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Research Article

Effects of inadequate laboratory resources on academic achievement and learning attitudes in Biology among senior secondary school students in Kontagora, Niger State, Nigeria

M. J. Kinta[a] **& J. Philip**[a]

[a]***Department of Biology, Federal University of Education, Kontagora, Niger State, Nigeria.***

Abstract
This study investigates the effects of inadequate laboratory resources on academic achievement and learning attitudes in Biology among senior secondary school students in Kontagora, Niger State, Nigeria. A descriptive survey design was employed, combining quantitative assessments of students' academic performance with qualitative analysis of their perceptions toward Biology education. The sample comprised 160 respondents randomly selected from two private and two public schools. Data were collected using a self-designed questionnaire, validated by a PhD holder in Biology. The questionnaire was divided into four sections; with responses rated on a 4-point Likert scale (Strongly Agree, Agree, Disagree, Strongly Disagree).Findings indicate that students in schools with well-equipped laboratories achieved significantly higher academic performance than those in under-resourced schools. Additionally, 46.9% of respondents reported that inadequate laboratory equipment hindered their understanding of Biology concepts. The study concludes that insufficient laboratory resources negatively affect both cognitive and affective learning outcomes in Biology. To address these challenges, the study recommends that government authorities, school administrators, and relevant stakeholders prioritize the provision, maintenance, and upgrading of Biology laboratory facilities. Such improvements would enhance students' academic performance and foster a more positive attitude toward the subject. These findings highlight the critical role of adequate laboratory resources in promoting effective science education and cultivating students' enthusiasm for Biology.

Keywords: Laboratory resources, academic achievement, Biology education, secondary schools, Nigeria

1. Introduction

Science education serves as a critical driver of social, economic, and technological progress (Olatoye, 2021). Among science disciplines, biology holds particular significance due to its direct relevance to medicine, agriculture, biotechnology, and environmental science (Çıbık, 2021). It fosters scientific literacy, problem-solving skills, and innovative thinking essential competencies for addressing global challenges such as climate change and health crises (Cibik, 2021).

Laboratory-based learning is fundamental to the effective teaching and understanding of Biology, as it provides students with hands-on experience that reinforces theoretical concepts (Hofstein & Lunetta, 2004). Inadequate laboratory facilities hinder students' academic performance and negatively influence their attitudes toward the subject (Adeyemo, 2010). The absence of functional laboratories, insufficient equipment, and a lack of qualified personnel contribute to poor learning outcomes, limiting students' ability to develop essential scientific skills (Ogunleye, 2019).

The scarcity of laboratory resources affects academic achievement and learning attitudes in Biology among senior secondary school students in Kontagora. Research indicates that students in schools with well-equipped laboratories demonstrate better performance and greater enthusiasm for science subjects compared to those in under-resourced institutions (Okebukola & Jegede, 2020). Conversely, students deprived of practical experiences often struggle with conceptual understanding, leading to disengagement and declining interest in Biology (Aina & Ogunleye, 2021). Given the critical role of Biology in science, technology, and medicine, addressing these deficiencies is essential for improving educational outcomes and fostering a positive learning environment. This study seeks to assess the extent to which inadequate laboratory resources influence students' performance in examinations and their motivation, confidence, and interest in Biology. The findings will

*Corresponding author: **M. J. Kinta**
Email address: kintamohammed@gmail.com (**M. J. Kinta**)
ORCiD: https://orcid.org/ 0009-0001-9616-7256↗

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provide valuable insights for policymakers, educators, and stakeholders to implement targeted interventions that enhance science education in Niger State and beyond.

This study investigates the impact of inadequate laboratory equipment on senior secondary biology students' academic performance and attitudes in Kontagora LGA. The findings aim to inform targeted policy interventions, advocate for improved resource allocation, and enhance biology education outcomes in the region.

Science education, particularly biology, plays a crucial role in equipping students with the knowledge and skills necessary for scientific inquiry and problem-solving. However, the effectiveness of biology instruction in Nigerian secondary schools is heavily dependent on the availability and functionality of laboratory equipment. In Kontagora, Niger State, reports indicate that many senior secondary schools lack adequate laboratory facilities, which may hinder students' academic performance and negatively influence their attitude toward biology (Abdullahi & Dangata, 2023).

Despite the emphasis on practical-based learning in the Nigerian secondary school curriculum, many schools still struggle with insufficient or obsolete laboratory equipment (Federal Ministry of Education, 2021). Studies have shown that students exposed to well-equipped laboratories demonstrate better understanding, retention, and application of biological concepts compared to those in poorly equipped settings (Ogunleye & Babajide, 2022). However, in Kontagora, observations suggest that students often resort to theoretical learning due to the absence of hands-on laboratory experiences, which may contribute to poor performance in examinations and a decline in interest in biology. Furthermore, previous studies have examined laboratory deficiencies in urban schools, there is limited research on how these challenges affect students in semi-urban and rural areas like Kontagora.

The aim of this study is to assess the effects of inadequate laboratory resources on academic performance and learning attitudes in Biology among senior secondary school students in Kontagora, Niger State, Nigeria. Specifically, the study objectives are to determine:

i. the availability and adequacy of laboratory resources for teaching and learning Biology in selected senior secondary schools in Kontagora.
ii. the relationship between laboratory resource availability and students' academic performance in Biology.
iii. the students' attitudes toward learning Biology in schools with insufficient laboratory facilities

To achieve the stated objectives, this study seeks to answer the following research questions:

1. What is the state of laboratory resources for Biology in senior secondary schools in Kontagora?
2. How does the availability of laboratory facilities influence students' academic performance in Biology?
3. What are the prevailing attitudes of students toward learning Biology in schools with inadequate laboratory resources?

This study will provide insight evidence for policymakers, educators, and stakeholders to improve laboratory infrastructure. It will also contribute to the broader discourse on science education in Nigeria.

2. Literature Review

Effective science education, particularly in Biology, relies heavily on laboratory-based learning to reinforce theoretical knowledge and develop essential scientific skills (Okebukola, 2020). However, in many Nigerian secondary schools especially in rural regions such as Kontagora, Niger State inadequate laboratory facilities hinder students' academic performance and negatively influence their attitudes toward learning (Adeyemo & Adedoja, 2021). This review synthesizes existing literature on the effects of insufficient laboratory resources on Biology education, focusing on academic achievement and student engagement.

2.1. Impact on Academic Achievement

Empirical studies consistently highlight the positive correlation between laboratory resource availability and academic success in Biology. Ajayi and Ajayi (2022) found that Nigerian secondary school students with access to functional laboratories achieved significantly higher examination scores than their counterparts in under-resourced schools. Similarly, Usman and Mohammed (2023) reported that inadequate laboratory equipment in Niger State contributed to low pass rates in Biology practical assessments, underscoring the critical role of experiential learning in academic performance.

2.2. Effects on Learning Attitudes

Students' attitudes toward Biology are shaped by their engagement in practical learning experiences (Akinoglu & Tandogan, 2021). In schools with insufficient laboratory resources, students frequently exhibit disinterest, frustration, and diminished motivation (Ojo & Olatunji, 2022). A study by Ibrahim and Bello (2023) in Kontagora revealed that the absence of hands-on demonstrations led students to perceive Biology as difficult and unengaging, fostering negative attitudes toward the subject.

3. Research Methodology

3.1. Research Design

A mixed-methods approach (quantitative and qualitative) was adopted to provide comprehensive insights into the research problem (Creswell, 2023).

3.1. Population and Sampling

The study population comprised senior secondary school (SSS) students enrolled in Biology across selected schools. A total of one hundred and sixty (160) participants were purposively sampled using a stratified random sampling technique to ensure adequate representation across gender, school type (public or private), and geographical location.

3.3. Instrument

A structured questionnaire survey was employed as the primary data collection instrument to evaluate students' academic performance and attitudes toward Biology in the school setting. The questionnaire was meticulously designed to capture both quantitative and qualitative data, ensuring a comprehensive assessment of key variables

3.4. Validation and Reliability

To ensure content validity, the questionnaire was reviewed by subject-matter experts and piloted with a small group of students for clarity and consistency.

Cronbach's alpha was computed to confirm internal reliability, with a threshold of $\alpha \geq 0.70$ considered acceptable (Taherdoost, 2023).

3.4. Data Analysis

Data collected were analyzed using descriptive statistics such as frequency and percentage. The analysis was carried out and Results were presented in tables, chart, and interpreted accordingly.

4. Results and Discussion

In this section, the results of the analysed data is presented.

Table 4.1: Availability and Adequacy of Laboratory Equipment

Statement	SA		A		D		SD		Total
	F	%	F	%	F	%	F	%	
My school has a biology laboratory	69	43.1	62	38.7	22	13.8	7	4.4	160
The laboratory is adequately equipped with basic biology tools	35	21.9	73	45.6	39	24.4	13	8.1	160
I have regular access to laboratory equipment during practical's	44	27.5	54	33.8	41	25.6	21	13.1	160
Lack of equipment limits our participation in practicals	39	24.4	67	41.8	36	22.5	18	11.3	160
Teachers improvise when materials are not available	60	37.5	51	31.9	30	18.7	19	11.9	160

***Keys**: Strongly Agree (SA), Agree (A), Disagree (D) AND Strongly Disagree (SD)*

In Table 4.1 reveals that 81.8% of students confirmed the presence of a biology laboratory in their schools, with 43.1% strongly agreeing and 38.7% agreeing. Only a minority expressed dissent (13.8% disagreed, 4.4% strongly disagreed), suggesting that most schools have dedicated lab spaces. However, this does not necessarily translate to functional or well-equipped facilities, as observed in similar Nigerian studies (Aina & Ogunbodede, 2023). Despite lab availability, perceptions of equipment adequacy were less favorable. While 67.5% of students acknowledged the presence of tools (21.9% strongly agreed, 45.6% agreed), a significant portion (24.4% disagreed, 8.1% strongly disagreed) raised concerns about insufficient resources. This aligns with research by Okafor and Eze (2022), who found that many Nigerian secondary schools lack essential lab apparatus, hindering effective science education.

Further analysis shows that 61.3% of respondents reported restricted equipment access (27.5% strongly agreed, 33.8% agreed), while 25.6% disagreed and 13.1% strongly disagreed, indicating inconsistent availability. This shortage directly impacts practical learning, as 66.2% of students (24.4% strongly agreed, 41.8% agreed) cited limited hands-on participation due to inadequate tools. A smaller percentage (22.5% disagreed, 11.3% strongly disagreed) may attend schools with better-resourced labs, reflecting disparities in educational infrastructure (Adeoye & Adesina, 2023).

To compensate for these gaps, 69.4% of students noted that teachers frequently employ alternative teaching methods (37.5% strongly agreed, 31.9% agreed) when equipment is lacking. However, 18.7% disagreed and 11.9% strongly disagreed, suggesting that such adaptive strategies are not uniformly implemented across schools. This finding resonates with Ogunniyi and Oladele (2023), who emphasized that while some educators improvise effectively, systemic underfunding remains a major barrier to quality science instruction.

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Table 4.2: Effect on Student's Academic Performance

Statement	SA		A		D		SD		Total
	F	%	F	%	F	%	F	%	
Inadequate lab equipments affects my understanding of biology topics	53	46.9	64	40.0	34	9.3	9	3.8	160
Practical lessons help me perform better in exams	75	39.9	69	43.1	15	9.4	1	7.6	160
My performance would improve if more equipment were provided	69	43.1	63	39.4	26	16.3	2	1.2	160
I often rely on theory alone due to lack of practical sessions	31	19.4	65	40.6	38	27.3	26	16.3	160
There is direct relationship between lab activities and my test scores	41	25.6	44	27.5	55	34.4	20	12.5	160

***Keys**: Strongly Agree (SA), Agree (A), Disagree (D) AND Strongly Disagree (SD)*

The above table reveal that an overwhelming majority of students (86.6%) comprising 46.6% who strongly agreed and 40.0% who agreed—reported that inadequate laboratory equipment negatively affects their understanding of biology concepts. Only 13.1% disagreed with this assessment. This finding aligns with existing research demonstrating that insufficient lab facilities impede active learning, particularly in STEM education (Okebukola et al., 2022).

A significant proportion of respondents (90.0%) 39.9% strongly agreeing and 43.1% agreeing associated hands-on learning with improved examination performance, while only 17.0% disagreed. This supports the findings of Hofstein and Lunetta (2023), who established that experiential learning enhances retention and application of scientific principles. Furthermore, 82.5% of students (43.1% strongly agreed, 39.4% agreed) believed their academic performance would improve with better-equipped laboratories, whereas 17.6% did not share this view. This is consistent with the work of Ajayi and Ekundayo (2022), who found that Nigerian students in well-resourced schools consistently outperform their peers in national science examinations.

The results indicate that 60.0% of students (19.4% strongly agreed, 40.6% agreed) resorted to theoretical learning when practical sessions were unavailable, though 40.0% disagreed. This trend is corroborated by studies showing that limited laboratory access compels educators to prioritize theoretical instruction, thereby diminishing students' critical thinking skills (Bajah, 2023).

While 53.1% of respondents (25.6% strongly agreed, 27.5% agreed) perceived a direct correlation between laboratory work and test scores, 46.9% (34.4% disagreed, 12.5% strongly disagreed) remained unconvinced. This discrepancy may be attributed to variations in teaching methodologies some institutions effectively integrate laboratory sessions into their curricula, while others treat them as supplementary (Jegede & Owolabi, 2023).

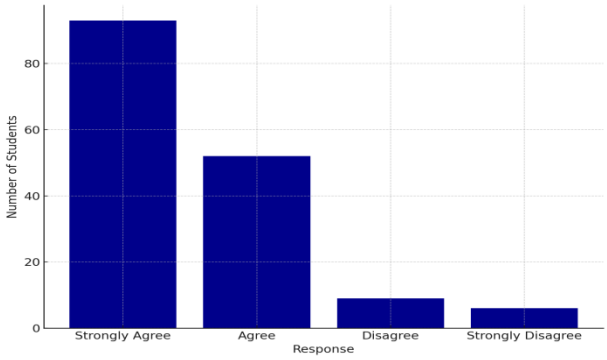

Figure 1. Chart showing responses on student's interest and attitude in learning Biology

The bar chart presents survey data on students' interest in and attitudes toward learning Biology. The results indicate a predominantly favorable disposition, with over 80 students expressing strong agreement regarding their interest in or positive attitude toward the subject. Approximately 60 students reported agreement, further supporting the trend of overall enthusiasm for Biology. In contrast, fewer than 20

*Corresponding author: **M. J. Kinta**
Email address: kintamohammed@gmail.com (**M. J. Kinta**)
ORCiD: https://orcid.org/ 0009-0001-9616-7256↗

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students either disagreed or strongly disagreed, suggesting that only a minority exhibit disinterest or reservations about the subject.

5. Conclusion

The findings of this study highlight the significant impact of deficient laboratory equipment on students' academic performance and attitude toward Biology in senior secondary schools in Kontagora, Niger State, Nigeria. The lack of adequate laboratory facilities, essential reagents, and functional equipment severely hinders effective teaching and learning, leading to poor comprehension of biological concepts and diminished practical skills. Students in under-resourced schools often struggle with abstract theories due to the absence of hands-on experiments, resulting in lower motivation, disengagement, and negative attitudes toward the subject.

Furthermore, the study reveals that inadequate laboratory resources contribute to rote learning rather than critical thinking and scientific inquiry, which are crucial for academic success in Biology. Teachers face immense challenges in delivering practical lessons, forcing them to rely on theoretical explanations, which further reduces students' interest and performance. The situation is exacerbated in rural and underfunded schools, where laboratory deficiencies are more pronounced compared to urban institutions

Recommendations:

Based on the findings and conclusion of this study, the following recommendations are made:

Based on the findings, the following recommendations are made:

- Government Intervention in Funding: Federal, state, and local governments should allocate dedicated budgets for equipping and upgrading biology laboratories in public senior secondary schools.
- School-Based Resource Management Committees: Each school should form a Laboratory Resource Management Committee to oversee equipment maintenance, monitor usage, and request replacements when necessary.
- Teacher Training and Retraining: Organize regular workshops for biology teachers on effective laboratory management, safe handling of equipment, and innovative teaching techniques.
- Integration of ICT and Virtual Laboratories: Schools should adopt virtual laboratory software to supplement physical labs, especially where equipment shortages exist.
- Public-Private Partnerships (PPP): Encourage partnerships with NGOs, alumni associations, and corporate bodies to fund laboratory upgrades and donate equipment.

Suggestions for Further Research

To investigate the effectiveness of virtual labs in resource-limited schools in northern part of Nigeria

Abbreviations

PPP Public-Private Partnerships

Author Contributions

Kinta, Mohammed Junior.: Conceptualization, Methodology, writing and editing

Philip, Jacklin: Writing original drafts about the paper

Conflicts of Interest

The authors certify that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper

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