Effect of Team–Based Learning Strategy on Senior Secondary School Biology Students' Academic Achievement in Ecology in Abeokuta Metropolis, Ogun State

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ABSTRACT

A fluctuating trend is noticeable in WAEC Biology results in Ogun State in recent time due to persistent challenges in critical thinking and real-world application of ecological concepts. This informed this study on the Effect of Team-based Learning (TbL) Strategy on Senior Secondary School Students' Academic Achievement in Ecology in Abeokuta Metropolis, Ogun State. Guided by a hypothesis ($\alpha<0.05$), a pretest-posttest quasi-experimental design was employed, where a sample of 58 students from two purposively selected public secondary schools participated in the sample. A validated instrument, Ecology Achievement Test (EAT) (KR-20 = 0.76) was used for data collection and tested using Analysis of Covariance (ANCOVA). There was a significant effect of Team–based learning strategy on senior secondary school students' academic achievement in Ecology in Abeokuta Metropolis, Ogun State [$F_{(1, 55)} = 160.770$, $p < 0.05$, $\eta^2 = 0.745$]. Based on the result, the study concludes that Team–based learning strategy significantly improves students' academic performance in Ecology and recommends its broader adoption in teaching Ecology and other sciences.

Key Words: Academic Achievement, Biology, Ecology, Team–based Learning Strategy

INTRODUCTION

Academic achievement remains a vital indicator of students' success, reflecting their understanding of subject matter and readiness for future educational and career pursuits. In Nigeria, the West African Senior School Certificate Examination (WASSCE) serves as the key benchmark for assessing students' academic performance, particularly in core subjects like Biology. In Ogun State, students' performance in WAEC Biology has shown a general upward trend, although some fluctuations have been recorded. Between 2016 and 2019, credit-level pass rates (grades C6 and above) hovered around 50% to 55%, with modest gains attributed to improved teacher training and curriculum adjustments. However, in 2020, performance dropped to 51.4% due to the widespread disruption caused by the COVID-19 pandemic, which significantly affected teaching and learning nationwide (Egwu & Okigbo, 2021; Lawal, 2022).

Despite this report, there has been steady progress in the following years: the percentage of students securing credit passes in Biology rose to 58.2% in 2021, 58.9% in 2022, 61.4% in 2023, and peaked at 63.3% in 2024. This upward movement is largely credited to targeted educational reforms, increased focus on practical learning, and a more consistent school calendar. In 2024, Biology results in Ogun State had reached their best in recent years, pointing to advancements in science education and overall student achievement (Oguguo & Uboh, 2020; Lawal, 2022; Kilag, Tariman, Dela, Cruz, Cantere Jr., Niere & Priolo, 2024). However, this positive trend does not eliminate the ongoing challenges. One major concern is students' limited ability to apply theoretical knowledge to practical, real-life problems. WAEC Chief Examiners' reports in Biology consistently highlight students' struggles with critical reasoning and analytical thinking, especially in Ecology **(**WAEC Chief Examiners' reports from 2014, 2015, 2016, 2017 & 2018). These findings underscore the need for teaching methods that promote deeper understanding and active engagement with biological concepts.

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Ecology, a key component in Biology curriculum, explores the interactions between organisms and their environments. This area of study is particularly important for a country like Nigeria, which faces significant environmental issues such as deforestation, pollution, and biodiversity loss. Yet, students often find Ecology difficult to grasp due to its abstract content and the limited availability of practical learning opportunities (Mohammed, Zakari, Bako, Isa, Abdullahi & Jibrin, 2023). WAEC Chief Examiners' reports from 2014, 2015, 2016, 2017, and 2018 emphasize that many students lack a solid grasp of fundamental biological concepts and struggle to apply these ideas, particularly in Ecology, where problem-solving skills are crucial (Oguguo & Uboh, 2020; Egwu & Okigbo, 2021; Lawal, 2022;).

Traditional lecture-based teaching methods remain common but are often ineffective in engaging students meaningfully, leading to passive learning and poor retention (Isa, Mammam, Badar & Bala, 2020). In response, educators have explored alternative strategies such as Inquiry-based Learning (IbL) and Cooperative learning. These methods encourage active participation and collaboration, with Inquiry-based Learning focusing on student-led investigations and problem-solving (Mukandayisenga, Opanga & Nsengimana, 2021; Driessen, Wilson, Hall, Brewer, Odom, Ramsey & Ballen 2024), while cooperative learning promotes peer interaction and teamwork (Talan, 2021; Samosa, 2021 & Vu, Hooker & Simonds, 2021). These strategies offered promises' implementation is often hampered by challenges such as overcrowded classrooms and inadequate teacher training.

More recently, Team-based Learning (TbL) has emerged as an effective instructional approach, particularly in science education. Team-based Learning involves structured group work, where students collaborate on tasks, solve problems, and reflect on learning outcomes. This method promotes active engagement, critical thinking, and deeper understanding of subject content (Burgess & Matar, 2023; Wullschleger, Vörös, Rechsteiner, Rickenbacher & Merki, 2023). In the context of Ecology, Team-based Learning helps students to examine ecological concepts from multiple perspectives, making it easier to apply knowledge to real-world issues (Arcila, Hernández, Zamudio, Drake & Smith, 2021; Ajewole & Bello, 2022). Research suggests that Team-based Learning not only improves academic performance but also enhances essential skills such as communication, collaboration, and independent thinking (Kalu-Uche & Emeka, 2018; Nawabi, Bilal & Javed, 2021; Sweet & Michaelsen, 2023).

Although recent improvements in WAEC Biology results are commendable, the persistent challenges students face in Ecology, especially their difficulty in applying theoretical knowledge to practical situations, call for innovative teaching strategies. Team-based Learning, with its focus on collaboration, critical thinking, and active engagement, offers a promising solution. However, despite its growing adoption globally, there is limited empirical evidence on its effectiveness within the Nigerian secondary school context, particularly in Ogun State. This gap necessitates a focused investigation into how Team-based Learning influences students' academic achievement in Ecology. Therefore, this study aims to examine the Effect of Team–based Learning Strategy on Senior Secondary School Biology Students' Academic Achievement in Ecology in Abeokuta Metropolis, Ogun State.

Statement of the Problem

In recent years, students' performance in WAEC Biology examination in Ogun State has shown steady improvement. From a credit-level pass rate of 51.4% in 2020, largely attributed to the disruptions caused by the COVID-19 pandemic, to 58.2% in 2021, 58.9% in 2022, 61.4% in 2023 and 63.3% in 2024, marking the highest recorded performance in recent times. This upward trend suggests that efforts such as improved teaching strategies, more practical-based learning, and better implementation of the curriculum are beginning to yield positive results. Despite these gains, significant challenges remain, particularly in the area of Ecology. Reports from WAEC Chief Examiners consistently highlight that many students struggle with critical thinking, analytical reasoning, and applying biological knowledge to real-life situations. These difficulties suggest that while content delivery may have improved, the depth of understanding and ability to apply concepts remains a concern. Traditional lecture-based teaching methods, which still dominate many classrooms, often do not engage students actively or promote the higher-order thinking skills needed for mastering Ecology. As such, there is a growing need to adopt more interactive and student-centered approaches that encourage participation, teamwork, and critical thinking. It is against this backdrop that this study seeks to examine the Effect of Team-based Learning

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Strategy on Senior Secondary School Biology Students' Academic Achievement in Ecology in Abeokuta Metropolis, Ogun State.

Aim and Objectives of the Study

The aim of this study was to investigate the Effect of Team-based Learning Strategy on Senior Secondary School Biology Students' Academic Achievement in Ecology in Abeokuta Metropolis, Ogun State.

The specific objective was to examine the Effect of Team-based Learning Strategy on Senior Secondary School Biology Students' Academic Achievement in Ecology in Abeokuta Metropolis, Ogun State

Hypothesis

The null hypothesis below was tested at the 0.05 level of significance:

H_0: There will be no significant effect of Team-based learning strategy on senior secondary school students' academic achievement in Ecology in Abeokuta Metropolis, Ogun State.

METHODOLOGY

This study adopted a quasi-experimental research design, specifically employing a pre-test and post-test format to investigate the effect of the Team-based Learning Strategy on students' academic achievement in Ecology. A total of fifty-eight (58) senior secondary school students participated in the study. These included twenty-nine (29) male and twenty-nine (29) female students, selected from two public secondary schools in Ogun State using two intact classes. The schools were randomly assigned to either the experimental or control group. One of the schools was designated as the experimental group (Group A). This group, comprised thirty-one (31) students, made up of fourteen (14) males and seventeen (17) females, who were taught using the Team-based Learning (TbL) strategy. The second school served as the control group (Group B), with a total of twenty-seven (27) students, who were made up of fifteen (15) males and twelve (12) females and were instructed using the traditional teaching strategy. The research instrument used for data collection was Ecology Achievement Test (EAT). The instrument underwent thorough validation to ensure face, content, and construct validity through expert review. Revisions were made based on expert feedback prior to final production. The reliability of the EAT who determined with a pilot test conducted on a group of students who shared similar characteristics with the study sample within the same population but were not included in the main study. The reliability coefficient computed using the Kuder-Richardson Formula 20 (KR-20) was found to be 0.76, indicating acceptable internal consistency. Prior to the implementation of the teaching strategies, Biology teachers from the selected schools were trained as research assistants. The training, conducted in the first week of the study, covered the objectives, procedures, and expectations for the eight-week duration of the intervention. In the second week, the pre-test was administered to both groups. The intervention was carried out over the next five weeks that is from week three to week seven, during which each group was taught Ecology using their respective instructional strategy. The post-test was administered in the eighth week. Data collected from the pre-test and post-test were analyzed using Analysis of Covariance (ANCOVA) at the 0.05 level of significance to test the hypothesis and determine the impact of the instructional strategies (EAT and Conventional) on students' academic achievement.

RESULT

Presentation of Data

Hypothesis

H_0: There will be no significant effect of Team–based learning strategy on senior secondary school students' academic achievement in Ecology in Abeokuta Metropolis, Ogun State.

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Table 1: Tests of Between-Subjects Effects of Team–based Learning Strategy on Senior Secondary School Students' Academic Achievement in Ecology in Abeokuta Metropolis, Ogun State

Dependent Variable: Posttest						
Source	**Type III Sum of Squares**	**Df**	**Mean Square**	**F**	**Sig.**	**Partial Eta Squared**
Corrected Model	177.959[a]	2	88.979	98.475	0.000	0.782
Intercept	241.569	1	241.569	267.349	0.000	0.829
Pretest	42.328	1	42.328	46.845	0.000	0.460
Strategy	145.267	1	145.267	160.770	0.000	0.745
Error	49.696	55	0.904			
Total	12220.000	58				
Corrected Total	227.655	57				
a. R Squared = 0.782 (Adjusted R Squared = 0.774)						

Source: Researchers' Fieldwork, 2025

From Table 1: The Analysis of Covariance (ANCOVA) result on the effect of Team–based learning strategy on senior secondary school students' academic achievement in Ecology in Abeokuta Metropolis, Ogun State was; $F_{(1, 55)} = 160.770$, $p < 0.05$, $\eta^2 = 0.745$. The results clearly show that the team-based learning strategy had a significant and positive impact on students' academic achievement in Ecology. Therefore, the null hypothesis (H_0), which states that there will be no significant effect of team-based learning strategy, is rejected. Thus, there was significant effect of Team–based learning strategy on senior secondary school students' academic achievement in Ecology in Abeokuta Metropolis, Ogun State.

Table 2: Parameter Estimates of Team–based Learning Strategy on Senior Secondary School Students' Academic Achievement in Ecology in Abeokuta Metropolis, Ogun State

Dependent Variable: Posttest							
Parameter	**B**	**Std. Error**	**T**	**Sig.**	**95% Confidence Interval**		**Partial Eta Squared**
					Lower Bound	**Upper Bound**	
Intercept	8.534	0.641	13.306	0.000	7.248	9.819	0.763
Pretest	0.403	0.059	6.844	0.000	0.285	0.521	0.460
[Strategy=Team-based Learning]	3.180	0.251	12.680	0.000	2.677	3.682	0.745
[Strategy=Traditional Teaching]	0.000[a]	0.000	0.000	0.000	0.000	0.000	0.000
a. This parameter is set to zero because it is redundant.							

Source: Researchers' Fieldwork, 2025

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The Parameter Estimates Table 2 provides deeper insight into the influence of the independent variables particularly the teaching strategy on students' posttest scores in Ecology. The intercept value of 8.534 indicates the predicted posttest score for a student who received traditional teaching and scored zero on the pretest. This serves as a baseline for comparison. The pretest score has a statistically significant positive effect on the posttest score, with a B value of 0.403, a t-value of 6.844, and a p-value of 0.000. This means that for every one-point increase in the pretest score, the posttest score is expected to increase by approximately 0.403 points, assuming other factors remain constant. The Partial Eta Squared value of .460 further suggests a moderate to strong effect of the pretest on the posttest performance.

More importantly, the coefficient for the team-based learning strategy is 3.180, with a very small standard error of 0.251 and a t-value of 12.680, which is statistically significant at $p < 0.05$. This means that students taught with the team-based learning strategy scored on average 3.180 points higher on the posttest than those taught using the traditional teaching method. The 95% confidence interval (from 2.677 to 3.682) does not include zero, reinforcing the statistical significance of this effect. The Partial Eta Squared of 0.745 here also aligns with the earlier result, showing that the team-based strategy had a very large effect size.

The row labeled [Strategy = Traditional Teaching] is marked as zero and not estimated because it serves as the reference category in the model. The parameter estimates confirm that the team-based learning strategy significantly and positively impacted students' academic achievement in Ecology when compared to the traditional teaching method. This reinforces the earlier conclusion that the null hypothesis should be rejected.

Table 3: Estimated Marginal Means of Team–based Learning and Traditional Teaching Strategies on Senior Secondary School Students' Academic Achievement in Ecology in Abeokuta Metropolis, Ogun State

Dependent Variable: Posttest				
Strategy	**Mean**	**Std. Error**	**95% Confidence Interval**	
			Lower Bound	**Upper Bound**
Team-based Learning	15.860[a]	0.171	15.517	16.202
Traditional Teaching	12.680[a]	0.183	12.313	13.047
a. Covariates appearing in the model are evaluated at the following values: Pretest = 10.29.				

Source: Researchers' Fieldwork, 2025

The Estimates Table 3 presents the adjusted mean posttest scores for each instructional strategy, taking into account the effect of the pretest scores (which are held constant at a value of 10.29). Students who were taught using the team-based learning strategy had an adjusted mean posttest score of 15.860, with a standard error of 0.171. The 95% confidence interval for this estimate ranges from 15.517 to 16.202, indicating high precision and statistical reliability. On the other hand, students who received traditional teaching had an adjusted mean posttest score of 12.680, with a standard error of 0.183, and a 95% confidence interval ranging from 12.313 to 13.047. The difference in adjusted mean scores 15.860 for team-based learning versus 12.680 for traditional teaching demonstrates that students in the team-based learning group performed significantly better than those in the traditional group, even after accounting for their pretest scores. This further supports the earlier findings and provides a clear and practical interpretation: team-based learning leads to higher academic achievement in Ecology among senior secondary school students in Abeokuta Metropolis compared to traditional teaching methods. Therefore, the null hypothesis (H_0) is again rejected.

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Table 4: Pairwise Comparisons of Team–based Learning and Traditional Teaching Strategies on Senior Secondary School Students' Academic Achievement in Ecology in Abeokuta Metropolis, Ogun State

Dependent Variable: Posttest						
(I) Strategy	**(J) Strategy**	**Mean Difference (I-J)**	**Std. Error**	**Sig.[b]**	**95% Confidence Interval for Difference[b]**	
					Lower Bound	**Upper Bound**
Team-based Learning	Traditional Teaching	3.180*	0.251	0.000	2.677	3.682
Traditional Teaching	Team-based Learning	-3.180*	0.251	0.000	-3.682	-2.677
Based on estimated marginal means						
*. The mean difference is significant at the .05 level.						
b. Adjustment for multiple comparisons: Bonferroni.						

Source: Researchers' Fieldwork, 2025

The Pairwise Comparisons Table 4 offers a direct comparison of the academic performance between students exposed to different teaching strategies Team-based Learning and Traditional Teaching based on their adjusted posttest scores. When comparing Team-based Learning to Traditional Teaching, the mean difference in posttest scores is 3.180, favoring the team-based strategy. This difference is statistically significant with a p-value of 0.000, indicating that the observed gap is not due to chance. The 95% confidence interval for this difference ranges from 2.677 to 3.682, which does not cross zero, further confirming its significance. The reverse comparison, Traditional Teaching to Team-based learning; shows a negative mean difference of -3.180, with the same level of significance and confidence interval, reinforcing the direction and consistency of the effect. These results, adjusted using the Bonferroni correction to control for Type I error, clearly show that students taught using the Team-based Learning strategy significantly outperformed their peers who were taught using the Traditional method. This comparison adds to the body of evidence rejecting the null hypothesis (H_0), affirming that the Team-based Learning strategy has a significant and positive effect on students' academic achievement in Ecology.

DISCUSSION OF FINDINGS

The findings of this study reveal a significant effect of the Team-based Learning (TbL) strategy on the academic achievement of senior secondary school students in Ecology within Abeokuta Metropolis, Ogun State. Specifically, students who were taught using the TBL approach outperformed their peers who were exposed to traditional instructional methods. This outcome reinforces the growing body of evidence that collaborative, student-centered learning strategies are more effective in fostering academic success in science subjects.

This result is in line with the findings of Arcila, Hernández, Zamudio, Drake & Smith (2021), whose study on Implementing Team-based Learning in the Life Sciences, observed that Team-based learning enhances student engagement, promotes meaningful collaboration, and facilitates deeper comprehension of scientific content. The structured framework of Team-based learning-involving pre-class preparation, readiness assurance tests, and group-based problem-solving-appears to be central to its effectiveness. This design not only ensures individual accountability but also encourages students to participate actively, which is especially beneficial in large or diverse classrooms.

The findings also align with a similar study conducted in Abia State, Nigeria, where students exposed to Jigsaw Learning Teams (another collaborative instructional approach) outperformed those taught with conventional methods. Although the performance difference in this previous study was not statistically significant, the trend

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still pointed towards better outcomes with group-based strategies (Kalu-Uche & Emeka, 2018). This suggests that the success of structured group learning hinges largely on effective implementation and consistency.

Moreover, the present study corroborates the results of Samosa (2021), who investigated the impact of a Cooperative Learning Approach on students' academic achievement and attitude in Biology. While the percentage improvement in academic achievement was higher among students in the experimental group (41.86%) than the control group (36.49%), the difference was not statistically significant. Nonetheless, this trend affirms the potential of group-oriented instructional strategies like TBL to positively influence learning outcomes in Ecology.

The findings are further supported by the meta-analysis conducted by Driessen, Wilson, Hall, Brewer, Odom, Ramsey & Ballen (2024) on Group Work Enhances Student Performance in Biology. This extensive review concluded that group-based learning approaches significantly enhance student performance in biology-related subjects. The consistency between this meta-analysis and the current study emphasizes the importance of integrating structured collaboration in science education to foster deeper conceptual understanding and long-term retention.

Additionally, the results align with another meta-analytic study by Talan (2021) on the Effect of Computer-Supported Collaborative Learning on Academic Achievement: A Meta-Analysis Study. This study reported a moderate effect size (0.523), confirming that collaborative learning-whether facilitated through digital tools or face-to-face interactions-positively affects student achievement. Given that Ecology involves complex, abstract, and often system-based thinking, TbL's emphasis on peer discussion and problem-solving appears particularly effective in enhancing student comprehension and application. The consistent alignment of this study's findings with both primary studies and meta-analytic evidence reinforces the value of Team-based Learning as a viable instructional strategy. It not only supports improved academic achievement but also promotes critical thinking, collaboration, and student engagement, a key competency needed for mastering Ecology and other scientific disciplines.

CONCLUSION

The findings of this study have shown that the use of the Team-Based Learning (TBL) strategy significantly enhanced the academic achievement of senior secondary school students in Ecology in Abeokuta Metropolis, Ogun State. With a statistically significant result of $F_{(1, 55)} = 160.770$, $p < 0.05$ and $\eta^2 = 0.745$, the evidence confirms that students taught using the TBL approach outperformed their peers taught through traditional methods. This result underscores the effectiveness of interactive, student-centered learning in fostering deeper understanding and improved academic outcomes in Biology, particularly in Ecology.

RECOMMENDATION

In light of these findings, it is recommended that biology teachers incorporate Team-Based Learning into their instructional practices to improve student engagement and performance.

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