SCIENCE EDUCATION

# Relationship between Biology Teachers' Awareness and Utilization of Laboratory Management Techniques in Senior Secondary Schools in Ondo State

Robert Goebognaan Dajal, Charles George Ekpo, Adamu Umar Mohammed, Deborah Ihinrere Odunyemi

University of Abuja, Abuja, Nigeria

Published November 2026

**Abstract**

This study investigated the relationship between biology teachers' awareness and utilization of laboratory management techniques in senior secondary schools in Ondo State, Nigeria. The study was anchored by two theories Jean Piaget (1930) of Constructivist Learning Theory, and David Kolb (1984) of Experiential Learning Theory. This study adopted a correlational survey research design. A sample of 616 respondents was selected using multi-stage sampling techniques from the population of 577 biology teachers in senior secondary schools and 41,848 Senior Secondary II (SS II) students across 281 schools in Ondo State. The data collected were analyzed using Statistical Package for Social Sciences (SPSS). Data were also gathered using the Biology Teachers' Laboratory Management Awareness and Utilization Scale (BTLMAUS). The Biology Teachers' Laboratory Management Awareness and Utilization Questionnaire measured ten awareness domains and ten corresponding utilization practices and yielded Cronbach's $\alpha = 0.89$. Data were analyzed using Pearson product-moment correlation at the 0.05 level of significance. Descriptive analysis indicated high awareness ($M = 3.20$, $SD = 0.62$) and comparatively high utilization ($M = 3.01$, $SD = 0.71$). Pearson product-moment correlation showed a strong positive relationship between awareness and utilization, $r = 0.72$, $p = 0.001$. The study concludes that awareness is a critical prerequisite for effective utilization, but awareness alone does not automatically translate to practice. Thus, teachers with higher awareness scores tended to report higher levels of practical utilization. The finding helps clarify the awareness–practice relationship in school laboratory management: awareness is not merely a theoretical attribute but is strongly associated with implementation behavior. It is recommended that continuous professional development programs be organized for biology teachers to bridge the gap between awareness and actual utilization of laboratory management techniques. Nevertheless, the cross-sectional and self-report nature of the data prevents causal interpretation. Professional development should also combine conceptual laboratory management knowledge with observable practice, coaching and institutional support.

**Keywords:** Biology education; teacher awareness; teacher practice; laboratory management; utilization; secondary schools; Ondo State

## 1 Introduction

Science education is widely recognized as a cornerstone of national development, equipping learners with the critical thinking, problem-solving and inquiry skills necessary to navigate an increasingly technological world. Within the sciences, biology occupies a central position because it deals with living organisms and the processes of life, making it directly relevant to health, agriculture, and

environmental sustainability. However, biology is a practical oriented subject. Its concepts are best understood when students engage in hands-on activities that allow them to observe, experiment, and manipulate materials directly. The laboratory, therefore, is not merely a supplementary facility but component of effective biology instruction. A critical factor shaping laboratory effectiveness is teachers' awareness of laboratory management techniques. Awareness encompasses teachers' understanding of procedures, safety measures, and organizational practices required for efficient laboratory operation. Adequate awareness ensures proper planning, resource utilization and the creation of a safe and conducive learning environment. However, the relationship between awareness and actual utilization is not always straightforward. Teachers may possess theoretical knowledge of laboratory management but fail to translate that knowledge into practice due to factors such as inadequate training, lack of administrative support, or insufficient time. Understanding the nature of the relationship between awareness and utilization is essential for effective interventions. Existing literature on laboratory management in Nigeria has largely focused on availability of facilities, safety compliance, or influence of laboratory resources on student outcomes. Few studies have specifically examined the link between biology teachers' awareness and their utilization of laboratory resources on student outcomes. Few studies have specifically examined the link between biology teachers' awareness and their utilization of laboratory management techniques, particularly in the context of Ondo State. This gap is significant because awareness without utilization is of limited practical value.

The present study seeks to fill this gap by providing empirical evidence on the correlation between these two variables. Studies of teacher awareness and utilization have sometimes documented mismatches. Isijola and Alfred (2022), although examining assessment modes rather than laboratory management, reported moderate awareness alongside lower utilization. Christian-Ike (2024) similarly described constraints that can prevent awareness from becoming routine instructional practice. Such findings make the awareness–utilization relationship an important empirical question. Within laboratory management research, awareness and utilization are often examined separately or treated as descriptive variables. The present study directly tests their association among biology teachers in Ondo State. It asks whether teachers who report stronger awareness of management techniques also report stronger implementation of those techniques. The findings are expected to inform teacher training programs, school administrators, and policy makers in their efforts to improve the quality of biology education. A persistent challenge in teacher professional practice is the gap between knowing what should be done and consistently doing it. In science laboratories, this distinction is consequential because management practices affect safety, resource preservation, practical lesson organization and students' opportunities for hands-on learning (Eze, 2014; Okebukola, 2012).

## 2 Methodology

### 2.1 Research design

The study adopted a correlational survey research design. This design is appropriate because the study sought to determine the relationship between two variables; biology teachers' awareness of laboratory management techniques and their utilization of those techniques without manipulating either variable. A correlation design allows the researcher to examine the strength and direction of the association between the variables as they naturally occur in the school environment. The survey approach was used to collect data from a sample of biology teachers across Ondo State, enabling the researcher to make inferences about the broader population.

### 2.2 Population of the study

Ondo has in total of 281 senior secondary schools while the population of senior secondary school teachers is 6,743 and 41,848 SS II students. The target population which comprises of 577 Biology teachers in Senior Secondary Schools in Ondo State, Nigeria as provided by the Ondo State Ministry of Education.

### 2.3 Instrumentation

The instruments used for data collection were Biology Teachers' Laboratory Management Awareness and Utilization Questionnaire (BTLMAUQ). Biology Teachers' Laboratory Management Awareness and Utilization Questionnaire (BTLMAUQ) was developed for Biology teachers to measure their awareness and level of utilization of laboratory management techniques. The instrument was divided into two sections. Section A sought information on personal data of biology teachers' such as gender, qualification, and teaching experience, while Section B consisted of questionnaire items statement which were divided into 2 clusters. Cluster I consisted of 10 items on teachers' awareness of laboratory management techniques and cluster II content 10 item on utilization of laboratory management techniques. A four-point modified rating scale was used for Cluster I which is Highly Aware (HA=4), moderately Aware (MA=3), Rarely Aware (RA=2), Not Aware (NA=1), and Cluster II which were Always Utilized (AU =4), Sometimes Utilized (SU=3), Rarely Utilized (RU=2), Not Utilized (NU=1).

### 2.4 Data collection

Data were collected using the Biology Teachers' Laboratory Management Utilization Questionnaire (BTLMUQ). A multi-stage sampling procedure was adopted for the study. At the first stage, Ondo State was divided into its three senatorial districts to ensure proper geographical coverage. In the second stage, a proportionate number of public secondary schools were randomly selected from each Local Government Area within the senatorial districts. At the third stage, not more than two biology teachers were selected from each sampled school. Finally, a simple random sampling technique was used to select 10 SS II students under each selected teacher in the sampled schools.

### 2.5 Data analysis

The data collected were analyzed using both descriptive and inferential statistics. Descriptive statistics, including frequency counts, percentages, mean, and standard deviation, were employed to determine the extent of biology teachers' utilization of laboratory management techniques. In addition, Pearson Product Moment Correlation (PPMC) was used to examine the relationship between teachers' utilization of laboratory management techniques and students' academic achievement in biology. All hypotheses were tested at the 0.05 level of significance. The decision rule for interpreting the questionnaire responses was based on a criterion mean of 2.50. Mean scores of 2.50 and above indicated agreement, while mean scores below 2.50 indicated disagreement. For hypothesis testing, the null hypothesis was rejected when the p-value was less than 0.05, and not rejected when the p-value was greater than 0.05.

## 3 Results and discussion

### 3.1 Demographic

Table 1 indicates the distribution of respondents based on gender. A break down revealed that 27 respondents representing 48% were male biology teachers while 29 respondents representing 52% were female biology teachers. This showed that the number of female respondents was more than that of male respondents.

**Table 1.** Distribution of biology teachers based on gender.

| Gender | Respondents | Percentage (%) |
|---|---|---|
| Male | 27 | 48.00 |
| Female | 29 | 52.00 |
| Total | 56 | 100.00% |

### 3.2 Research questions

**Table 2.** shows the mean score and standard deviation level of awareness of laboratory management techniques among biology teachers in senior secondary schools. The results revealed a sectional mean of 3.20, indicating high level of biology teachers' awareness of laboratory management techniques. Analysis revealed that items 8, 3, 7, and 2 recorded the Mean = (3.32, 3.28, 3.26, 3.25) with standard deviations of (0.60, 0.61, 0.61, and 0.65 respectively), and items 10, 4, 5, and 6 with standard deviation of (0.71, 0.59, 0.62 and 0.59) This shows that biology teachers were more aware of the following laboratory management techniques: waste disposal methods in the laboratory, adherence to techniques for maintaining laboratory records, regular maintenance and servicing of laboratory equipment, and keeping safety rules that guide laboratory management. Therefore, analysis indicated that the sectional mean score of teachers' levels of awareness was 3.20 with a standard deviation of 0.62. This shows that biology teachers are highly aware of laboratory management techniques in Senior Secondary Schools, Ondo State.

| S/N | Statements | HA | MA | RA | NA | Mean | SD | Decision |
|---|---|---|---|---|---|---|---|---|
| | Proper labeling and arrangement of laboratory equipment. | 18 | 31 | 7 | 0 | 3.19 | 0.67 | Highly Aware |
| | Keeping safety rules that guide laboratory management. | 21 | 28 | 7 | 0 | 3.25 | 0.65 | Highly Aware |
| | Adherence to techniques for maintaining laboratory records. | 21 | 30 | 5 | 0 | 3.28 | 0.61 | Highly Aware |
| | Regular use of laboratory manuals for biology experiments. | 15 | 35 | 6 | 0 | 3.16 | 0.59 | Highly Aware |
| | Keeping procedures for handling hazardous substances in the laboratory. | 16 | 33 | 7 | 0 | 3.16 | 0.62 | Highly Aware |
| | Keeping accurate inventory management techniques for laboratory materials. | 15 | 35 | 6 | 0 | 3.16 | 0.59 | Highly Aware |
| | Regular maintenance and servicing of laboratory equipment. | 20 | 31 | 5 | 0 | 3.26 | 0.61 | Highly Aware |
| | Waste disposal methods in the laboratory. | 22 | 30 | 4 | 0 | 3.32 | 0.60 | Highly Aware |
| | Adherence to student's safety procedures during laboratory practical. | 16 | 34 | 6 | 0 | 3.17 | 0.60 | Highly Aware |

| S/N | Statements | HA | MA | RA | NA | Mean | SD | Decision |
|---|---|---|---|---|---|---|---|---|
| | Proper design of effective seating arrangements for laboratory sessions. | 16 | 30 | 9 | 1 | 3.10 | 0.71 | Highly Aware |
| | Sectional Mean | | | | | 3.20 | 0.62 | Highly Aware |

**Table 3.** Mean scores and standard deviation of biology teachers level of utilization of laboratory management techniques in senior secondary schools n=56.

| S/N | Statements | AU | SU | RU | NU | Mean | SD | Decision |
|---|---|---|---|---|---|---|---|---|
| 11 | Students following laboratory safety rules during practical. | 12 | 33 | 10 | 1 | 2.99 | 0.68 | Sometimes Utilized |
| 12 | Regularly maintaining and repairing laboratory equipment. | 13 | 29 | 14 | 0 | 2.96 | 0.72 | Sometimes Utilized |
| 13 | Use of laboratory manuals to guide students in carrying out experiments. | 13 | 31 | 10 | 2 | 3.00 | 0.73 | Always Utilized |
| 14 | Cleaning and arrangement of equipment after use. | 12 | 28 | 16 | 0 | 2.91 | 0.72 | Sometimes Utilized |
| 15 | Keeping accurate records of laboratory resources and their usage. | 13 | 27 | 14 | 2 | 2.91 | 0.79 | Sometimes Utilized |
| 16 | Correct handling of hazardous substances. | 16 | 29 | 11 | 0 | 3.07 | 0.70 | Always Utilized |
| 17 | Proper storage of laboratory chemicals and equipment. | 14 | 29 | 12 | 1 | 3.01 | 0.71 | Always Utilized |
| 18 | Scheduling practical sessions effectively to maximize learning. | 15 | 32 | 8 | 1 | 3.07 | 0.70 | Always Utilized |
| 19 | Supervising students closely during practical activities. | 12 | 35 | 8 | 1 | 3.05 | 0.64 | Always Utilized |
| 210 | Implementing proper waste management practices in the laboratory. | 16 | 31 | 8 | 1 | 3.10 | 0.70 | Always Utilized |
| | Sectional Mean | | | | | 3.01 | 0.71 | Always Utilized |

The result in Table 3 showed the analysis of the extent to which biology teachers utilized laboratory management techniques in senior secondary schools in Ondo State, Nigeria. From the analysis, it was discovered that, the responses of biology teachers to 6 items out of 10 items that were raised in the questionnaire were always utilized and 4 items were sometimes utilized. Item 20 which stated the proper waste management practices in the laboratory, had the highest Mean of 3.10 with a Standard Deviation of 0.70. The sectional Mean of 3.01 of the ten (10) items on respondents' questionnaire indicated that biology teachers in senior secondary schools in Ondo State, Nigeria always utilized laboratory management techniques in their teaching.

**Table 4.** Correlation between biology teachers' awareness and utilization of laboratory management techniques in senior secondary schools in Ondo state n=56.

| Variable Correlated | N | Pearson Correlation (r) | P- Value | Decision |
|---|---|---|---|---|
| Awareness vs. Utilization | 56 | 0.72 | 0.001 | Significant |

The Pearson Product Moment Correlation analysis was used to determine the relationship between biology teachers' awareness and their utilization of laboratory management techniques. As presented in Table 4, the analysis yielded a correlation coefficient ((r)) of 0.72 and a p-value of 0.001. Since the p-value is less than the 0.05 level of significance, the null hypothesis is rejected.

This result reveals a strong, positive relationship between biology teachers' awareness and their utilization of laboratory management techniques. The correlation coefficient of 0.72 indicates a high positive linear relationship. As biology teachers become more aware of proper laboratory management techniques, such as safety protocols, inventory control, and equipment upkeep, their practical application and day-to-day utilization of these techniques in the laboratory increase correspondingly. Therefore, teachers' level of awareness serves as a strong predictor of how well they manage and utilize laboratory resources. Enhancing teachers' awareness is a crucial factor in improving the practical utilization of laboratory techniques in senior secondary schools in Ondo State.

## 4 Iii discussion and findings

The strong positive correlation indicates that awareness and utilization move together in this sample. Teachers who reported greater knowledge of laboratory management techniques also tends to report more frequent application of those techniques. This supports treating awareness as an enabling condition for practice. Although contextual barriers can prevent implementation (Isijola and Alfred, 2022; Christian-Ike, 2024), the present data show substantial correspondence between the two constructs. Awareness-building may therefore be useful when combined with resources, supervision and opportunities to practice.

The findings revealed that biology teachers possess a high level of awareness regarding laboratory management techniques, particularly concerning waste disposal methods and safety rules. However, their actual utilization of these techniques, while generally positive, falls slightly short of their awareness levels. Teachers frequently implement waste management practices, but routine maintenance, cleaning and accurate record-keeping are less commonly executed. This discrepancy suggests that while teachers know the correct protocols, practical constraints such as inadequate funding, time limitations, and insufficient laboratory support staff hinder full implementation. Furthermore, the study established a strong, positive, and significant relationship between teachers' awareness and their utilization of laboratory management techniques. This indicates that teachers with greater knowledge of these protocols are significantly more likely to apply them. However, because awareness is slightly higher than actual practice, it is evident that knowledge alone is insufficient to guarantee optimal laboratory management.

## 5 Conclusion

Biology teachers in Ondo State are highly aware of laboratory management techniques, which translate into a high level of utilization, and these two variables are strongly linked. Awareness and

utilization of laboratory-management techniques were strongly and positively related among the sampled biology teachers. The result supports an integrated approach to professional development in which knowledge, practice and institutional support are developed together. To bridge the gap between knowing and doing, educational stakeholders must address the systemic barriers hindering utilization. The result supports an integrated approach to professional development in which knowledge, practice and institutional support are developed together. It is recommended that school administrators and the state government provide adequate funding for laboratory maintenance, supply modern equipment and employ dedicated laboratory assistants to support teachers.

## References

[1] Christian-Ike C (2024). Science teachers' awareness and utilization of innovative teaching strategies in Nigeria. *International Journal of Educational Research*, 10(3), 101–112.

[2] Eze EU (2014). Effective management of school science laboratories for better teaching and learning of science subjects. *Journal of Education and Practice*, 5(6), 95–100.

[3] Isijola OA, Alfred TO (2022). Measures of science teachers' awareness and utilization of assessment modes in classroom learning in Ondo State, Nigeria. *Journal of Science Education and Research*, 10(2), 98–110.

[4] Nworgu BG (2015). Educational research: Basic issues and methodology. *3rd ed*. University Trust Publishers.

[5] Okebukola PA (2012). Teaching science in the laboratory: The importance of effective management for student success. *Journal of Science Education and Technology*, 21(5), 497–510.

[6] Onu CI, Osuafor MA, Obialor BO (2021). Analysis of biology teachers' awareness and utilization of laboratory management techniques in secondary schools in Enugu State. *Nigerian Journal of Science Education*, 13(1), 102–119.