Evaluation of the Accessibility and Application of Biology Laboratory Resources in Senior Secondary Schools in Kwara State

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ABSTRACT

Biology is one of the science subjects, taught with laboratory resources like specimens, apparatus, and equipment. Teaching the subject is faced with many challenges among which are unavailability and consequently low utilization of the biology laboratory resources. This study investigated the accessibility and application of biology laboratory resources used in senior secondary schools in Kwara State, Nigeria. The study adopted a quantitative descriptive survey design and the population was 257 biology teachers sampled through a multistage sampling techniques, the study employed the Laboratory Rating Scale Questionnaire (LARSQ) as the instrument for data collection. Descriptive statistics such as frequency counts, percentages, means and standard deviations were used to answer the research questions, while inferential statistics (t-test and ANOVA) were employed to test hypotheses at the 0.05 significance level. Findings revealed that majority of the laboratory resources were accessible to some extent, but its application rate was low. Significant differences were observed in teachers' views on laboratory resources based on school location. The study concludes that inconsistent accessibility and application of some laboratory resources may continue to hinder effective teaching of biology in Nigerian schools. Recommendations were made for improved provision, training, and monitoring of laboratory practices to enhance students' academic performance.

Keywords: Biology education, evaluation, accessibility, applications, laboratory resources

INTRODUCTION

Science education plays a central role in developing students' intellectual skills, problem-solving abilities, and scientific literacy, all of which are essential for national development. At the senior secondary school level, effective teaching and learning of science particularly Biology, Chemistry, and Physics depends largely on the accessibility, and proper application of laboratory resources used. In Kwara State, schools vary widely in terms of facilities and resource provisions, creating disparities in students' learning experiences. While some schools may possess relatively equipped laboratories, others struggle with outdated, insufficient, or completely absent laboratory materials. Even where materials are accessible, issues such as lack of trained personnel, inadequate maintenance, poor funding, and teacher-centered instructional practices, may limit their effective application. These challenges raised concerns about the quality of science education being delivered and the preparedness of students for higher-level scientific courses and careers.

Evaluation of laboratory accessibility and applications of resources used in senior secondary schools in kwara state is therefore crucial. Such an assessment will provide evidence-based insights into current resource conditions, highlight gaps in laboratory use, and guide policy makers, school administrators, and teachers in implementing strategies to improve science teaching and learning.

The accessibility and application of biology laboratory resources remain central to effective science teaching and learning in secondary schools. Laboratory resources including equipment, specimens, reagents, and instructional materials provides opportunities for learners to translate theoretical knowledge into practical experiences. Recent studies emphasize that the availability and accessibility of these resources significantly influence the quality of biology instruction, as practical activities enable students to observe, manipulate, and understand biological concepts more concretely (Mmassy et al., 2025)

Despite their importance, empirical evidence indicates disparities in resource distribution between schools, with many lacking essential laboratory materials, practical manuals, and adequate time for laboratory sessions (Mmassy et al., 2025; Cabusor & Antonio, 2025). Similarly, financial constraints, insufficient infrastructure, and lack of maintenance have been identified as key barriers limiting access to functional laboratory facilities (Hashmi, 2025).

The state of accessibility of biology laboratory resources in Nigeria is generally characterized by uneven distribution and moderate availability, with significant differences across regions and school types. Evidence from recent studies indicates that while some urban and well-funded schools have relatively adequate laboratory facilities, many public secondary schools still face shortages of essential biology equipment, specimens, and consumables. For instance, research has shown that schools in more developed areas tend to report better access to laboratory resources compared to their rural counterparts, where infrastructural deficits and limited funding remain persistent challenges (Adeyemi & Ogunleye, 2024; Bello et al., 2025). Moreover, the issue of accessibility extends beyond mere availability to include functionality and adequacy of the resources. Several studies have revealed that even where laboratory facilities exist, they are often outdated, insufficient, or poorly maintained, thereby reducing their effectiveness for practical teaching (Okeke & Ibrahim, 2024; Yusuf & Adebayo, 2025. In addition, accessibility is closely linked to the level of utilization of biology laboratory resources in schools. Findings from recent research suggest that inadequate teacher training, lack of technical support, and insufficient time allocated for practical work often hinder the effective application of available laboratory materials (Olatunji et al., 2024; Hassan & Sadiq, 2025). Consequently, students in schools with limited access or poor utilization of laboratory resources tend to perform lower in biology compared to those in better-equipped environments. Overall, the state of accessibility of biology laboratory resources in Nigeria can be described as inconsistent and inadequate in many contexts, highlighting the need for improved funding, policy implementation, and resource management to ensure equitable and effective science education.

Empirical evidence on the accessibility and application of biology laboratory resources in Nigeria reveals consistent patterns of inadequacy and its impact on teaching and learning outcomes. A descriptive survey conducted in Enugu State involving 417 biology teachers found that while some laboratory safety practices were moderately implemented, the overall management

and utilization of biology laboratory resources were at a low level, indicating gaps in effective access and use (Achufusi & Ezeobi, 2024).

Similarly, a study in Abeokuta involving 602 students and 53 teachers reported that biology laboratory facilities were not adequately available and had low usability, although they significantly predicted students' academic achievement (Adeyemi & Okonkwo, 2024) . Further empirical findings from Nasarawa State, based on a sample of 500 students, showed that proper organization and management of laboratory resources positively influenced students' academic achievement and knowledge retention in biology (2025). Accessibility of biology laboratory resources in Nigerian secondary schools is influenced by several interrelated factors, many of which constrain effective teaching and learning. One major factor is inadequate funding, which limits the procurement, maintenance, and upgrading of laboratory equipment and consumables. In many public schools, budgetary allocations to science education are insufficient, resulting in poorly equipped or non-functional laboratories (Adeyemi & Ogunleye, 2024; Bello et al., 2025). Infrastructural deficits, including lack of dedicated laboratory spaces, unreliable electricity supply, and overcrowded classrooms, further restrict students' access to available resources. Additionally, disparities between urban and rural schools contribute to unequal distribution of laboratory materials, while insufficient teacher training and technical support reduce the effective utilization of existing resources (Olatunji et al., 2024).

Conversely, several mitigating factors can enhance accessibility and effective use of biology laboratory resources. Increased government investment and targeted intervention programs can improve the provision and equitable distribution of laboratory facilities across schools. School-level initiatives such as proper resource management, regular maintenance, and improvisation of teaching materials also play a crucial role in bridging resource gaps (Hassan & Sadiq, 2025). Furthermore, continuous professional development for teachers, particularly in laboratory management and innovative instructional strategies, can enhance the application of available resources. The integration of digital tools and virtual laboratory simulations also offers alternative means of access where physical resources are limited, thereby supporting more inclusive and effective biology instruction.

Recent developments in the application of laboratory resources have emphasized the shift from traditional hands-on laboratories toward more flexible, technology-enhanced environments that support both educational and research goals. The adoption of **virtual** and remote laboratory systems has grown rapidly, driven by the need to overcome barriers such as limited funding, resource scarcity, and geographic disparities in access to well-equipped facilities. For example, virtual laboratories have been extensively examined in STEM education research, where they are shown to provide scalable, cost-effective platforms that facilitate experiential learning and student engagement without the constraints of physical space and equipment availability (Hanine et al., 2025). Similarly, systematic analyses of

collaborative remote labs highlight how communication and group awareness tools integrated into these environments can foster deeper learning and interaction, positioning virtual labs as a complementary extension to physical lab infrastructure (Kurtz et al., 2025). These innovations suggest that applying diverse laboratory formats not only enhances accessibility but also supports pedagogical adaptability across disciplines.

At the same time, empirical studies continue to explore how laboratory resources influence learning outcomes and instructional effectiveness. In secondary and tertiary education, collectively, these findings underscore the importance of strategically applying a range of laboratory resources physical, virtual, and hybrid to optimize both educational equity and instructional effectiveness in contemporary science.

Statement of the Problem

Despite the Nigerian government's efforts to promote sciences through laboratory activities through the procurement of different resources, a numbers of factors including and challenging (Aypay, 2011). However, accessibility, and applications of the laboratory resources became worrisome. This was also demonstrated by the candidates' unsatisfactory performance in the practical and in biology as seen on the West African Senior School Certificate Examinations (WASSCE) results from year 2014-2022 where error on the part of technicalities were been identified, this could be tantamount to the resources applications and its accessibilities .

The effective teaching and learning of biology in senior secondary schools largely depend on the accessibilities and proper applications of laboratory resources. However, in many schools, especially in developing regions such as Kwara State, access to essential biology laboratory equipment remains limited or inconsistent. This lack of accessibility often restricts students' ability to engage in practical, hands-on activities, which are crucial for understanding complex biological concepts. As a result, students may rely primarily on theoretical learning, leading to shallow comprehension, reduced interest in the subject, and poor academic performance (Ezeiheukwu, 2025; Lazaro & Paglinawan, 2025).

Moreover, the application of available laboratory resources presents another challenge. Even when schools possess the necessary apparatus and materials, studies have shown that inadequate training, poor maintenance, and insufficient supervision can hinder the effective use of these resources in instructional activities. Teachers may underutilize the laboratory due to large class sizes, time constraints, or limited pedagogical knowledge about integrating laboratory work into the curriculum (Hanine et al., 2025; James et al., 2025). Consequently, the potential of laboratory resources to enhance experiential learning, critical thinking, and scientific inquiry among students is not fully realized. Addressing these issues is essential for ensuring that all students have equal opportunities to benefit from practical biology education and achieve optimal learning outcomes. There were few little researches on accessibility and applications of laboratory resources. As a result, this study evaluated the accessibility and applications of biology laboratory resources in senior secondary schools in Kwara State**.** Moderating variables like school

location and the school type were considered.

Objectives of the Study

The main objective of this study was to evaluate the accessibility and applications of biology laboratory resources in senior secondary schools in Kwara State. Specifically, the study seek to;

1. determined the accessibility of biology laboratory resources in senior secondary schools in kwara State
2. determined the applications of biology laboratory resources in senior secondary schools in kwara state
3. Sought the views of biology teachers on the accessibility of laboratory apparatus based on school location

Research questions

This study provided answers to the following research questions;

1. What is the level of accessibility of biology laboratory resources in senior secondary schools in Kwara State?

2. How are biology laboratory resources applied in senior secondary schools in Kwara State?

3. What are the views' of biology teachers' on accessibilties of laboratory specimen(s) based on school location in Kwara State?

Resaerch hypothesis

$H0_1$: There is no statistically significant difference in the views of biology teachers on the accessibilities of laboratory apparatus based on school location.

$H0_2$: There is no significant difference on the views of biology teachers on the application of laboratory specimen based on the school type

METHODOLOGY

The study was a descriptive of survey type. The target populations were the SSS 111 biology teachers. The study sampled 257 biology teachers who were selected through a multistage sampling techniques, the study employed both adopted and adapted instruments, Laboratory Rating Scale Questionnaire and WAEC Biology Seccondary School Accreditations kits (LARSQ) and had reliability index of 0.84,0.81and 0.76 respectively as measured by Cronbach Alpha. The data gotten was analyzed using both descriptive and inferential statistics; frequency counts and percentage, mean and standard deviations and *t*-test statistics and Analysis of Variance (ANOVA) at 0.05 level of significant. Findings from the study revealed that majority of biology teachers viewed most of the laboratory resources accessible and but low in terms of applications. There was no significant difference in the view of biology teachers on accessibility and applications of laboratory specimens and apparatus based on school location, $t(255) = -.36$, $p > 0.05$. It was concluded that laboratory specimens, equipment and apparatus are readily accessible and were duly

applied to some extent for teaching and learning of biology topics and that it can improve biology students towards better learning outcome provided they have equal exposure and accessibilities to different laboratory resources.

RESULTS

Research Question one: What is the level of accessibility of biology laboratory resources in senior secondary schools in Kwara State**?**

Table 1:
Analysis of Biology Teachers' Views on Accessibility of Laboratory Resources

S/N	Perception on the Accessibility of Laboratory Apparatus	Accessible	Not Accessible
1.	Microscope, microscope slide	203 (79%)	54 (21%)
2.	Specimen bottles, separating funnel	230 (89%)	27 (10%)
3.	Beaker-100ml	219 (85%)	38 (15%)
4.	Dissecting board, Hand lenses	209 (81%)	48 (19%)
5.	Thermometer (10-100c), Test tubes racks in 12 hole and barometers	108 (42%)	149 (58%)
6.	Bunsen burners (adjustable)	227 (88%)	30 (12%)
7.	Corks (assorted)	209 (81%)	48 (19%)
8.	Plant cell (prepared slide)	175 (68%)	82 (32%)
9.	T.S prepared slide	156 (61%)	101 (39%)
10.	Blood cell (prepared slide)	154 (59%)	103 (40%)

Table 1 presented the views of the biology teachers on the accesibility of the laboratory apparatus. The table 1 shows that of all 257 Biology teachers responses on each of the item 1 apparatus (microscope, microscope slide) with the value of 203 (10%) not available among others. It can be inferred that, of all apparatus, item 5 Thermometer, 10-100c), Test tubes rack of 209 (81%) accessible and 48(19%) not accessible and 108 (42%) accessible and 149 (58%) not accessible were rarely with low accessible while other apparatus, ranging from item 1,2,4,6,7,8,9 and 10 were sufficiently perceived accessible by the Biology teachers. Therefore, having 50% above accessibility rate. This implies that, majority of the laboratory apparatus are accessible which will influences a positive improvement on the teaching and learning of biology.

Research Question Two: How are biology laboratory resources applied in senior secondary schools in Kwara State?

Table 1
Analysis of Biology Teachers' View on the application of Laboratory Specimens

S/N	Perception on the Application of Laboratory Specimens	Applied	Not been Applied
1.	Preserved biological specimens (assorted)	234 (91%)	23 (9%)
2.	Skeleton of man, Human eyes, L.S of skin	208 (81%)	49 (19%)
3.	AscarisLumbrecoides (preserved)	163 (63%)	94 (37%)
4.	Tilapia fish (preserved)	141 (55%)	116 (45%)
5.	Tapeworm (preserved)	165 (64%)	92 (36%)

Table 2 indicated that, of all the items on the laboratory specimens. It could be observed from the table, that majority of the listed laboratory

specimens has higher percentage recorded that of 50% above. It can be deduced that biology teachers viewed that laboratory specimens were highly applied during teaching and learning of biology and that, this application of these laboratory specimens can bring about positive impacts on the biology students' academic performance

Research Question Three: How do biology teachers' views on the application of laboratory specimens based on school location?

Table 3

Mean and Standard Deviation on Teachers views on the application of laboratory specimens based on school location?

School Location	N	Mean	Std. Deviation
Rural	147	93.29	10.22
Urban	110	93.44	7.42

Table 3 shows that mean score for the rural biology teachers was 93.29and standard deviations of 10.22 while that of urban biology teachers was 93.44 with the standard deviations of 7.42 respectively. This indicates that urban biology teachers obtained higher than the rural biology teachers. This implies that, most of the urban biology teachers have access to the laboratory resouces compared with their rural counterparts.

DISCUSSION

This study revealed that majority of the biology teachers have access to the laboratory apparatus and equipment 81 % such as microscope, microscope slidess. Though level of their individual accessibilities this equipment, apparatus and the specimens differs. This implies that majority of biology teacher had access to some of this equipmentts, apparatus and can improve the learnig outcome of the students but its level of usabilities may be challenging This is in alignemnt with Mmassy et al., (2025) who reported that accessibility and application of biology laboratory resources remain central to effective science teaching and learning and in contrary to Adejimi (2023) who was of the viewed that students can only learn through practical experice despite the mitigating factors raised by Hassan & Sadiq, (2025). With the high percentage of biology teachers' level of accessibilities', students' biology students can be improved when engaged with both practicals and knowledge of good accessibilities by the teachers.

Study also revealed an encouraging applications of some of these laboratory resources like the assorted specimens and equipments to teaching and learning of biology. This is in agreement with Bayo (2022) who posited that performance of the students seems much better when teacher apply the knowlege in due time and disagreed with Achufusi & Ezeobi,(2024) who posited that management and utilization and applications of biology laboratory resources were at a low level which can hindered the effective learnng.

Finally, findings from the study also revealed that biology teachers at rural areas had much access to the laboratory resources than those at

urban areas. This implies that schools in more developed areas tend to report better access to laboratory resources compared to their rural counterparts, where infrastructural deficits and limited funding remain persistent challenges as raised by Adeyemi & Ogunleye, 2024; Bello et al., (2025). However, Okeke & Ibrahim, (2024); Yusuf & Adebayo, (2025). Who posited that government had equal treatment to both but lapses may lies in the areas of mismanagements, functionality and adequacy of the resources among others.

CONCLUSION

The effective teaching and learning of science subjects depend largely on the adequate provision and meaningful accessibilities and applications of laboratory resources. However, t challenges faced by many senior secondary schools ranging from inadequate accessibilities to low application rate, continue to hindered students' practical competence, engagement and overall students' hands-on activities. An assessment of these issues provides a necessary foundation for understanding existing gaps and developing targeted interventions these implies these elements are valuable tools for enhancing students' academic performance and better learning outcomes in biology. Also, this study concluded that regardless of school location, school type biology teachers generally hold similar view regarding the accessibilities to laboratory resources like lab apparatus, equipment and speciments only that applications part needed to be improved.

RECOMMENDATIONS

The following recommendations have been made:

1. Government officials should conduct regular safety audits and inspections of laboratory resources by ensuring all apparatus and equipment are in good working conditions for further easier accessibilities to both teachers, students amd other staked holders.
2. School authority should establish an orientations, re-orientations and seminars for the biology teachers on the accessibilities and conditions of laboratory specimens as well as knowledge of safety to aid all round support applications.
3. Government officials should conduct regular safety audits and inspections of laboratory resources on the already supplied schools to ensure equity and egaliatrian treatement, inclusiveness and to ensure that they left no stone untruened irrespetive of the localties.

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