# Pedagogical Practices of Biology Teachers and Students' Learning Engagement in Secondary Schools in North-Central Nigeria

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**ABSTRACT**
Biology is a fundamental science subject that contributes to health, agriculture, environmental sustainability, and technology. However, students' learning engagement remains low in many Nigerian secondary schools, partly due to differences in teachers' pedagogical practices. This study examined Biology teachers' pedagogical practices and their relationship with students' learning engagement in Unity and State secondary schools in North-Central Nigeria. A correlational design was used with 420 Biology teachers selected through multi-stage sampling. Data were collected using a validated questionnaire (Cronbach's alpha = 0.80) and analyzed using descriptive statistics and Pearson Product Moment Correlation (PPMC) at the 0.05 significance level. Teachers frequently used learner-centred practices, including questioning, cooperative learning, practical activities, instructional materials, feedback, and technology integration (mean = 3.42). Significant relationships were found in Unity ($r = .557$, $p < .05$) and State ($r = .623$, $p < .05$) schools. The study concludes that learner-centred practices enhance students' engagement and recommends continuous teacher development and improved instructional resources.

**ABSTRAK**
Biologi merupakan mata pelajaran sains dasar yang berperan dalam kesehatan, pertanian, keberlanjutan lingkungan, dan teknologi. Namun, keterlibatan siswa dalam pembelajaran Biologi masih rendah di banyak sekolah menengah di Nigeria, salah satunya dipengaruhi oleh perbedaan praktik pedagogis guru. Penelitian ini mengkaji praktik pedagogis guru Biologi dan hubungannya dengan keterlibatan belajar siswa di sekolah menengah Unity dan State di North-Central Nigeria. Penelitian menggunakan desain korelasional dengan 420 guru Biologi yang dipilih melalui *multi-stage sampling*. Data dikumpulkan menggunakan kuesioner tervalidasi (Cronbach's alpha = 0,80) dan dianalisis menggunakan statistik deskriptif serta *Pearson Product Moment Correlation* (PPMC) pada taraf 0,05. Guru sering menerapkan praktik berpusat pada peserta didik, seperti bertanya, pembelajaran kooperatif, praktikum, media pembelajaran, umpan balik, dan integrasi teknologi (rata-rata = 3,42). Hubungan signifikan ditemukan pada sekolah Unity ($r = 0{,}557$; $p < 0{,}05$) dan State ($r = 0{,}623$; $p < 0{,}05$). Penelitian menyimpulkan bahwa praktik berpusat pada peserta didik meningkatkan keterlibatan belajar dan merekomendasikan pengembangan profesional guru serta peningkatan sumber daya pembelajaran.

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**KEYWORDS**
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## INTRODUCTION

Biology is the branch of science that studies living organisms and their interactions with one another and the environment. As a core science subject in Nigerian secondary schools, it provides learners with essential knowledge

and skills in health, agriculture, environmental sustainability, and biotechnology, thereby preparing them for careers in medicine, agriculture, environmental science, and related disciplines. Biology, the scientific study of living organisms and their interactions with one another and the environment (Dehghani et al., 2025). Despite its significance, students' learning engagement and academic performance in Biology remain a persistent concern, largely due to the pedagogical practices employed during classroom instruction (Dewsbury et al., 2022).

Pedagogical practices refer to the instructional methods, teaching strategies, classroom interactions, assessment techniques, and learning activities used by teachers to facilitate learning (Suyo-Vega et al., 2024). Effective Biology teaching requires learner-centred pedagogies that promote inquiry, critical thinking, collaboration, experimentation, problem-solving, and active participation. Grounded in constructivist learning theory, these approaches encourage learners to actively construct knowledge through practical activities, questioning, visual instructional materials, cooperative learning, prompt feedback, and real-life applications, thereby enhancing students' interest and engagement (Tymoshenko et al., 2024). Students' learning engagement is widely recognised as an important indicator of educational quality because engaged learners exhibit greater motivation, participation, persistence, and academic achievemen (Wong et al., 2024). In Biology, engaged students actively participate in practical activities, discussions, scientific inquiry, and the application of biological concepts to real-life situations. Consequently, improving students' engagement has become a major goal of science education.

Educational reforms in Nigeria advocate learner-centred instructional practices to improve meaningful learning and scientific literacy. However, differences in school ownership, teacher competence, instructional resources, and classroom environments may affect the implementation of these practices. Although evidence from North-Central Nigeria suggests that Biology teachers frequently employ learner-centred strategies, variations persist between Unity and State secondary schools due to differences in infrastructure, funding, and resource availability (Fufa & Ensene, 2023).

## Statement of the Problem

Despite the growing emphasis on learner-centred teaching approaches in science education, many secondary school students in Nigeria continue to demonstrate low levels of learning engagement and unsatisfactory academic performance in Biology (Ahiakwo & Oko-Jaja, 2023) A considerable number of students remain passive during classroom instruction, participate minimally in discussions and practical activities, and often struggle to apply biological concepts to real-life situations. This situation has raised concerns among educators, curriculum planners, and policymakers, particularly because Biology serves as a foundational subject for careers in medicine, agriculture, environmental science, biotechnology, and other science-related disciplines. The persistent challenges in students' engagement suggest that the desired outcomes of the learner-centred curriculum have not been fully realised in many secondary schools (Folashade, 2023).

One possible explanation for this situation is the variation in the pedagogical practices employed by Biology teachers. While some teachers effectively implement inquiry-based, collaborative, and activity-oriented instructional strategies, others continue to rely predominantly on conventional teacher-centred methods that provide limited opportunities for students to participate actively in the learning process. In addition, disparities in instructional resources, laboratory facilities, teacher professional development, and classroom environments between Unity and State secondary schools may further influence the quality of Biology instruction and students' learning experiences.

Although several studies have examined students' achievement and factors influencing science education in Nigeria, empirical evidence specifically focusing on the pedagogical practices employed by Biology teachers and how these practices differ across Unity and State secondary schools in North-Central Nigeria remains limited. Existing studies have largely concentrated on instructional methods, academic performance, or teacher competence without providing comprehensive evidence on the nature of pedagogical practices and the contextual influence of school ownership on students' learning engagement. This gap limits the availability of context-specific evidence needed by educators, school administrators, and policymakers to design interventions that enhance the quality of Biology teaching. It is against this background that the present study examined the pedagogical practices employed by Biology teachers and the influence of school ownership in Unity and State secondary schools in North-Central Nigeria. This study therefore examined the pedagogical practices employed by Biology teachers and the influence of school ownership to provide evidence for improving Biology teaching and students' learning engagement.

## Research Objective

1. Investigate the pedagogical practices employed by Biology teachers in secondary

explore the relationship between teachers' pedagogical practices and secondary school students perceived learning engagement

### Research Questions

1.What pedagogical practices do Biology teachers employ in secondary schools in North-Central Nigeria?

### Research Hypothesis

1.There is no significant relationship in the pedagogical practices employed by Biology teachers in unity and state schools.

## REVIEWED LITERATURE

### Concept of Pedagogical Practices

Pedagogical practices refer to the instructional strategies, teaching methods, classroom interactions, assessment techniques, and learning activities that teachers employ to facilitate students' learning and achieve desired educational objectives (Moore, 2014). They encompass all the approaches teachers use to create meaningful learning experiences, manage classroom instruction, assess learners' progress, and encourage active participation during lessons. In Biology education, pedagogical practices extend beyond simply transmitting scientific knowledge; they involve engaging students in activities that enable them to observe, investigate, experiment, analyse, and apply biological concepts to real-life situations. The effectiveness of Biology teaching therefore depends not only on what teachers know but also on how effectively they communicate that knowledge to learners.

Effective pedagogical practices in Biology are strongly rooted in Constructivist Learning Theory and Shulman's Pedagogical Content Knowledge (PCK) framework. Constructivist Learning Theory posits that learners actively construct knowledge by connecting new information with their prior experiences through exploration, inquiry, collaboration, and reflection. Consequently, Biology teachers are expected to create learner-centred classrooms where students actively participate in discussions, investigations, practical activities, and problem-solving tasks rather than passively receiving information. Similarly, Shulman's Pedagogical Content Knowledge (PCK) framework emphasises that effective teaching requires more than mastery of subject matter; it also demands the ability to present complex concepts in ways that are understandable, engaging, and appropriate for learners' developmental levels. Teachers with strong pedagogical content knowledge can simplify abstract biological concepts, anticipate students' misconceptions, and employ appropriate instructional strategies that enhance understanding and retention (Musene, 2025).

Within Biology classrooms, effective pedagogical practices include inquiry-based learning, cooperative learning, practical laboratory activities, fieldwork, project-based learning, classroom discussions, demonstrations, questioning techniques, concept mapping, and the use of visual representations such as charts, models, diagrams, and animations. These learner-centred approaches encourage students to think critically, investigate scientific phenomena, develop problem-solving skills, and relate biological knowledge to everyday life. They also promote higher levels of cognitive, behavioural, and emotional engagement, enabling students to become active participants in the learning process rather than passive recipients of information.

The effectiveness of these pedagogical practices is further enhanced by teachers' instructional competence, particularly their ability to integrate information and communication technology (ICT) into classroom instruction. With the rapid advancement of educational technologies, Biology teachers increasingly have access to digital tools that enrich teaching and learning experiences. Abdulraheem et al. (2025) reported that Biology teachers' ICT competence varies according to their professional experience and participation in training programmes, with teachers possessing higher levels of digital competence demonstrating more effective instructional delivery. The integration of technology through multimedia presentations, virtual laboratories, simulations, educational videos, interactive whiteboards, digital microscopes, online collaborative platforms, and virtual demonstrations enables teachers to explain abstract biological processes more vividly and accurately. These technological tools promote active participation, stimulate curiosity, improve conceptual understanding, and sustain students' interest and engagement in Biology, thereby contributing significantly to improved learning outcomes.

### Meaning of Students' Learning Engagement

Students' learning engagement is widely recognised as a multidimensional construct that reflects the degree to which learners actively participate in and commit themselves to the learning process. It encompasses three interrelated dimensions: behavioural engagement, emotional engagement, and cognitive engagement. Behavioural engagement refers to students' active participation in classroom activities, including attending lessons regularly, completing assignments, participating in discussions, and engaging in practical activities. Emotional engagement involves students' feelings, attitudes, and sense of belonging toward learning, their teachers, and the school

environment. Cognitive engagement, on the other hand, relates to the mental effort students invest in understanding concepts, solving problems, thinking critically, and applying knowledge to new situations. Together, these dimensions determine the extent to which students are involved in and benefit from classroom instruction.

In Biology education, students' learning engagement is particularly important because the subject is practical, inquiry-oriented, and closely connected to everyday life. Understanding biological concepts requires learners to observe natural phenomena, conduct experiments, analyse scientific evidence, ask questions, and apply scientific knowledge to real-world issues such as environmental conservation, disease prevention, genetics, biotechnology, and public health. Consequently, students are more likely to develop meaningful understanding when they are actively involved in the learning process rather than merely listening to classroom lectures. An engaging Biology classroom therefore encourages learners to explore, investigate, collaborate with peers, and construct knowledge through hands-on experiences.

The level of students' engagement is greatly influenced by the pedagogical approaches adopted by teachers. Learner-centred instructional strategies create opportunities for students to become active participants in their own learning by encouraging discussion, inquiry, collaboration, critical thinking, and problem-solving. Such approaches shift the focus of classroom instruction from the teacher to the learner, enabling students to take greater responsibility for their learning while developing confidence, curiosity, and scientific reasoning skills. When students are encouraged to ask questions, share ideas, conduct investigations, and reflect on their learning experiences, they are more motivated to participate actively and persist in challenging learning tasks.

Empirical evidence consistently demonstrates the positive relationship between learner-centred pedagogy and students' learning engagement. Bolaji et al. (2025) found that instructional approaches such as inquiry-based learning, problem-based learning, and collaborative learning significantly enhance students' classroom participation, motivation, conceptual understanding, and academic achievement compared with conventional teacher-centred methods. These instructional strategies stimulate students' interest by making Biology lessons more interactive, relevant, and intellectually challenging. As students become more actively engaged in learning activities, they develop deeper conceptual understanding, stronger problem-solving abilities, improved scientific literacy, and greater confidence in applying biological knowledge to real-life situations. This underscores the importance of adopting effective pedagogical practices that foster students' behavioural, emotional, and cognitive engagement, ultimately leading to improved learning outcomes in Biology.

## Influence of School Ownership on Pedagogical Practice

Beyond classroom instruction, students' learning engagement is also shaped by a variety of contextual factors within the school environment. These factors include school ownership, availability of instructional resources, class size, school leadership, teacher quality, classroom climate, and the overall learning environment. Although teachers play a central role in facilitating learning, the conditions under which teaching and learning occur can either enhance or hinder students' willingness and ability to participate actively in classroom activities. A supportive school environment provides students with opportunities to explore, collaborate, ask questions, and engage meaningfully with learning tasks, whereas inadequate facilities and unfavourable learning conditions may limit students' participation and interest.

In the Nigerian education system, notable differences exist between Unity (Federal Government) secondary schools and State secondary schools. Unity schools generally receive greater government funding, better infrastructural facilities, more equipped science laboratories, improved access to instructional materials, smaller teacher–student ratios, and relatively more stable staffing. In contrast, many States secondary schools face challenges such as overcrowded classrooms, inadequate laboratory equipment, limited instructional resources, irregular professional development opportunities for teachers, and insufficient funding. These disparities create unequal learning conditions that may influence how Biology is taught and the extent to which students actively engage in learning activities.

Adera (2025) observed that variations in school resources, learning facilities, and classroom environments significantly influence students' engagement and academic achievement in Biology. Students who learn in well-resourced schools with functional laboratories, adequate teaching materials, and conducive classroom environments are generally more motivated to participate in practical activities, collaborative learning, and scientific investigations than those in schools with limited resources. This suggests that the quality of the learning environment can either facilitate or constrain students' engagement in Biology lessons. Nevertheless, the availability of resources alone does not guarantee meaningful learning engagement.

Adam et al. (2024) argued that the quality of teaching, particularly the pedagogical practices employed by teachers, has a greater influence on students' engagement than school ownership itself. According to the authors,

effective teachers are capable of creating stimulating and interactive learning experiences even in resource-constrained environments by employing learner-centred instructional strategies that encourage participation, inquiry, collaboration, and critical thinking. This implies that while school ownership may determine the availability of educational resources, it is the teacher's instructional competence and pedagogical effectiveness that largely determine how those resources are utilised to promote learning. Similarly, Badmus (2023) reported that effective classroom management, positive teacher–student relationships, and the consistent use of active learning strategies significantly enhance students' participation, motivation, and commitment to learning. A classroom characterised by mutual respect, encouragement, open communication, and supportive interactions creates an atmosphere in which students feel confident to ask questions, express ideas, participate in discussions, and engage in practical activities without fear of criticism or failure. Such positive classroom environments foster both emotional and behavioural engagement, leading to improved learning experiences.

Learner-centred classroom environments significantly improve students' engagement and academic achievement by promoting autonomy, collaboration, and deeper understanding of subject concepts. When students are actively involved in constructing knowledge through inquiry, experimentation, discussion, and problem-solving, they develop stronger critical thinking skills and retain concepts more effectively than through passive learning approaches. Complementing these findings, Bolaji et al. (2025) demonstrated that the integration of technology-enhanced and blended learning approaches further strengthens interaction, collaboration, and communication among learners. The use of multimedia resources, virtual laboratories, educational simulations, and online collaborative platforms makes Biology lessons more interactive, engaging, and relevant to students' experiences, thereby sustaining their interest and improving learning outcomes.

Förtsch et al. (2017), opined that students' learning engagement in Biology is influenced by the interaction of effective pedagogical practices and a supportive school environment rather than by a single factor. Although school ownership may affect the availability of instructional resources and learning opportunities, the quality of classroom instruction, teachers' pedagogical competence, positive teacher–student relationships, effective classroom management, and the integration of educational technologies are the major determinants of students' behavioural, emotional, and cognitive engagement. Bizimana et al. (2022), emphasised that improving students' engagement in Biology requires adequate investment in instructional resources alongside continuous professional development to strengthen teachers' learner-centred pedagogical skills.

## METHODS

This study adopted a correlational research design to examine the pedagogical practices employed by Biology teachers and their relationship with students' learning engagement in secondary schools in North-Central Nigeria. The study was conducted among Biology teachers in public Unity and State secondary schools in the region. A sample of 420 Biology teachers was selected through a multi-stage sampling procedure. Data were collected using a structured questionnaire titled *Biology Teachers' Pedagogical Practices and Students' Learning Engagement Questionnaire (BTPPSLEQ)*, designed on a four-point Likert scale of Always (4), Often (3), Sometimes (2), and Never (1), with a benchmark mean of 2.50 used for decision-making. The instrument was validated by experts in Science Education and Educational Measurement and Evaluation, while its reliability was established using Cronbach's Alpha, which yielded a reliability coefficient of 0.80. Data collected were analysed using descriptive statistics, including frequency counts, percentages, mean, and standard deviation, to answer the research question, while Pearson Product Moment Correlation (PPMC) was employed to test the hypothesis at the 0.05 level of significance.

## RESULTS AND DISCUSSIONS

Table 1. Frequency of Biology Teachers' Use of Pedagogical Practices

| SN | Items | Always F (%) | Often F (%) | Sometimes F (%) | Never F (%) | Mean |
|---|---|---|---|---|---|---|
| 1 | I use real-life examples to explain biological concepts. | 294 (70.0%) | 102 (24.3%) | 22 (5.2%) | 2 (0.5%) | 3.64 |
| 2 | I incorporate visual aids (e.g., charts, models, diagrams) during lessons. | 238 (56.7%) | 138 (32.9%) | 44 (10.5%) | 0 (0.0%) | 3.46 |
| 3 | I encourage students to ask questions and engage in discussions. | 336 (80.0%) | 66 (15.7%) | 17 (4.0%) | 1 (0.2%) | 3.75 |
| 4 | I organise group or cooperative learning activities. | 181 (43.1%) | 151 (36.0%) | 83 (19.8%) | 5 (1.2%) | 3.21 |
| 5 | I conduct regular practical or hands-on experiments. | 161 (38.3%) | 169 (40.2%) | 86 (20.5%) | 4 (1.0%) | 3.16 |

| SN | Items | Always F (%) | Often F (%) | Sometimes F (%) | Never F (%) | Mean |
|---|---|---|---|---|---|---|
| 6 | I provide prompt and constructive feedback on students' performance. | 211 (50.2%) | 167 (39.8%) | 39 (9.3%) | 3 (0.7%) | 3.40 |
| 7 | I relate Biology topics to current environmental or health-related issues. | 245 (58.3%) | 146 (34.8%) | 23 (5.5%) | 6 (1.4%) | 3.50 |
| 8 | I use instructional materials aligned with the curriculum. | 256 (61.0%) | 120 (28.6%) | 39 (9.3%) | 5 (1.2%) | 3.49 |
| 9 | I integrate technology (e.g., videos, simulations) into my teaching. | 160 (38.1%) | 140 (33.3%) | 103 (24.5%) | 17 (4.0%) | 3.05 |
| 10 | I use students' assessment results to improve my teaching strategies. | 242 (57.6%) | 141 (33.6%) | 36 (8.6%) | 1 (0.2%) | 3.49 |
| | **Average Mean** | | | | | **3.42** |

## Testing of hypothesis

Table 2. Relationship between Pedagogical Practices and Students' Learning Engagement in Unity and State Schools

| School ownership | Variable | N | Pearson Correlation (r) | Sig. (2-tailed) (p) | Remark |
|---|---|---|---|---|---|
| Unity | Pedagogical practices | 65 | .557** | .000 | Rejected |
| State | Pedagogical practices | 355 | .623** | .000 | |

## Discussion of Findings

Biology teachers in North-Central Nigeria frequently employed learner-centred pedagogical practices, Specifically, teachers frequently encouraged classroom discussions and questioning, used real-life examples, incorporated visual instructional materials, related Biology concepts to environmental and health issues, organised cooperative learning activities, conducted practical lessons, provided constructive feedback, and integrated technology into instruction. This finding indicate that Biology teachers are increasingly adopting instructional approaches that actively engage learners in the teaching-learning process rather than relying solely on traditional lecture methods. The finding supports Constructivist Learning Theory, which posits that meaningful learning occurs when learners actively construct knowledge through inquiry, collaboration, experimentation, and interaction with their environment. It also corroborates Shulman's Pedagogical Content Knowledge (PCK) framework, which emphasises that effective teaching requires teachers to transform subject matter into forms that learners can easily understand through appropriate instructional strategies. The frequent use of questioning, practical activities, visual materials, and collaborative learning observed in this study demonstrates that many Biology teachers possess the pedagogical competence necessary to facilitate meaningful learning experiences.

The finding is consistent with Suyo-Vega et al. (2024), who reported that innovative learner-centred pedagogical practices significantly enhance classroom interaction, critical thinking, and students' participation in science learning. Similarly, Tymoshenko et al. (2024) found that active instructional approaches promote students' academic growth and deeper conceptual understanding. The result also agrees with Dewsbury et al. (2022), who concluded that inclusive and active pedagogies improve students' participation, reduce learning gaps, and enhance academic performance. Furthermore, the finding supports Bolaji et al. (2025), who observed that integrating modern instructional approaches, including technology-enhanced learning, promotes greater student engagement and improves Biology instruction.

The study equally aligns with Wong et al. (2024), whose meta-analysis established that student engagement is positively associated with teachers' use of interactive and learner-centred instructional strategies. The frequent use of discussions, questioning, and practical activities reported in the present study provides opportunities for behavioural, emotional, and cognitive engagement, which are essential dimensions of effective learning. However, the finding contrasts with Fufa et al. (2023), who reported that although learner-centred teaching is widely recommended, many secondary school teachers encounter challenges such as inadequate instructional resources, overcrowded classrooms, and insufficient professional training, which limit effective implementation of learner-centred strategies. The discrepancy may be attributed to contextual differences in the study areas, variations in teacher professional development opportunities, or recent educational reforms.

A significant relationship in the pedagogical practices employed by Biology teachers in Unity and State secondary schools This finding indicates that school ownership significantly influences the pedagogical practices employed by Biology teachers. Although teachers in both categories of schools employed learner-centred

strategies, differences in instructional practices appear to exist due to variations in institutional support, resource availability, and learning environments. This finding is consistent with the reviewed literature on the influence of school ownership on teaching practices. Adera (2025) argued that well-resourced schools provide better learning environments, adequate laboratory facilities, and improved instructional materials, thereby enabling teachers to implement learner-centred instructional strategies more effectively. Similarly, the finding supports Bizimana et al. (2022), who reported that supportive classroom environments and adequate instructional resources enhance students' engagement by enabling teachers to employ cooperative learning, practical activities, and inquiry-based instruction more effectively.

The finding also corroborates Förtsch et al. (2017), who maintained that students' engagement and classroom effectiveness result from the interaction between quality pedagogy and a supportive school environment rather than from instructional strategies alone. This implies that while teachers' pedagogical competence remains essential, school ownership may indirectly influence classroom practices through differences in funding, infrastructure, laboratory facilities, instructional materials, and administrative support. However, the finding only partially agrees with Adam et al. (2024), who argued that effective pedagogical practices depend more on teachers' instructional competence than on school ownership or resource availability. According to their position, competent teachers can implement learner-centred approaches even in resource-constrained environments. Likewise, Badmus (2023) emphasised that classroom management and positive teacher-student relationships contribute more significantly to students' engagement than infrastructural differences alone. While these studies acknowledge the importance of teacher quality, the present study suggests that disparities in school ownership remain significant factors influencing the implementation of effective pedagogical practices in North-Central Nigeria development opportunities, and ensuring adequate support for teachers irrespective of school ownership. This would facilitate the consistent implementation of effective pedagogical practices capable of enhancing students' learning engagement in Biology.

## CONCLUSIONS

The study concludes that Biology teachers in North-Central Nigeria frequently employ learner-centred pedagogical practices that promote students' active participation, inquiry, collaboration, practical activities, and the effective use of instructional materials. However, significant differences in pedagogical practices between Unity and State secondary schools indicate that school ownership and disparities in instructional resources influence the implementation of these teaching strategies. This underscores the need for continuous professional development, equitable provision of instructional resources, and greater support for learner-centred teaching approaches to enhance students' learning engagement and improve the quality of Biology education.

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