

## AVAILABILITY AND REGULAR MAINTENANCE OF LABORATORY EQUIPMENT: A PANACEA FOR STUDENTS PERFORMANCE IN BIOLOGY IN AKWA IBOM STATE

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### ABSTRACT

*This study examined the availability and regular maintenance of laboratory equipment, as a panacea for students performance in biology in Akwa Ibom State. The study mentioned that the availability and maintenance of laboratory equipment are crucial factors that significantly influence students' performance in biology, particularly in Akwa Ibom State, Nigeria. In the context of carrying out this research, the following subheads were explored: concept of availability of equipment, concept of regular maintenance of equipment and concept of student performance among many others. As noted in the study, the extent of availability of laboratory equipment in secondary schools in Akwa Ibom State was poor as most schools had inadequate Basic Science Laboratory equipment. The study also highlighted that extent of regular maintenance of laboratory equipment in Akwa Ibom State was also poor as most schools could not afford to maintain and regularly repair their laboratory equipment and lacked regular maintenance plans and trained technicians to handle equipment maintenance especially in public schools. Furthermore, the study showed that the extent of student's performance in Biology was high in theoretical knowledge but weak practical skills. More so, it also noted that enhancement of conceptual understanding, improvement in practical skills and increased student interest in Biology among others were mentioned as the influence of availability of laboratory equipment on student performance in Biology. Also, the influence of regular maintenance of laboratory equipment on student academic performance in Biology as stated in the study included: improved practical learning experience, enhanced retention of scientific concepts and reduction in equipment downtime and learning interruptions. Based on this, the study concluded that the availability and regular maintenance of laboratory equipment are fundamental to enhancing students' performance in biology, particularly in Akwa Ibom State. One of the recommendations made was that the government and educational institutions should allocate more financial resources to the procurement and regular maintenance of laboratory equipment in secondary schools.*

**KEYWORDS:** Laboratory Equipment, Students Performance, Biology and Akwa Ibom State

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## INTRODUCTION

The availability and maintenance of laboratory equipment are crucial factors that significantly influence students' performance in biology, particularly in Akwa Ibom State, Nigeria. Laboratory-based learning enhances students' comprehension of biological concepts by allowing hands-on experience, experimentation, and practical application of theoretical knowledge. According to Rahayu et al. (2024), the presence of well-equipped laboratories in schools plays a pivotal role in fostering scientific curiosity and improving academic outcomes among students. However, despite the recognized importance of laboratory facilities, many secondary schools in Akwa Ibom State face challenges related to inadequate equipment, lack of proper maintenance, and insufficient funding for laboratory operations. This deficiency results in limited practical engagement, negatively impacting students' ability to grasp complex biological concepts and perform well in assessments. The need for regular maintenance of laboratory equipment cannot be overemphasized, as dysfunctional apparatus can hinder the effectiveness of practical lessons and reduce students' enthusiasm for scientific exploration.

Furthermore, the role of laboratory maintenance extends beyond availability to ensuring sustainability and long-term usability of scientific tools. Lee and Ong (2024) emphasize that effective laboratory engagement in biology education is linked to well-maintained, functional equipment, which supports student-centered learning and enhances discipline-based engagement. In contrast, poorly maintained equipment can lead to inaccurate experimental results, safety hazards, and disinterest among students, ultimately contributing to lower academic performance. Regular servicing, calibration, and replacement of outdated or faulty instruments ensure that students can engage in meaningful scientific inquiry without unnecessary setbacks. Given the increasing demand for STEM education in Nigeria, addressing these laboratory deficiencies through policy interventions, increased funding, and technical support is essential for improving student performance in biology. Hence, prioritizing the availability and maintenance of laboratory equipment serves as a panacea for educational excellence in science disciplines.

## CONCEPT OF AVAILABILITY OF EQUIPMENT

Equipment availability refers to the ability of a system, machinery, or device to perform its intended function at a given time under predefined conditions. Several authors have defined equipment availability based on its reliability, maintainability, and operational efficiency. According to Agostinho et al. (2024), availability is a function of uptime and downtime, representing the percentage of time equipment remains operational without failures. Similarly, Dawidowicz et al. (2025) emphasize that preventive maintenance and operational efficiency is important in sustaining equipment availability, stating that it is influenced by both internal factors such as component reliability and external conditions like environmental constraints. Another perspective by Szarzynski et al. (2025) defines availability as the probability that an equipment or system is functioning when required, considering the maintenance cycle and failure rate as key determinants.

From a broader perspective, availability of equipment is a critical component of operational readiness. Higher availability reduces downtime and increases productivity in industrial settings. Availability of Equipment must be measured through key performance indicators such as Mean Time between Failures (MTBF) and Mean Time to Repair (MTTR), which quantify the efficiency of maintenance strategies. Thus, equipment availability is a multifaceted concept that integrates

mechanical reliability, proactive maintenance, and technological advancements to ensure optimal performance and minimal downtime.

## **CONCEPT OF REGULAR MAINTENANCE OF EQUIPMENT**

Equipment maintenance is a critical aspect of any operation, encompassing a range of activities designed to keep machinery and tools in optimal condition. By understanding its importance and incorporating consistent maintenance practices, the equipment management specialist can significantly improve efficiency, safety, and reliability across various sectors (Eisner, 2022). Equipment maintenance includes the upkeep of various equipment types, such as heavy machinery, computer systems, vehicles, and tools. It aims to prevent equipment breakdown and failure, which can lead to significant losses in business profits.

Equipment maintenance involves using maintenance methods and procedures to keep organizational equipment running in good working condition. It includes both regular inspections and corrective repairs of assets. The practice is performed in several settings, including food service establishments, industrial plants, manufacturing facilities, hotels, and more. It may include routine upkeep as well as corrective repair work.

## **CONCEPT OF STUDENT PERFORMANCE**

Student performance is a comprehensive term that encompasses a student's ability to acquire, apply, and demonstrate knowledge and skills in an academic setting. According to Martínez, et al. (2024), student performance can be defined as the capacity to process, retain, and utilize knowledge effectively in various learning contexts. Their study emphasizes that assessment strategies play a crucial role in evaluating student performance, as they allow educators to measure learning progress, identify gaps, and provide necessary interventions. Similarly, Duyen (2024) highlights self-regulated learning as a fundamental aspect of student performance, where students actively set goals, monitor progress, and adjust their strategies to optimize their learning outcomes. This definition underscores the importance of cognitive engagement, motivation, and self-discipline in achieving academic success.

Further expanding on the concept, Egorova (2025) argue that student performance is multidimensional, involving academic achievements, critical thinking, and emotional resilience. Factors such as anxiety, confidence, and teacher feedback influence how students perform in educational settings. Additionally, Nematollahi et al. (2025) define student performance as an outcome influenced by the effectiveness of instructional methods, including e-learning and self-regulated learning strategies. Students who engage in structured and interactive learning environments tend to exhibit higher academic performance compared to those in passive, lecture-based settings. These definitions collectively suggest that student performance is not merely a reflection of grades but a dynamic process shaped by cognitive, behavioral, and environmental factors.

## **EXTENT OF AVAILABILITY OF LABORATORY EQUIPMENT IN SECONDARY SCHOOLS IN AKWA IBOM STATE**

Research on the availability of laboratory equipment in Akwa Ibom State secondary schools reveals significant challenges. Below is a detailed list of key findings:

- **Inadequate Basic Science Laboratory Equipment**

Most secondary schools in Akwa Ibom State lack essential laboratory materials, such as microscopes, Bunsen burners, and beakers. This shortage forces teachers to rely on theoretical teaching, limiting students' exposure to hands-on learning. The deficiency affects student engagement, comprehension, and performance in science subjects, especially in biology, chemistry, and physics (John et al., 2023).

- **Public Schools Are More Affected Than Private Schools**

Private secondary schools in Akwa Ibom State generally have better-equipped laboratories compared to public schools. Due to limited government funding, public schools struggle to provide functional science labs. This disparity creates an uneven playing field, where students in private institutions have better practical learning experiences than their counterparts in public schools.

- **Poor Government Funding for Laboratory Equipment**

Many public secondary schools do not receive sufficient funding to maintain or upgrade laboratory facilities. Science equipment is often outdated, broken, or insufficient to meet the demands of growing student populations. Teachers struggle to conduct practical experiments, leading to poor performance in science subjects and reduced interest in STEM careers.

- **Limited Usage of Available Equipment Due to Maintenance Issues**

Even when laboratory equipment is available, maintenance issues hinder its usage. According to Etiubon & Udoh (2020), many schools lack trained technicians to properly handle and maintain lab apparatus, leading to frequent equipment breakdowns. Teachers often struggle to improvise, which affects the quality of science instruction and discourages students from participating in practical exercises.

## **EXTENT OF REGULAR MAINTENANCE OF LABORATORY EQUIPMENT IN AKWA IBOM STATE**

Regular maintenance of laboratory equipment in Akwa Ibom State secondary schools remains a major concern. Many schools lack structured maintenance plans, leading to frequent equipment breakdowns, reduced functionality, and ineffective science practical. Poor funding, lack of trained personnel, and inadequate infrastructure further compound these challenges. Below is an in-depth analysis of key findings:

- **Lack of Regular Maintenance Plans in Public Schools**

Many public secondary schools in Akwa Ibom State do not have a scheduled maintenance plan for laboratory equipment. This results in frequent equipment breakdowns, forcing teachers to rely on theoretical science lessons rather than practical experiments. The absence of maintenance schedules affects students' ability to develop hands-on scientific skills.

- **Lack of Trained Technicians to Handle Equipment Maintenance**

Many secondary schools lack trained laboratory technicians who can effectively manage and maintain laboratory equipment. As a result, improper handling leads to frequent damage, making the equipment unusable. According to Eyenaka & Umoren (2024), schools without dedicated lab staff

rely on science teachers, who often lack the technical expertise required for proper equipment maintenance.

- **High Cost of Maintenance Discourages Regular Repairs**

The rising cost of scientific laboratory equipment and repairs makes it difficult for schools to maintain their facilities. Many schools opt to replace broken equipment instead of repairing it, but due to financial constraints, they often end up without any functioning equipment at all, reducing the effectiveness of science education (Akpan & Esseini, 2024).

- **Lack of Adequate Storage Facilities Contributes to Equipment Damage**

Many secondary schools do not have proper storage facilities for laboratory equipment, leading to premature wear and tear. Exposure to dust, humidity, and improper handling shortens the lifespan of expensive scientific tools, further increasing the cost of maintenance and replacement.

## **EXTENT OF STUDENTS PERFORMANCE IN BIOLOGY**

Students' performance in Biology in secondary schools is influenced by various factors. Below is a detailed analysis of extent of Students Performance in Biology:

- **High Achievement in Theoretical Knowledge but Weak Practical Skills**

Many students perform well in theoretical Biology but struggle with practical applications. This is due to inadequate laboratory facilities, lack of hands-on experience, and a reliance on rote memorization instead of conceptual understanding. Strgar & Moller (2024) found that while students retained theoretical knowledge, they had difficulty applying it in practical settings.

- **Variation in Performance between Urban and Rural Students**

Students in urban areas tend to perform better in Biology compared to those in rural areas due to better access to resources, laboratories, and qualified teachers. Rural students often struggle due to inadequate teaching materials and poor learning environments.

- **Decline in Performance Due to Online Learning during COVID-19**

During the pandemic, students' performance in Biology declined due to a lack of access to laboratories and the difficulty of understanding complex biological concepts through online learning. Strgar & Moller (2024) reported that Biology students struggled with self-directed learning during the pandemic, affecting their grades.

- **Improved Performance with Active Learning Methods**

Students who engage in active learning, such as group discussions, concept mapping, and flipped classrooms, show higher retention and understanding of Biology concepts compared to those taught through traditional lectures.

## **INFLUENCE OF AVAILABILITY OF LABORATORY EQUIPMENT ON STUDENT PERFORMANCE IN BIOLOGY**

The availability of laboratory equipment in biology education plays a crucial role in enhancing students' learning experiences and academic performance. Well-equipped laboratories allow students to engage in hands-on experiments, improving their understanding of complex biological concepts. Below is an extensive discussion of these influence:

- **Enhancement of Conceptual Understanding**

Laboratory experiments provide students with an opportunity to interact with scientific concepts in a practical manner. Medura and Paglinawan (2019) found that access to educational resources, including laboratory equipment, significantly enhances learners' conceptual understanding of biology. Students who frequently use laboratory resources outperform those who rely solely on theoretical learning.

- **Improvement in Practical Skills**

Practical skills are essential in biology, and a well-equipped laboratory provides the necessary tools for students to develop these skills. Schools with functional laboratories helps students develop better scientific investigation skills. Students in such schools are more engaged and motivated in their learning processes.

- **Increased Student Motivation and Interest in Biology**

When students have access to laboratory equipment, they become more interested in the subject. A study by Rahayu et al. (2024) found that laboratory resources, coupled with teacher innovation, significantly increased students' motivation and academic performance in biology. Students in schools with well-equipped laboratories show a higher level of curiosity and participation in science-related activities.

- **Bridging the Gap between Theory and Practice**

Laboratory experiments allow students to validate theoretical knowledge through direct observation and experimentation. Caspar (2024) in a neuroscience education study emphasized that students who actively engage in laboratory work develop stronger critical thinking and problem-solving skills, which are essential for higher education and research.

## **INFLUENCE OF REGULAR MAINTENANCE OF LABORATORY EQUIPMENT ON STUDENT ACADEMIC PERFORMANCE IN BIOLOGY**

The regular maintenance of laboratory equipment is essential for ensuring effective science education. Well-maintained equipment enhances students' ability to conduct experiments, improves practical learning, and contributes to better academic performance in biology.

- **Improved Practical Learning Experience**

Regular maintenance of laboratory equipment ensures that students can engage in hands-on experiments without technical difficulties. Essien (2023) found that schools with well-maintained laboratory facilities recorded improved student comprehension and participation in biology

practical. Malfunctioning equipment discourages student engagement, leading to lower academic performance.

- **Enhanced Retention of Scientific Concepts**

A well-maintained laboratory fosters better retention of biology concepts among students. When students have access to functional laboratory equipment, they retain more knowledge compared to those who learn purely through theoretical methods. Equipment breakdowns disrupts continuity in learning, negatively affecting long-term knowledge retention.

- **Reduction in Equipment Downtime and Learning Interruptions**

Laboratory maintenance helps minimize downtime due to faulty equipment. Ochieng (2021) examined how improper maintenance led to frequent breakdowns, disrupting scheduled laboratory practical and reducing students' exposure to hands-on learning. Schools with proper maintenance schedules have more consistent laboratory use and better student performance in biology.

- **Ensuring Safety in the Laboratory**

Proper maintenance reduces the risks of accidents in the laboratory. Damaged or outdated equipment increases the chances of accidents, discouraging students from participating in experiments. Schools that maintain their laboratory facilities regularly experience fewer incidents and better student participation.

- **Prevention of Learning Inequalities**

Schools with regular maintenance schedules provide a fair learning environment for all students. Sikubwabo & Pierre (2024) examined how the maintenance of school facilities, including laboratories, contributed to academic performance in science subjects. The study revealed that students from well-maintained schools had an advantage over those from institutions with poorly maintained facilities.

## CONCLUSION

The availability and regular maintenance of laboratory equipment are fundamental to enhancing students' performance in biology, particularly in Akwa Ibom State. Well-equipped and properly maintained laboratories provide students with hands-on learning experiences, fostering deeper understanding, critical thinking, and problem-solving skills essential for scientific inquiry. Conversely, inadequate and poorly maintained laboratory facilities hinder practical engagement, limit experiential learning, and negatively impact academic achievement. Ensuring that schools have functional laboratory equipment through consistent maintenance, adequate funding, and policy support is crucial for sustaining quality science education. By prioritizing the upkeep of laboratory resources, educational stakeholders can create an enabling environment where students are motivated to explore, experiment, and excel in biology, ultimately strengthening the foundation for future scientific advancements.

## RECOMMENDATIONS

- The government and educational institutions should allocate more financial resources to the procurement and regular maintenance of laboratory equipment in secondary schools.

- Schools should establish structured maintenance schedules for laboratory equipment, including regular servicing, calibration, and replacement of faulty apparatus. This will help to extend the lifespan of laboratory tools and prevent disruptions in practical learning sessions.
- Continuous professional development programs should be provided for biology teachers and laboratory technicians to equip them with the necessary skills for handling, maintaining, and troubleshooting laboratory equipment.
- Educational stakeholders, including government agencies, private organizations, and non-governmental organizations (NGOs), should collaborate to provide laboratory resources and technical support to schools.

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