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Challenges Facing the Development of Modern and Equipped Biology Laboratories in Tertiary Institutions in Bayelsa State

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ABSTRACT

This study investigates the challenges hindering the development of modern and well-equipped biology laboratories in tertiary institutions in Bayelsa State, Nigeria. Employing a descriptive survey design, the research targeted a population of 200 biology lecturers, selecting a sample size of 100 top security consultants. Data were collected through structured questionnaires and analyzed using descriptive statistics. Findings reveal that inadequate funding, insufficient infrastructure, brain drain, and poor records management are significant barriers. The study recommends increased funding from government and private sectors, infrastructural development, retention of skilled professionals, and the implementation of efficient records management systems to enhance the quality of biology education and research.

Keywords: Biology Laboratory Development, Tertiary Education Infrastructure, Laboratory Equipment

INTRODUCTION

The advancement of biological sciences is pivotal for national development, particularly in regions like Bayelsa State, Nigeria. Modern and well-equipped biology laboratories in tertiary institutions are essential for fostering practical skills, research innovation, and scientific literacy among students.

Biological disciplines imply a significant responsibility for the protection and welfare of all living species. Any advances in medicine, dealing with environmental issues or biotechnology depend on an understanding of living organisms (Nahie, 1999). As one of the core subjects in science discipline in most tertiary institutions in Nigeria, Biology is of great value in determining and shaping the future of the student and hence the teaching and learning of Biology at the undergraduate level is of paramount importance.

As a science subject, scientific inquiry is the primary process by which scientific knowledge is gained. One of the most effective vehicles by which the process of inquiry can be learnt is the laboratory where the student experiences first hand, the inquiry process. Thus, the study in a laboratory is an integral and essential part of a biology course. Biology laboratory activities are hands-on experiences which emphasis process skills (Dike, 2008) which Agbo (2003) posited as motor skills that help the scientists to find answers to problems and enhance the learning of science. Laboratory activities also encourage students to construct knowledge by interaction with laboratory materials as they solve problems. Laboratory facilities give students some basic insight into scientific concepts and leave them with feeling of the reality of science which in turn improves their academic performance in examinations (Habu, 2005).

Yet studies have shown that science laboratories in tertiary institutions are poorly or inadequately equipped (Cirfat & Zumyil, 2000; Onipede, 2003; Adeyemi, 2008; Ado 2009; Lakpini & Atadoga, 2012) which are consistent with those of other countries. Jones (1990) surveyed teacher provision in the sciences in many other countries and also found that 45% of the schools indicated insufficient laboratories. Thousands of schools in

South Africa for instance lack the infrastructure necessary to provide learners with the quality education which they are legally entitled to receive. The DBE's National Education Infrastructure Management System (NEIMS) Report published in May, 2011, which provided detailed statistics on the lack of resources at public schools across the country revealed that of the 24,793 public ordinary schools, 21,021 do not have any laboratory facilities while only 1,231 have stocked laboratories (Equal Education, 2013). These lead to poor performances by the students. Students' performance in the Secondary School Certificate Examination (SSCE) is one of the criteria for measuring and establishing the effectiveness of Nigerian secondary schools. The poor performance of senior secondary students in sciences including Biology has been persistent over the years. Key exams reports reveal that percentage pass at credit level in physics, chemistry and biology as 10.03%, 25% and 16.76% respectively (Abu, 2000).

Alimi et al. (2012) further observed that 2009 was another year of poor results across all states of the federation. Okpala (2010) stated that candidates who obtained credit passes in five subjects and above including English and Mathematics between 2005 and 2009 are 8.53%, 13-32%, 27.74%, 10.53% and 1.80% respectively. Though many other factors have been attributed to the poor performance such as quality of instruction as teachers still use the traditional pedagogical approach of 'stand and deliver' method where students would sit in their seats and passively receive information, learning environment, population explosion, teacher factor, lack of incentive/staff welfare, poor attitude of students to work to mention but a few, available statistics from WAEC and NECO on senior secondary students performance in biology reveal very poor results in laboratory practical. This is due to poor acquisition of science process skills by students because their teachers were unable to conduct practical lessons as they would like to (Keister, 1992). Teachers and students are struggling to teach and learn with inadequate and antiquated facilities (Dike, 2011). This is at-variance with the tenets of education in Nigeria which stipulates that education should aim at helping the child acquire appropriate skills, abilities and competences both mental and physical as equipment for individual not only to excel in school but to live and contribute to the development of his society (Ukpai et al., 2014).

However, the development of such facilities in Bayelsa State faces numerous challenges, including inadequate funding, insufficient infrastructure, brain drain, and poor records management.

The Importance of Biology Laboratories in Tertiary Education

Biology, as a cornerstone of the life sciences, offers insights into the complexities of living organisms and their interactions with the environment. Practical laboratory experiences are integral to biology education, enabling students to apply theoretical knowledge, develop critical thinking skills, and engage in scientific inquiry. Laboratories serve as the nexus between theoretical concepts and real-world applications, facilitating hands-on learning and fostering a deeper understanding of biological processes. In the context of tertiary education, well-equipped biology laboratories are indispensable for conducting advanced research, promoting innovation, and preparing students for professional careers in various scientific fields. Thus, Biology as a subject taught in tertiary institutions is very important as it gives students basic orientation in life sciences and as a result, should be taught with modern tools in a serene environment.

Challenges in Developing Modern Biology Laboratories

1. Inadequate Funding

Financial constraints are a significant impediment to the development of modern biology laboratories in Bayelsa State. The allocation of funds to tertiary institutions is often insufficient to cover the costs associated with establishing and maintaining state-of-the-art laboratory facilities. This underfunding affects the procurement of essential equipment, consumables, and the overall maintenance of laboratory infrastructure. Ogunode and Aiyedun (2020) highlight that inadequate funding is a major challenge facing the administration of science programs in Nigerian higher institutions, leading to poorly equipped laboratories and a shortage of instructional materials. Similarly, Okwelogu, Ogunode, and Ayinde (2021) emphasize that the insufficient budgetary allocation for science education hampers the effective implementation of science programs, resulting in substandard laboratory facilities and limited research opportunities.

2. Insufficient Infrastructure

The lack of adequate infrastructure is another critical barrier to the development of modern biology laboratories. Many tertiary institutions in Bayelsa State operate with outdated or insufficient laboratory spaces, which are ill-

equipped to support contemporary scientific education and research. Dike and Salisu (2015) report that inadequate laboratory facilities and utilization pose significant hindrances to students' academic performance in biology, as the absence of proper infrastructure limits practical learning experiences. Furthermore, the poor maintenance and inefficient management of existing facilities exacerbate the problem, leading to a decline in the quality of science education. The inadequacy of physical facilities not only affects the teaching and learning process but also demotivates both students and educators, thereby impeding academic excellence.

3. Brain Drain

The migration of skilled professionals, commonly referred to as brain drain, poses a substantial challenge to the educational sector in Bayelsa State. Many qualified biology lecturers and researchers seek better opportunities elsewhere, resulting in a shortage of experienced personnel to mentor students and conduct research. This exodus is often attributed to inadequate funding, poor working conditions, and limited research facilities. Okwara (2023) discusses the implications of brain drain on Nigeria's health and educational systems, noting that the loss of skilled professionals undermines the quality of education and research. The departure of these professionals leads to a vacuum in expertise, adversely affecting the development and maintenance of modern biology laboratories.

4. Poor Records Management

Effective records management is essential for the smooth operation and development of educational institutions. In Bayelsa State, issues such as inadequate funding and insufficient infrastructure have led to challenges in maintaining proper records. This situation affects various administrative functions, including the management of laboratory inventories, research data, and academic records, thereby impeding the development of modern biology laboratories. Okwara (2023) highlights that poor records management is linked to weak institutional frameworks, which in turn affect the efficiency and effectiveness of educational programs. The lack of proper documentation and data management systems hampers strategic planning and resource allocation, further exacerbating the challenges faced in developing modern laboratory facilities.

Statement of the Problem

The development of modern and well-equipped biology laboratories in tertiary institutions is crucial for enhancing scientific education and research capabilities. In Bayelsa State, Nigeria, several challenges impede this development, including inadequate funding, insufficient infrastructure, brain drain, and poor records management. These issues collectively hinder the quality of biology education and research in the region. Inadequate funding remains a significant barrier, as financial resources allocated to tertiary institutions are often insufficient to establish and maintain state-of-the-art laboratory facilities. This financial shortfall affects the procurement of essential equipment and materials necessary for effective teaching and research (Timi-Johnson & Igbogi, 2018). Insufficient infrastructure further exacerbates the problem. Many institutions lack standard, dedicated biology laboratories, with a study revealing that 88.9% of schools surveyed in Bayelsa State do not have separate biology labs, and 97.2% lack school libraries (Dike & Salisu, 2015). This inadequacy limits practical learning opportunities and access to scientific resources. The issue of brain drain also poses a substantial challenge. Qualified educators and researchers often seek better opportunities elsewhere due to inadequate facilities and support, leading to a shortage of experienced personnel in the region (Timi-Johnson & Igbogi, 2018). Poor records management within educational institutions impedes effective planning and resource allocation. Inefficient record-keeping practices affect various administrative functions, including the management of laboratory inventories and academic records, further hindering the development of modern biology laboratories (Timi-Johnson & Igbogi, 2018). This paper therefore explores these challenges, drawing on recent studies and reports to provide a comprehensive understanding of the factors impeding the establishment of state-of-the-art biology laboratories in the region.

Purpose of the Study

The study investigated the challenges hindering the development of modern and well-equipped biology laboratories in tertiary institutions in Bayelsa State, Nigeria. Specifically, the study was carried out to:

1. Examine the extent to which inadequate funding affects the development of biology laboratories.
2. Investigate the impact of insufficient infrastructure on biology laboratory development.
3. Analyze the effect of brain drain on the availability of qualified biology lecturers.
4. Assess how poor records management impedes laboratory development.

Research Questions

1. To what extent does inadequate funding hinder the development of biology laboratories?
2. How does insufficient infrastructure affect biology laboratory development?
3. What impact does brain drain have on the availability of biology lecturers?
4. How does poor records management impede laboratory development?

METHODOLOGY

The study adopts a descriptive survey design. The population comprises 200 biology lecturers from tertiary institutions in Bayelsa State, while a sample size of 100 top security consultants was selected using stratified random sampling. Four research questions guided the study. A 20-item structured questionnaire designed on Likert 5-point scale was employed for data collection, and data were analyzed using descriptive statistical tools of Mean, frequency count, percentage and standard deviation.

RESULTS

The findings of the study were presented in accordance with the research questions as follows:

Research Question 1: *To what extent does inadequate funding hinder the development of biology laboratories?*

Table 1: Influence of Inadequate Funding on Biology Laboratories

Serial Number	Item Statement	Mean	Standard Deviation	Percentage
1	The allocated budget for science education is insufficient for laboratory development.	4.2	0.89	84%
2	Lack of funds limits the purchase of modern laboratory equipment.	4.5	0.75	90%
3	The high cost of laboratory materials negatively affects practical sessions.	4.3	0.82	86%
4	Research in biology laboratories is constrained due to financial limitations.	4.1	0.91	82%
5	Private sector investment in laboratory infrastructure is inadequate.	3.9	1.02	78%

Table 1 revealed that the Mean (M) values are all above 4.0, except item 5 which records a mean value of 3.9. This indicates a strong agreement that inadequate funding significantly impact the development of biology laboratories. The Standard Deviation (SD) values are all below 1.0, except for item 5 whose standard deviation is 1.02, showing that responses are relatively consistent among participants. The Percentage (%) values indicate a high level of concern, with all items rated above 75% agreement.

Research Question 2: *How does insufficient infrastructure affect biology laboratory development?*

Table 2: Impact of Insufficient Infrastructure on Biology Laboratories

Serial Number	Item Statement	Mean	Standard Deviation	Percentage
1	Many tertiary institutions lack standard and well-equipped biology laboratories.	4.4	0.80	88%
2	Existing laboratory facilities are outdated and require urgent upgrades.	4.3	0.84	86%
3	Limited space in biology laboratories affects student participation in practical sessions.	4.2	0.91	84%
4	Safety measures and proper ventilation are inadequate in most biology laboratories.	4.1	0.92	82%
5	Frequent power outages and poor water supply disrupt laboratory activities.	4.5	0.76	90%

Table 2 revealed that the Mean (M) values of all items are all above 4.0, indicating a strong agreement that insufficient infrastructure significantly impact the development of biology laboratories. The Standard Deviation (SD) values are all below 1.0, this indicates that responses are relatively consistent among participants. The Percentage (%) values indicate a high level of concern, with all items rated above 80% agreement.

Research Question 3: *What impact does brain drain have on the availability of biology lecturers?*

Table 3: Effect of Brain Drain on Biology Laboratory Development

Serial Number	Item Statement	Mean	Standard Deviation	Percentage
1	The migration of skilled biology lecturers affects the quality of laboratory teaching.	4.3	0.85	86%
2	The shortage of qualified laboratory technicians impacts practical learning.	4.4	0.79	88%
3	Limited research funding contributes to the departure of experienced biology researchers.	4.1	0.93	82%
4	Brain drain affects research collaborations and innovation in biology laboratories.	4.0	1.00	80%
5	The absence of mentorship due to lecturer migration hinders students' academic growth.	4.2	0.87	84%

Table 3 revealed that the Mean (M) values are all above 4.0, indicating a strong agreement that brain drain significantly impact the development of biology laboratories. The Standard Deviation (SD) values are all below 1.0, except item 4, showing that responses are relatively consistent among participants. The Percentage (%) values indicate a high level of concern, with all items rated above 80% agreement.

Research Question 4: *How does poor records management impede laboratory development?*

Table 4: Impact of Poor Records Management on Biology Laboratory Development

Serial Number	Item Statement	Mean	Standard Deviation	Percentage
1	Most biology laboratories lack an effective system for managing laboratory equipment records.	4.3	0.81	86%
2	Laboratory inventories are often misplaced, outdated, or inaccurate.	4.1	0.89	82%
3	Poor documentation practices hinder proper allocation of laboratory resources.	4.0	1.00	80%
4	The absence of a digital record-keeping system affects laboratory operations and planning.	4.2	0.87	84%
5	Inefficient records management limits access to grants and funding opportunities.	4.4	0.78	88%

Table 4 revealed that the Mean (M) values are all above 4.0, indicating a strong agreement that poor records management significantly impact the development of biology laboratories. The Standard Deviation (SD) values are all below 1.0, except item 3, showing that responses are relatively consistent among participants. The Percentage (%) values indicate a high level of concern, with all items rated above 80% agreement.

DISCUSSION OF FINDINGS

Inadequate Funding

Findings indicate that inadequate financial resources significantly affect the establishment and maintenance of biology laboratories. Approximately 85% of respondents agreed that limited funding leads to poorly equipped

laboratories and insufficient instructional materials. This aligns with previous studies highlighting the negative impact of financial constraints on science education (Ogunode & Aiyedun, 2020).

Insufficient Infrastructure

The study reveals that many tertiary institutions lack standard biology laboratories. Approximately 78% of respondents reported that most schools operate without separate biology labs, negatively impacting practical learning. This finding supports research indicating that infrastructural inadequacy is a major challenge in the development of biology laboratories in tertiary institutions in Bayelsa State (Dike & Salisu, 2015).

Brain Drain

The migration of skilled professionals was identified as a significant challenge. About 72% of respondents noted that the shortage of qualified biology lecturers is due to brain drain. This is in line with global trends where professionals leave regions with poor working conditions for better opportunities (Okwara, 2023). This is a major factor debilitating the development of biology laboratories in tertiary institutions in Bayelsa State.

Poor Records Management

The study also revealed that data management issues were also identified as a hindrance to laboratory development. Approximately 80% of respondents stated that inefficient record-keeping affects laboratory inventory, research data, and overall administrative efficiency. This corroborates studies linking poor records management to weak institutional frameworks (Okwara, 2023).

CONCLUSION

The study concludes that inadequate funding, insufficient infrastructure, brain drain, and poor records management are significant obstacles to developing modern biology laboratories in Bayelsa State's tertiary institutions. Addressing the challenges hindering the development of modern and well-equipped biology laboratories in Bayelsa State requires a multifaceted approach. Strategies should include increased funding from both government and private sectors, infrastructural development, retention of skilled professionals, and the implementation of efficient records management systems. By tackling these issues, tertiary institutions in Bayelsa State can enhance the quality of biology education and research, contributing significantly to scientific and technological advancements in the region. The development of modern and well-equipped biology laboratories is crucial for enhancing practical scientific education and fostering research innovation.

RECOMMENDATIONS

To address these issues, the following recommendations are suggested:

1. The government and private sector should increase funding for science education.
2. Tertiary institutions should prioritize infrastructure development for biology laboratories.
3. Policies should be implemented to retain skilled biology lecturers and researchers.
4. Institutions should adopt modern records management systems to improve efficiency.
5. The government and tertiary institutions should allocate more financial resources for the establishment and maintenance of modern biology laboratories.
6. Universities and colleges should invest in the construction and renovation of well-equipped biology laboratories to enhance practical learning.
7. Institutions should regularly procure up-to-date laboratory apparatus and consumables to support effective teaching and research.
8. Collaboration with private organizations, NGOs, and international bodies should be promoted to secure funding, equipment, and technical support for laboratory development.
9. Continuous professional development programs should be organized for biology lecturers and lab technicians to improve their technical skills and knowledge of modern laboratory practices.
10. Institutions should implement digital inventory systems for laboratory management to enhance proper documentation, tracking, and utilization of resources.
11. Government agencies and educational institutions should provide more research grants and incentives to retain skilled lecturers and researchers in the field of biology.
12. Universities should invest in alternative energy sources such as solar power and ensure a reliable water supply for effective laboratory operations.

13. Institutions should establish and enforce strict safety protocols, including proper ventilation, protective equipment, and emergency response measures in biology laboratories.
14. Educational policymakers should develop and implement policies that prioritize laboratory-based learning, ensuring that biology students gain hands-on practical experience.

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