results of this study, Owo and Ihua-Maduenyi (2020) discovered that students' post-achievement scores increased significantly when they used a blended learning technique. However, Irwan, Angraini, and Tiara (2020) claimed that the use of blended learning does not considerably raise university students' academic performance.

The findings of this research indicated that when basic science is taught utilizing a blended learning approach, male students do marginally better than their female counterparts. Further investigation, however, showed that when BLS is used to teach basic science, there is no discernible difference in the performance of male and female students. Additionally, the partial eta squared showed that gender accounts for 1.4% of the variation in students' academic performance. This might be as a result of BLS being a gender-neutral approach that gives both male and female students the chance to experiment with the learning processes. Regardless of the gender of the students, it also guarantees efficient use of the learning resources. This is similar to the findings of Diovu, Ogbonna, and Eze (2021), who found that gender had no discernible impact on senior secondary school students' mathematical achievement and that BLS has a major effect on students' achievement. The study's results were likewise in line with those of Abidoye (2015), who found that gender had no discernible impact on students' academic performance when they are taught utilizing a blended learning approach. The study's results, however, contradict those of Nichols (2010) and Rouhollah and Shaffer-bin (2014), who believed that when students are taught courses using a blended learning technique, gender has a major impact on their academic progress. Similarly, Godpower-Echie and Owo (2019) stated that there exists significant variation in the academic performance of male and female students in basic science. Similarly, the results of the current study contradict those of Ajai and Imoko (2015) and Khader (2016), who found a significant difference in post-achievement ratings between male and female students in science and mathematics, respectively.

## Conclusion

The conclusion derived from the investigation is that the utilization of BLS is more efficient in enhancing students' achievement in basic science. The implication is that incorporating BLS in science instruction could enhance students' academic achievement and foster meaningful learning regardless of gender.

## Recommendations

The researchers suggested that, in light of the study's findings:

1. Pre-service and in-service teachers should get refresher training on the basics of BLS and ICT usage through conferences and workshops.
2. Basic science teachers should implement the BLS in their instruction, as should other educators.
3. Facilities for information and communication technology should be made available to guarantee that the BLS is used.
4. To ensure that students achieve more, the strategy should be included in the curriculum by the curriculum planners.

## Conflict of Interest

No conflict of interest is declared by the authors.

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