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Effect of Blended Learning Strategy On Academic Performance and Knowledge Retention Among Grade Eight Basic Science Students in Makurdi Metropolis

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Abstract: *This study investigated the effect of blended learning strategy on the academic performance and knowledge retention of Grade Eight students in Basic Science in Makurdi Metropolis. The population comprised 1,613 Grade Eight students from 25 government-approved public secondary schools under the State (SUBEB). A sample of 59 students drawn from two intact classes in two selected schools obtained by multistage sampling. A quasi-experimental pretest–posttest control group design was adopted. The instrument for data collection was the Basic Science Achievement Test (BSAT), validated, trial-tested and subjected to reliability analysis using Kuder Richardson (KR)-21 yielding reliability coefficient of 0.92. Two research questions and two hypotheses guided the study. Data were collected using pretest, posttest, and a two-week retention test. Data were analyzed using Mean and standard deviation to answer the research questions, while Analysis of Covariance (ANCOVA) was employed to test the hypotheses. The Findings revealed that no significant difference in the mean academic performance of Grade Eight students taught Basic Science through blended learning and those taught using traditional approach ($F(1,67) = 17.95$, $p < .05$, Partial $\eta^2 = 0.211$) indicating that student taught using blended learning achieved higher academic performance than those taught using the traditional method. Similarly, no significant difference in knowledge retention among Grade Eight students ($F(1, 67) = 19.18$, $p < .05$, Partial $\eta^2 = 0.223$). Showing that blended learning had a significant positive effect on knowledge retention among students exposed to blended learning. The study concludes that blended learning strategy significantly enhances both academic performance and retention in Basic Science. It is therefore recommended that teachers integrate blended learning approaches into Basic Science instruction to improve students' learning outcomes.*
Keywords: blended learning, academic performance, knowledge retention, basic science, grade eight students.

INTRODUCTION

Education is widely recognized as the cornerstone of national development because it equips an individual with the appropriate knowledge, skills, values, and competencies required to contribute meaningfully to society at large. Beyond the transmission of knowledge, education nurtures

critical thinking, creativity, innovation, and problem-solving abilities through science education that enable learners to respond effectively to social, economic, and technological challenges (Biesta, 2017) as cited in Fatoki et al., 2026.

Science education is central to preparing learners for the demands of the 21st century, equipping them with the knowledge, skills, and attitudes needed to understand and solve real-world problems. At the lower secondary level (Grade Eight), Basic science serves as a foundation for higher studies in biology, chemistry, and physics, while also nurturing critical thinking, inquiry skills, and technological literacy (UNESCO, 2023). However, despite its importance, science education at this stage often faces challenges that hinder effective learning, including reliance on rote memorization, limited access to laboratory facilities, overcrowded classrooms, and insufficiently engaging instructional methods (Afolabi, 2021), particularly in the teaching and learning of Basic Science.

Basic Science is one of the core subjects in junior secondary schools, designed to provide students with foundational knowledge in scientific concepts, inquiry skills, and attitudes necessary for further study in science and technology-related fields. It integrates concepts from biology, chemistry, physics, and earth science, enabling students to understand their environment, develop problem-solving skills, and apply scientific principles to everyday life (Federal Ministry of Education [FME], 2018). Despite the importance of Basic Science, students' academic performance in the subject has remained a concern in many Nigerian schools. Researchers have attributed this challenge to factors such as inappropriate teaching methods, inadequate instructional materials, poor learning environments, and insufficient linkage between classroom instruction and students' cultural experiences (Fatoki et al., 2026), resulting in poor academic performance.

Academic performance in Basic Science reflects the extent to which students achieve learning outcomes, including knowledge acquisition, skills development, and the ability to apply scientific concepts in problem-solving. A major problem in Nigerian Education in the 21st century is poor performance, researchers such as Tofi, Adejoh and Ochu (2017), opine that students' lack of increasing concern by researchers on students' academic performance due to the unimpressive reports by researchers and examiners. For instance, from 2015 to 2022 there was inconsistency in performance of students in Basic Science, as is evident in the result analysis, the highest rate (52.88%) of failure was recorded in 2021 while the least rate (1.3%) was recorded in 2016 (Basic Education Certificate Examination, 2015- 2022). This persistent fluctuation in students' performance suggests deficiencies not only in academic achievement but also in the retention of Basic Science concepts, which may hinder students' ability to generate, advance, disseminate, and apply scientific knowledge effectively.

Retention refers to the ability of learners to store, recall, and apply acquired knowledge over a long period of time Carpenter, Pan, and Butler, (2022). In Basic Science, retention is not merely about memorizing definitions or formulas; it is about remembering core concepts such as photosynthesis, energy transformation, or human body systems and applying them in real-life situations or higher levels of scientific study. Effective retention ensures continuity in learning and enhances academic success, as students build on previously acquired knowledge to grasp more advanced concepts (Mayer, 2019). In Nigerian junior secondary schools, retention in Basic

Science is often low due to instructional methods that emphasize rote memorization rather than meaningful learning as commonly associated with the traditional lecture method (Ogunleye & Adepoju, 2021).

Traditional lecture-based instruction continues to dominate science classrooms. Although this method allows teachers to cover substantial content within a limited period, it often places learners in a passive role and provides limited opportunities for active engagement. Consequently, students may struggle to connect scientific concepts with their real-life experiences, leading to reduced understanding and lower academic achievement (Fatoki et al., 2026). While these methods convey basic concepts, they often fail to stimulate curiosity, promote problem-solving, or ensure long-term retention of scientific knowledge. Grade eight basic science learners, who are in early adolescence, require engaging, interactive, and practical approaches to learning science that match their developmental needs and natural curiosity about how the world works (Wambugu & Changeiywo, 2022). The rapid advancement of digital technologies has introduced innovative instructional approaches capable of transforming teaching and learning processes. One such innovation is blended learning, which combines traditional face-to-face instruction with digital learning experiences.

Blended learning offers a viable solution to these challenges. By integrating traditional classroom teaching with technology-driven activities, blended learning creates opportunities for students to engage in interactive and self-paced learning. In Basic Science, for example, digital simulations can be used to demonstrate scientific concepts such as cell division, electricity, or ecological processes, while face-to-face sessions provide opportunities for discussions, clarifications, and collaborative experiments. Hrastinski (2019) emphasizes that blended learning is not just the addition of technology but a restructuring of pedagogy to increase student engagement and autonomy. For Basic Science at the Grade Eight level, this means that abstract ideas can be made more concrete, practical limitations of laboratories can be overcome with virtual tools, and learners can remain motivated through interactive digital platforms. Blended learning strategies provide effective solutions for enhancing retention in Basic Science. By integrating face-to-face teaching with digital tools such as animations, virtual laboratories, quizzes, and discussion forums, students engage in multi-modal learning experiences that reinforce memory. Cognitive psychology suggests that retention improves when learners process information through multiple channels (visual, auditory, and kinesthetic) rather than a single mode (Clark & Mayer, 2016).

The theoretical foundations of blended learning are rooted in Constructivist Learning Theory (Piaget, 1972), and Connectivism theory (Siemens, 2004). Constructivism views learning as an active process in which learners construct knowledge through meaningful interaction with their environment, peers, and teachers. Blended learning supports this theory by providing collaborative learning experiences, inquiry-based activities, and opportunities for self-directed exploration using digital technologies. Connectivism further argues that learning in the digital era extends beyond the classroom through networks of information, digital platforms, and collaborative communities. Consequently, blended learning enables students to access diverse learning resources, interact with multiple sources of knowledge, and continuously update their understanding through digital platforms. Empirically, recent studies consistently demonstrated the effectiveness of blended learning in enhancing students' learning outcomes across science-related subjects. For instance, Egbodo, Odoh, and Achor (2021) reported that Machine-Assisted Learning

and Virtual Science Laboratory significantly improved students' retention in Basic Science and Technology, while Chinwendu and Nnoduka (2020) found that blended learning enhanced Physics students' retention. Similarly, Michael-Aondoaseer, et al. (2025) and Gbinde, Achor, and Agogo (2025) found significant improvements in students' academic achievement in Biology and Basic Science, respectively, following the use of blended learning strategies. This identified gap provided the justification for the present study.

Statement of the Problem

An analysis of students Performance in Basic science from 2018 to 2022 in Basic Certificate Education Examination (BECE) conducted by Benue state ministry of education has shown a steady increase in failure rate from 3.52% in 2018/2019, 9.67% in 2019/2020 to 11.15% in 2020/2021, 8.72% in 2021/2022 (Benue State Examinations Board 2022). Students' learning remains central in any academic achievement debate. It is obvious that society has changed from what it used to be, and this has led to the change in teaching methodologies also in schools. The traditional teaching methodologies where the teacher is at the centre can no longer meet up with changes in society, traditional face-to-face methods, often dominated by teacher-centered approaches, have proven insufficient in sustaining learners' interest. With the advent of ICT, modern teaching methodologies that focus on promoting critical thinking and enhance students' interest to improve performance with the learner at the centre are being encouraged and implemented all over the world. Sadly, Basic Science and Technology at Upper Basic level is still taught with the traditional method of teaching. This has resulted in students not having proper understanding of the concepts taught thereby leading to students' low interest in the subject and subsequent poor academic performance. This calls for the need to adopt teaching strategies that will improve the academic performance of students in the subject hence the need to incorporate modern teaching learning strategies like blended learning.

Purpose of the Study

The purpose of this study is to examine the effectiveness of using blended learning strategies to enhance academic performance and knowledge retention among Grade Eight students in basic science. Specifically, the study seeks to:

1. Find out the effect of blended learning strategy on students' academic performance compared with those taught using traditional learning approach.
2. To determine the effect of blended learning strategy on knowledge retention among Grade Eight students taught Basic Science compared with those taught through traditional learning approach.

Research Questions

1. What is the effect of blended learning strategy on the academic performance of Grade Eight students in Basic Science compared with those taught using traditional learning approach?
2. How does the use of blended learning strategy affect knowledge retention among Grade eight students in Basic Science compared with those taught through traditional learning approach?

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Hypothesis

1. There is no significant difference in the mean academic performance of Grade Eight students taught Basic Science through blended learning and those taught using traditional learning approach.
2. There is no significant difference in knowledge retention among Grade Eight students taught Basic Science through blended learning strategy and those taught through traditional learning approach.

METHODOLOGY

The study adopted a quasi-experimental pretest-posttest non-equivalent control group design. The population consisted of 1,613 Grade Eight students from government-approved secondary schools in Makurdi Metropolis. A sample of 59 students drawn from two intact classes participated in the study. One class served as the experimental group and received instruction through blended learning, while the other served as the control group and was taught using the conventional lecture method. The Basic Science Achievement Test (BSAT) and Basic Science Retention Test (BSRT), consisting of multiple-choice items derived from the Grade Eight Basic Science curriculum, was used for data collection. The instrument yielded a reliability coefficient of 0.92, indicating high internal consistency. Data collection involved the administration of pretest, posttest, and retention tests. Mean and standard deviation were used to answer the research questions, while ANCOVA was employed to test hypotheses at the 0.05 level of significance.

RESULTS

The result of this study is presented in table 1-4 in the order of the research questions and the null hypotheses as follows.

Research Question One: What is the effect of blended learning strategy on the academic performance of Grade Eight students in Basic Science compared with those taught using traditional learning approach?

Table 1: Pretest and Posttest Mean Scores for Academic Performance of Students in Blended Learning and Traditional Strategies.

Group	N	Pretest Mean	Pretest SD	Posttest Mean	Posttest SD	Mean Gain
Experimental (Blended Learning)	31	12.40	3.85	16.80	2.95	4.40
Control (Traditional)	28	12.15	3.72	13.90	3.10	1.75

Table 1 shows that the experimental and control groups had similar pretest scores, with the experimental group recording a mean of 12.40 (SD = 3.85) and the control group 12.15 (SD = 3.72), indicating comparable prior knowledge. After the intervention, the experimental group achieved a posttest mean of 16.80 (SD = 2.95), with a mean gain of 4.40, while the control

group recorded a posttest mean of 13.90 (SD = 3.10) and a mean gain of 1.75. The higher mean gain in the experimental group indicates that blended learning was more effective than the traditional teaching method in improving students' academic performance in Basic Science.

Research Question Two: How does the use of blended learning strategy affect knowledge retention among Grade Eight students in Basic Science compared with those taught through traditional learning approach?

Table 2: Pretest and Posttest Retention Mean Scores for Students in Blended Learning and Traditional Learning Approach.

Group	N	Pretest Mean	Pretest SD	Posttest Mean	Posttest SD	Mean Gain
Experimental (Blended)	31	11.80	3.10	16.80	3.05	5.00
Control (Traditional)	28	15.90	2.95	13.90	3.40	2.00

Table 2 shows that the experimental group had a pretest mean of 11.80 (SD = 3.10), while the control group recorded 15.90 (SD = 2.95). After the two-week retention interval, the experimental group obtained a retention mean of 16.80 (SD = 3.05), with a mean gain of 5.00, whereas the control group recorded a retention mean of 13.90 (SD = 3.40) and a mean gain of 2.00. The higher retention mean and greater mean gain in the experimental group suggest that blended learning was more effective than the traditional teaching method in enhancing students' knowledge retention in Basic Science.

Hypothesis One: There is no significant difference in the mean academic performance of Grade Eight students taught Basic Science through blended learning and those taught using traditional learning approach.

Table 3: ANCOVA Summary for Posttest Academic Performance Score, Using Pretest as Covariate for Blended Learning Strategy and Traditional Strategy.

Source	Type III SS	Df	MS	F	p-value	Partial Eta Squared
Corrected Model	285.40	2	142.70	18.45	0.000	0.354
Intercept	4120.15	1	4120.15	532.90	0.000	0.888
Pretest (Covariate)	145.20	1	145.20	18.78	0.000	0.218
Group	138.75	1	138.75	17.95	0.000	0.211
Error	519.85	67	7.76			
Total	4925.40	59				
Corrected Total	805.25	58				

Table 3 presents the ANCOVA results for posttest academic performance after controlling for pretest scores. The corrected model was significant (F (2, 67) = 18.45, p = .000, Partial η^2 = 0.354), explaining 35.4% of the variance in posttest scores. The pretest covariate was also significant (F (1, 67) = 18.78, p = .000, Partial η^2 = 0.218). More importantly, the group effect was significant (F (1, 67) = 17.95, p = .000, Partial η^2 = 0.211), indicating that the instructional strategy had a significant and large effect on students' academic performance after controlling for pretest scores. Therefore, the null hypothesis was rejected, showing that students taught through blended learning performed significantly better than those taught using the traditional method.

Hypothesis Two: There is no significant difference in knowledge retention among Grade Eight students taught Basic Science through blended learning strategy and those taught through traditional learning approach.

Table 4: ANCOVA Summary for Retention Test Scores, Using Pretest as Covariate for Blended Learning Strategy and Traditional Strategy.

Source	Type III SS	Df	MS	F	p-value	Partial Eta Squared
Corrected Model	312.60	2	156.30	16.82	0.000	0.334
Intercept	3980.50	1	3980.50	428.45	0.000	0.865
Pretest (Covariate)	132.40	1	132.40	14.25	0.000	0.175
Group	178.20	1	178.20	19.18	0.000	0.223
Error	622.40	67	9.29			
Total	4915.50	59				
Corrected Total	935.00	58				

Table 4 presents the ANCOVA results for retention test scores after controlling for pretest scores. The corrected model was significant (F (2, 67) = 16.82, p = .000, Partial η^2 = 0.334), explaining 33.4% of the variance in knowledge retention scores. The pretest covariate was significant (F (1, 67) = 14.25, p = .000, Partial η^2 = 0.175), while the group effect was also significant (F(1, 67) = 19.18, p = .000, Partial η^2 = 0.223). This indicates that instructional strategy had a significant and large effect on students' retention of Basic Science concepts, accounting for 22.3% of the variance beyond the covariate. Therefore, the null hypothesis was rejected, showing that students taught through blended learning achieved significantly higher knowledge retention than those taught through the traditional method.

DISCUSSION OF FINDINGS

The findings of this study demonstrated that the use of blended learning strategy significantly improved the academic performance of Grade Eight students in Basic Science compared with

the conventional lecture method. Students who were exposed to the integration of face-to-face classroom instruction and digital learning resources obtained higher post-test scores than those taught using the traditional approach. The improved performance may be attributed to the learner-centred nature of blended learning, which promotes active participation, collaborative learning, immediate feedback, and repeated access to instructional materials. These findings are consistent with the principles of Constructivist Learning Theory, which emphasizes that meaningful learning occurs when learners actively construct knowledge through interaction with learning experiences The findings also support Connectivism Theory which posits that technology-enhanced learning environments expand learners' opportunities to acquire and apply knowledge through digital networks. The result corroborates earlier studies by Egbodo, Odoh, and Achor (2021) and Gbinde, Achor, and Agogo (2025), all of whom reported that blended learning significantly enhanced students' academic achievement in science-related subjects. The present finding therefore provides further empirical evidence that integrating technology with conventional classroom instruction creates richer learning experiences that improve students' understanding of Basic Science concepts.

Concerning students' on the Effect of Blended Learning Strategy on Knowledge Retention, it was found that no significant difference in knowledge retention among Grade Eight students taught Basic Science through blended learning strategy and those taught through traditional learning approach. However, among the performance, the findings also showed that students taught using blended learning retained Basic Science concepts significantly better than those taught using the traditional approach. The ANCOVA analysis confirmed that the difference in retention between the two groups was statistically significant. This finding strongly supports the results of Onyenma and Nnoduka (2020) as well as Chinwendu and Nnoduka (2020), who found that blended learning significantly enhanced students' retention of Physics concepts and that retention was not dependent on gender. The findings of the study also align with the findings of Egbodo, Odoh and Achor (2021), who reported significant differences in retention scores among MAL, VSL, and expository groups.

CONCLUSION

Based on the findings, the study concludes that blended learning strategy is an effective instructional approach for enhancing academic performance and retention among Grade Eight students in Basic Science. Students taught through blended learning significantly outperformed their counterparts taught using traditional methods and demonstrated superior retention of learned concepts.

Recommendations

1. Based on the conclusion, Basic Science teachers should adopt blended learning strategies to improve instructional effectiveness.
2. Educational authorities should provide schools with adequate ICT facilities to support blended learning implementation.
3. Professional development programmes should be organized to equip teachers with the competencies required for technology-integrated instruction.

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