TEACHERS' BIOLOGICAL LITERACY LEVELS AND SCHOOL OWNERSHIP AS DETERMINANTS OF LEARNING ENGAGEMENT AMONG SECONDARY SCHOOL STUDENTS IN OYO STATE NIGERIA

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Abstract

This study examined the extent to which teachers' biological literacy and school ownership influence secondary school students' learning engagement in Biology in Oyo State, Nigeria. A descriptive research design was adopted for the study. The population comprised Biology teachers in unity (federal) and state secondary schools in Oyo State, from which 50 teachers were selected using stratified and simple random sampling techniques based on school ownership. Data were collected using a structured and validated instrument titled *Teachers' Perception of Students' Learning Engagement and Biological Literacy Questionnaire (TPSLEBLQ)*, which had a reliability coefficient of 0.80, indicating acceptable internal consistency. Data were analysed using descriptive statistics (mean and standard deviation) to answer the research questions, while an independent samples t-test was used to test the hypothesis at a 0.05 level of significance. The findings revealed that teachers' biological literacy had not adequately translated into meaningful student engagement in Biology, as the overall mean scores fell below the established benchmark. Results further showed that students' level of learning engagement in Biology was generally low. In addition, there was no statistically significant difference in students' learning engagement based on school ownership, indicating that both unity and state schools experience similar challenges in promoting active student participation in Biology lessons. The study concludes that teacher-related factors, particularly the effective translation of biological literacy into classroom practice, play a more critical role in shaping students' engagement than school ownership. It therefore recommends targeted professional development programmes focused on strengthening teachers' biological literacy, pedagogical content knowledge, and the use of learner-centred instructional approaches to enhance students' engagement and improve learning outcomes in Biology.

Keywords: Biological literacy, Learning engagement, School ownership, Biology education, Secondary schools

Introduction

Education remains a fundamental driver of personal growth and national development, as it equips individuals with the knowledge, skills, and values needed to function productively in society. Within the educational system, science education occupies a central position because it enables learners to understand the natural world, develop problem solving abilities, and apply scientific knowledge to everyday life. Through science education, students are prepared to make informed decisions on issues related to health, environmental sustainability, and technological advancement, which are increasingly important in a rapidly evolving global society. An essential component of effective science education is literacy. Literacy goes beyond basic reading and writing skills to include the ability to interpret information, communicate ideas clearly, and apply knowledge meaningfully across various contexts. (Banda & Kaani,2026).

Expanding this concept, scientific literacy focuses on learners' understanding of scientific concepts and processes, their ability to evaluate scientific information critically, and their capacity to apply scientific reasoning to personal and societal challenges. Scientific literacy therefore empowers students to engage thoughtfully with science-related issues and to participate responsibly in a knowledge-driven world. Biology education contributes significantly to the development of scientific literacy by helping learners understand living organisms, life processes, human health, and environmental interactions. As a core science subject at the secondary school level, Biology provides students with foundational knowledge and skills necessary for scientific reasoning, informed decision-making, and preparation for careers in fields such as medicine, agriculture, and environmental sciences (Stracke et al.,2022). However, meaningful learning in Biology is not achieved through content transmission alone. It requires active student engagement, sustained interest, and opportunities for learners to relate biological concepts to real-life experiences. In many secondary schools in Nigeria, particularly in the North-Central region, students' engagement in Biology lessons has continued to raise concern, as reflected in low interest levels, limited classroom participation, and fluctuating academic performance.

Teachers play a critical role in shaping students' learning experiences in Biology, and one key factor influencing student engagement is teachers' level of biological literacy. Biological literacy refers to teachers' understanding of fundamental biological concepts, their ability to apply scientific reasoning, interpret biological information accurately, and communicate ideas effectively. Teachers who possess strong biological literacy are more likely to explain concepts clearly, connect lessons to everyday life, and adopt teaching strategies that encourage inquiry and critical thinking. Such teachers often create engaging learning environments that motivate students to participate actively in Biology lessons. In contrast, teachers with limited biological literacy may rely heavily on memorization-based instruction, provide shallow explanations, and struggle to stimulate students' interest, thereby reducing learning engagement (Akanni, 2024).

Beyond teacher-related factors, school ownership also influences teaching and learning conditions in secondary schools. In Nigeria, secondary schools are commonly classified as unity

(federal) or state-owned institutions. These school types often differ in terms of funding, availability of instructional materials, teacher deployment, class size, supervision, and overall learning environment. These differences may affect both teachers' instructional practices and students' opportunities to engage meaningfully during Biology lessons. While students in better-resourced schools may benefit from interactive teaching methods and supportive learning environments, those in less-resourced schools may experience constraints that limit participation and sustained engagement. Learning engagement itself is a multidimensional concept encompassing behavioural, emotional, and cognitive involvement in learning activities. Engaged students participate actively in class, demonstrate interest and positive attitudes toward learning, and invest effort in understanding complex ideas (Almasri, (2021)

In Biology education, student engagement is particularly important because the subject requires observation, experimentation, inquiry, and the application of knowledge to real-world situations. Examining the influence of teachers' biological literacy levels and school ownership on students' learning engagement is therefore vital for improving Biology education outcomes in secondary schools in Oyo state Nigeria. Despite the recognized importance of teachers' competence and school-related factors, there is limited empirical evidence examining how teachers' biological literacy levels and school ownership jointly influence students' learning engagement in Biology, especially within the context of Oyo State Nigeria. The main purpose of this study is:

1. examine the influence of teachers' biological literacy on students' learning engagement;
2. examine teachers' biological literacy levels and school ownership as determinants of learning engagement among secondary school students in Oyo State; and
3. determine the level of students' learning engagement in Biology.

Research Questions

1. What is the influence of teachers' biological literacy levels on students' learning engagement in secondary schools in Oyo State?
2. What is the level of students' learning engagement in Biology?

Research Hypotheses

$H_0$1: There is no significant difference in the learning engagement of secondary school students in Biology based on school ownership (unity and state schools) in Oyo State Nigeria.

REVIEW OF LITERATURE

Biological literacy, which involves a sound understanding of core biological concepts, scientific reasoning, interpretation of biological information, and effective communication, is essential for effective Biology instruction. Teachers with strong biological literacy are better able to design conceptually accurate, inquiry-driven, and contextually relevant lessons (Holman, 2025). Tijani and Adeduyigbe (2026) further note that higher teacher content knowledge and scientific literacy enhance instructional quality, classroom interaction, and student engagement. Consequently, teachers with strong subject competence are more likely to adopt learner-centred strategies that promote curiosity, critical thinking, and active participation.

Beyond content knowledge, teachers' ICT competence and instructional skills significantly influence teaching effectiveness. Abdulraheem et al. (2025) found that Biology teachers' ICT literacy varies with experience and training, with higher ICT competence linked to improved instructional delivery. Such competencies enable teachers to integrate simulations, demonstrations, and digital tools that enhance interaction and sustain students' interest in Biology.

Student engagement is a multidimensional construct comprising behavioural, emotional, and cognitive dimensions. In Biology education, engagement is particularly critical due to the subject's emphasis on observation, experimentation, and real-life application. Evidence shows that student-centred instructional strategies, supported by teacher competence, significantly improve engagement and learning outcomes. For instance, Bolaji (2025) and Bolaji et al. (2025) report that inquiry-based, problem-based, and collaborative learning approaches enhance participation and conceptual understanding compared to traditional teacher-centred methods.

However, structural school factors, particularly school ownership, also shape engagement. In Nigeria, unity (federal) and state schools differ in resources, class size, teacher quality, and learning environment. Adera (2025) observed that such differences influence students' engagement and performance in Biology. Nonetheless, Adam et al. (2024) argue that teacher-related factors, especially biological literacy and pedagogical competence, exert a stronger influence on engagement than school type alone.

Similarly, classroom instructional practices and learning environments are critical determinants of engagement. Structured classroom management, active learning strategies, and positive teacher student relationships significantly enhance participation and interest (Badmus, 2023). Oyak (2024) further reports that student-centred classroom environments improve engagement and academic outcomes in science education. In addition, the integration of technology-enhanced and blended learning approaches has been shown to further strengthen engagement by promoting interactivity and collaboration (Bolaji et al., 2025). Collectively, these findings suggest that student engagement in Biology is best explained by the interaction of teacher competence and instructional practices, rather than content knowledge alone, with pedagogical design serving as the key mediator of engagement outcomes (Owolarafe et al., 2024).

Methodology

This study adopted a descriptive research design to examine teachers' biological literacy and school ownership as determinants of students' learning engagement in Biology in Oyo State, Nigeria. The population comprised Biology teachers in both unity (federal) and state secondary schools within the state. A sample of 50 Biology teachers was selected using stratified and simple random sampling techniques, with schools first categorised based on ownership (unity and state), after which teachers were randomly selected from each category to ensure representation. The sample consisted of 8 teachers from unity schools and 42 teachers from state schools, with the smaller number of unity school teachers reflecting their limited availability compared to the larger number of state-owned schools in the state. Data were collected using a structured questionnaire titled Teachers' Perception of Students' Learning Engagement and Biological Literacy Questionnaire *(*TPSLEBLQ*)*, which measured teachers' biological literacy and their perceptions of students' learning engagement in Biology. The instrument was validated by experts in Biology education and educational measurement, and its reliability was established using the Cronbach's Alpha method, yielding a coefficient of 0.80, indicating acceptable internal consistency. Data obtained were analysed using descriptive statistics (mean and standard deviation), while an independent samples t-test was used to test the hypothesis.

Results

RQ1: What is the influence of teachers' biological literacy levels on students' learning engagement in secondary schools in Oyo state?

Table 1*: Influence of Teachers' Biological Literacy Levels on Students' Learning Engagement in Secondary Schools in Oyo State Nigeria*

Items	Mean	Std. Deviation
1. My students can explain how human activities affect the environment and climate	1.52	0.64
2. My students demonstrate understanding of how diseases are spread and prevented.	1.54	0.70
3. My students can describe biological processes such as photosynthesis and respiration accurately.	1.44	0.61
4. My students understand how traits are inherited.	1.88	0.84
5. My students relate biological knowledge to real-life problems.	1.66	0.79
6. My students show awareness of the importance of sanitation and hygiene.	1.52	0.76

7. My students understand the importance of biodiversity in ecological balance.	2.12	0.71
8. My students make informed health-related decisions based on biological knowledge.	1.87	0.79
9. My student can interpret biological data such as food chains or life cycles.	1.70	0.70
10. My students understand the importance of a balanced diet to human health.	1.30	0.64
Grand Mean	1.65	

Table 1 reveals the influence of teachers' biological literacy levels on students' learning engagement in secondary schools in Oyo State Nigeria, on the 4-point Likert scale of Always (A), Often (O), Rare (R), and Never (N). In order to answer research question 1, a benchmark of 2.5 was set for this analysis. The benchmark of 2.5 was calculated by adding up each value of the 4-Likert scale and divided by 4 (A = 4, O = 3, R= 2, and N = 1. 4+3+2+1=10 divided by 4 = 2.5. Therefore, any statement equal to or above 2.5 was considered in agreement, while statements below was considered not in agreement. The analysis shows that all the mean value of is below the 2.5 benchmark. Also, the grand mean of 1.65 was found to be below the benchmark of 2.5. Since the grand mean is below the benchmark (2.5) of the scale, this implies that teachers' biological literacy has not sufficiently translated into high student learning engagement.

RQ2: What is the level of students' learning engagement in Biology?

Table 2: Level of Students' Learning Engagement in Biology

Items	Mean	Std. Deviation
1. My students actively participate in Biology class discussions.	1.40	0.63
2. My students ask thoughtful questions during Biology lessons.	1.740	0.75

3. My students show enthusiasm during practical sessions.	1.60	0.72
4. My students submit Biology assignments on time.	1.70	0.78
5. My students remain focused during Biology lessons	1.50	0.67
6. My students apply Biology knowledge to real-world problems.	2.20	0.80
7. My students collaborate well in group activities.	1.70	0.81
8. My students take initiative to read or research Biology outside class hours.	2.24	0.74
9. My students persist through challenging Biology topics.	2.16	0.86
10. My students participate in extracurricular Biology activities (e.g., science clubs).	2.12	0.93
Grand Mean	**1.81**	

Table 2 presents the level of students' learning engagement in Biology using a benchmark mean of 2.50. The benchmark of 2.5 was calculated by adding up each value of the 4- Likert scale and divided by 4 (A = 4, O = 3, R= 2, and N = 1. 4+3+2+1=10 divided by 4 = 2.5). Therefore, any statement equal to or above 2.5 was considered in agreement, while statements below was considered not in agreement. The analysis shows that all the mean value of is below the 2.5 benchmark. The results show that the grand mean score is 1.81, which is below the benchmark, indicates that students' learning engagement in Biology is low. In line with the objective of the study to determine the level of students' learning engagement in Biology, the findings reveal that engagement among secondary school students in North-Central Nigeria is generally low.

Table :3

$H_0$1: There is no significant difference in the learning engagement of secondary school students in Biology based on school ownership (unity and state schools) in Oyo state Nigeria.

School Type	N	X	SD	DF	T	Sig. (2-tailed)	Decision
Unity	8	17.25	4.71	48	-.665	.509	
State	42	18.36	4.25				

An independent samples t-test was conducted to examine the difference in learning engagement in Biology between students from unity schools and state schools in Oyo State, Nigeria. The results revealed that students in state schools ($\bar{X}$ = 18.36, SD = 4.25) had a slightly higher mean learning engagement score than those in unity schools ($\bar{X}$ = 17.25, SD = 4.71). However, this observed difference was not statistically significant at the 0.05 level ($t(48) = -0.665$, $p = 0.509$). Therefore, the null hypothesis was not rejected. This indicates that there is no significant difference in the learning engagement of secondary school students in Biology based on school ownership (unity and state schools). The finding suggests that school ownership does not significantly influence students' learning engagement in Biology in Oyo State, Nigeria, implying that other factors may play a more critical role in shaping students' engagement in Biology learning.

Discussion of Findings

The findings of this study reveal that teachers' biological literacy has not sufficiently translated into high levels of students' learning engagement in Biology in secondary schools in Oyo State. As shown in Table 1, all item mean scores, as well as the grand mean ($\bar{X}$ = 1.65), fell below the established benchmark of 2.50. This suggests that, despite the recognized importance of biological literacy in effective Biology instruction, students are not adequately engaged in understanding core biological concepts, applying scientific reasoning, or relating Biology knowledge to real-life contexts. This finding contrasts with previous studies that emphasize the critical role of teachers' biological literacy in fostering meaningful student engagement. Biological literacy equips teachers with the competence to present accurate content, employ inquiry-based strategies, and connect abstract concepts to students' everyday experiences (Holman, 2025).

Tijani and Adeduyigbe (2026) similarly reported that teachers with strong content knowledge and scientific literacy tend to demonstrate higher instructional quality and more effective classroom interactions, which promote deeper student engagement. However, the low engagement observed in this study suggests that the issue may not solely be a deficiency in biological literacy itself, but rather in the pedagogical translation of such knowledge into classroom practice. As noted by Shulman (1987), effective teaching requires not only mastery of subject matter but also the pedagogical content knowledge needed to transform that knowledge into teachable and engaging forms. In many cases, teachers may rely heavily on conventional, lecture-based approaches that limit students' active participation, thereby reducing opportunities for meaningful engagement despite adequate content knowledge.

Low level of students' learning engagement reported in Table 2 (grand mean = 1.81) further confirms that Biology lessons in the study area are not sufficiently stimulating students' behavioural, emotional, and cognitive involvement. This may be attributed to limitations in instructional practices, particularly the inadequate use of learner-centred and activity-based teaching strategies. Abdulraheem et al. (2025) reported that variations in teachers' ICT literacy and instructional competence significantly influence classroom effectiveness, while Bolaji et al. (2025) emphasized that inquiry-based, team-based, and problem-based instructional strategies enhance students' participation and conceptual understanding. The persistence of low engagement in this study therefore suggests that such strategies may not be effectively implemented in classrooms. In addition, the limited integration of instructional technologies and interactive teaching tools may further constrain teachers' ability to create dynamic learning environments that foster engagement (Abdulraheem et al., 2025).

Beyond pedagogy, classroom practices and learning conditions also appear to play a significant role. In many secondary schools, overcrowded classrooms, time constraints, and pressure to cover the syllabus often compel teachers to prioritise content delivery over interactive learning. This aligns with the observations of Badmus (2023), who noted that ineffective classroom organisation and limited teacher student interaction can significantly reduce students' engagement levels. Furthermore, Biology as a subject requires practical and experiential learning; however, inadequate laboratory facilities and limited opportunities for hands-on activities may hinder students' ability to explore and internalise biological concepts. Oyak (2024) emphasized that practical exposure and laboratory experiences are essential for stimulating students' curiosity and promoting deeper engagement in science subjects. Where such opportunities are lacking, learning becomes overly theoretical, thereby weakening students' interest and participation.

With respect to school ownership, the results of the independent samples t-test revealed no significant difference in students' learning engagement in Biology between unity and state schools ($t(48) = -0.665$, $p = 0.509$). This finding suggests that school ownership alone does not significantly determine students' engagement levels. Although state schools recorded slightly higher mean engagement scores, the difference was not statistically meaningful. This result contradicts earlier studies such as Adera (2025), which reported that school type significantly influences students' engagement due to differences in resources and learning environments. However, the present finding implies that systemic challenges affecting Biology instruction such as teaching methods, classroom practices, and teacher competence may cut across both unity and state schools in the region.

The absence of a significant difference based on school ownership supports Adam et al. (2024), who argued that teacher-related factors, particularly biological literacy and pedagogical competence, exert a stronger influence on student engagement than structural characteristics of schools. Similarly, Badmus (2023) and Oyak (2024) emphasized that classroom organisation, instructional strategies, and teacher student interactions play a more decisive role in shaping student engagement than school type. These findings suggest that improving student engagement in Biology requires more than enhancing teachers' biological literacy; it necessitates strengthening

pedagogical skills, promoting interactive classroom practices, and increasing opportunities for practical and laboratory-based learning experiences.

The study indicates that students' learning engagement in Biology in secondary schools in Oyo State is generally low, Teachers' biological literacy and pedagogical practices appear inadequate to effectively stimulate students' behavioural, cognitive, and emotional involvement in Biology lessons. Additionally, school ownership was not found to significantly influence engagement, suggesting that teacher related factors and classroom practices play a more decisive role than structural characteristics.

Conclusion

The study concludes that teachers' biological literacy alone does not guarantee students' learning engagement, as the main challenge lies in its limited translation into effective pedagogy, interactive classroom practices, and adequate laboratory exposure. This underscores the need for science teacher professional development to prioritise pedagogical content knowledge and practical teaching skills over content mastery alone. Emphasis should be placed on learner-centred strategies, use of ICT, and simple hands-on laboratory activities to foster active participation. Ultimately, sustained, practice-oriented training is essential for enabling teachers to transform their biological literacy into engaging and meaningful classroom instruction.

Recommendations

1. Education ministries should provide regular training to strengthen teachers' content knowledge and learner centred strategies to improve student engagement in Biology.
2. Policies should enhance teacher competence and ensure equitable access to teaching resources, including laboratories and ICT tools, across all schools.
3. Education authorities should promote interactive, practical, and technology-enhanced teaching methods to increase students' engagement and interest in Biology.
4. School administrators should support effective classroom practices by encouraging hands-on activities, proper instructional monitoring, and use of improvised teaching materials.

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