

Biology Teachers' Level of Awareness of Laboratory Management Techniques in Senior Secondary Schools in Ondo State

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Abstract

This study examined biology teachers' level of awareness of laboratory management techniques in senior secondary schools in Ondo State. A correlational survey research design was adopted for this study. The sample consisted of 616 respondents selected through a multistage sampling technique from a population of 577 biology teachers and 41,848 Senior Secondary II students across 281 public secondary schools. Data were collected using the Biology Teachers' Laboratory Management Awareness Questionnaire (BTLMAQ) and Biology Achievement Test (BAT). The instruments were validated by experts, and a reliability coefficient of 0.89 was obtained using Cronbach's alpha reliability. Data were analyzed using mean and standard deviation to answer research questions, while Pearson product-moment correlation and the independent t-test were used to test hypotheses at the 0.05 level of significance. Descriptive statistics showed an overall awareness mean of 3.20 (SD = 0.62), interpreted in the thesis as moderate awareness. Waste-disposal methods recorded the highest item mean ($M = 3.32$, $SD = 0.60$), followed by laboratory record maintenance ($M = 3.30$, $SD = 0.61$) and equipment maintenance and servicing ($M = 3.27$, $SD = 0.61$). Effective seating arrangement recorded the lowest mean ($M = 3.10$, $SD = 0.71$). Biology teachers demonstrated a high level of awareness of laboratory management techniques. The findings imply that although biology teachers possess a high level of awareness of laboratory management techniques, such awareness alone is not sufficient to significantly enhance students' academic achievement. The study further implies that the actual utilization of laboratory management techniques plays a significant role in improving students' performance in biology. When teachers actively organize, supervise, and manage laboratory activities effectively, students are more likely to develop better understanding and achieve higher academically. Therefore, this study recommends continuous professional development programs aimed at strengthening teachers' practical laboratory management competencies.

Keywords: biology education; laboratory management; teacher awareness; science laboratory; senior secondary schools; Ondo State

1 Introduction

Education is widely recognized as a key driver of individual growth and societal development, with science education playing a pivotal role in fostering critical thinking, problem solving, and technological advancement. Biology holds a central position in the sciences, as it equips learners with knowledge of living organisms and develops essential scientific inquiry skills. Effective biology instruction depends heavily on practical, hands-on experiences that allow students to observe, experiment, and engage directly with scientific concepts. Laboratory activities, in particular, enhance understanding, retention, and academic achievement, making them indispensable for quality science education (Ogunleye, 2012).

Despite the recognized importance of laboratory-based instruction, studies in Nigeria suggest that many senior secondary schools face challenges in implementing effective practices. Biology, as a practical-oriented subject, requires well-organized and properly managed laboratory activities to facilitate meaningful learning. However, evidence indicates that laboratories are often poorly managed or underutilized, restricting students' exposure to practical experience. This limitation contributes to a superficial understanding of scientific concepts, lower academic performance, and decreased interest in the subject (Achufusi & Ezenduka, 2017). In Ondo State, these issues continue to affect the effectiveness of biology instruction and the overall quality of science education.

A critical factor shaping laboratory effectiveness is teachers' awareness of laboratory management techniques. Teachers' awareness encompasses their understanding of the procedures, safety measures, and organizational practices required for efficient laboratory operation. Adequate awareness ensures proper planning, resource utilization, and the creation of safe and conducive learning environments. Previous studies indicate that while teachers may possess some knowledge of laboratory practices, this awareness is often insufficient or poorly applied in classroom settings, limiting its influence on students' learning outcomes (Alahmadi, 2017; Muhammad, 2016).

This study investigates biology teachers' awareness of laboratory management techniques in senior secondary schools in Ondo State. Through a questionnaire and a Biology Achievement Test (BAT), the researchers sought to investigate the factors influencing the level of biology teachers' awareness of laboratory management techniques in senior secondary schools and the correlation between biology teachers' awareness of laboratory management techniques and students' academic achievement in senior secondary schools in Ondo State. Findings from this study are expected to inform strategies for strengthening laboratory instruction, enhancing teachers' competencies, and improving student outcomes in biology. Enhancing teachers' awareness is therefore essential for improving both the quality of laboratory instruction and students' academic achievement in biology.

2 Methodology

2.1 Research design

This study adopted a correlational survey research design to examine biology teachers' level of awareness of laboratory management techniques in senior secondary schools in Ondo State, Nigeria. Correlational research involves determining the relationship between two or more variables without their manipulation.

2.2 Population of the study

Ondo State has a total of 281 public senior secondary schools, with 6,743 senior secondary school teachers and 41,848 SS II students. The target population comprised the 577 biology teachers in senior secondary schools in Ondo State, Nigeria.

2.3 Sampling

A sample size of 616 respondents was used for the study, consisting of 56 biology teachers and 560 SS II students. This study employed a multistage sampling procedure. First, the state was stratified into the three senatorial districts to ensure adequate geographical coverage. Senior secondary schools were then selected proportionately from the Local Government Areas within each district

through simple random sampling, and two biology teachers were randomly selected in each selected school. Subsequently, ten SS II students were randomly selected for each participating teacher.

2.4 Data collection

Data were gathered using the Biology Teachers' Laboratory Management Awareness Questionnaire (BTLMAQ) and Biology Achievement Test (BAT). The BTLMAQ measured teachers' awareness of laboratory management techniques, and BAT assessed students' academic achievement in biology. To establish reliability, a pilot study was conducted using 20 biology teachers from schools with similar characteristics to those in the main study but not included in the sample.

2.5 Data analysis

Data obtained for the purpose of this study were analyzed based on the research questions and test of hypotheses. Mean and standard deviation were used to answer the research questions, while the null hypotheses were tested using Pearson product-moment correlation, regression, the Mann-Whitney U test and the independent t-test at the 0.05 level of significance.

3 Results and discussion

3.1 Demographic data

Table 1 indicates the distribution of respondents based on gender. A breakdown 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 by gender.

Gender	Respondents	Percentage (%)
Male	27	48.21
Female	29	51.79
Total	56	100.00

3.2 Research question

The result in Table 2 showed the analysis of the level of awareness of laboratory management techniques among biology teachers in senior secondary schools. Analysis revealed that items 8, 3, 7, and 2 recorded the highest mean scores of 3.32, 3.30, 3.27, and 3.25 with standard deviations of 0.60, 0.61, 0.61, and 0.65 respectively. 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.

On the other hand, items 10, 4, 5, and 6 recorded relatively lower mean scores of 3.10, 3.15, 3.15, and 3.16 with standard deviations of 0.71, 0.59, 0.62 and 0.59, respectively. This indicates that biology teachers were less aware of proper design of effective seating arrangements for laboratory sessions, regular use of laboratory manuals for biology experiments, procedures for handling hazardous substances, and accurate inventory management techniques for laboratory materials. Further

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 had a high level of awareness of laboratory management techniques in senior secondary schools.

Table 2. Mean scores and standard deviations of biology teachers' level of awareness of laboratory management techniques in senior secondary schools ($n = 56$).

S/ N	Statement	VA	MA	RA	NA	Mean	SD	Decision
1	Proper labeling and arrangement of laboratory equipment.	18	31	7	0	3.18	0.67	Highly aware
2	Safety rules that guide laboratory management should be followed.	21	28	7	0	3.25	0.65	Highly aware
3	Adherence to techniques for maintaining laboratory records.	21	30	5	0	3.30	0.61	Highly aware
4	Regular use of laboratory manuals for biology experiments.	15	35	6	0	3.15	0.59	Highly aware
5	Keeping procedures for handling hazardous substances the laboratories.	16	33	7	0	3.15	0.62	Highly aware
6	Keeping accurate inventory management techniques for laboratory materials.	15	35	6	0	3.16	0.59	Highly aware
7	Regular maintenance and servicing of laboratory equipment.	20	31	5	0	3.27	0.61	Highly aware
8	Waste disposal methods in the laboratory.	22	30	4	0	3.32	0.60	Highly aware
9	Adherence to student's safety procedures during laboratory practical.	16	34	6	0	3.17	0.60	Highly aware
10	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

VA = very aware, MA = moderately aware, RA = rarely aware, NA = not aware.

The results in Table 3 show the Pearson product-moment correlation analysis examining the relationship between biology teachers' awareness of laboratory management techniques and students' academic achievement in senior secondary schools. The analysis yielded a correlation coefficient (r) of -0.06 with a p -value of 0.640. Since the p -value (0.640) is greater than the 0.05 level of significance, the null hypothesis is accepted. This finding indicates that no statistical relationship exists between teachers' awareness of laboratory management and students' academic performance. Consequently, possessing familiarity with laboratory procedures does not automatically translate to enhanced student achievement, rather, actual hands-on execution, instructional methodologies, and the physical adequacy of laboratory infrastructure serve as stronger determinants of academic success.

Table 3. Correlation between biology teachers' awareness and students' academic achievement ($n = 560$).

Variables correlated	N	Pearson correlation (r)	p -value	Decision
Awareness vs. students' academic achievement	560	-0.06	0.640	Not significant

3.3 Test of hypothesis

The null hypotheses were tested using correlation, regression and t-test statistics. All tests were conducted at the 0.05 level of significance.

H_{01} : There is no significant influence of biology teachers' level of awareness of laboratory management techniques on students' achievement in senior secondary schools in Ondo State.

The result of the analysis in Table 4 revealed that there was a weak positive relationship between biology teachers' level of awareness of laboratory management techniques and students' academic achievement in biology in senior secondary schools. The Pearson correlation coefficient (r) of 0.13 indicates a very low positive correlation between the two variables. Furthermore, the p -value of 0.94 was greater than the 0.05 level of significance. As a result, the null hypothesis was accepted. This shows that biology teachers' level of awareness of laboratory management techniques does not have a significant influence on students' academic achievement in biology in senior secondary schools in Ondo State.

Table 4. Correlation between biology teachers' level of awareness of laboratory management techniques and students' achievement in biology in senior secondary schools.

Variables	Statistic	Awareness	Achievement	Decision
Awareness	Pearson correlation	1.00	0.13	Weak positive relationship
	Sig. (2-tailed)		0.94	
Achievement	Pearson correlation	0.13	1.00	Weak positive relationship
	Sig. (2-tailed)	0.94		

4 Discussion of findings

The findings of this study, which align with previous research in the field, show that biology teachers' level of awareness of laboratory management techniques did not have a statistically significant influence on students' academic achievement. Although awareness appeared to have some influence, it was not strong enough to produce measurable improvements in achievement. This finding is consistent with Achufusi and Ogechukwu (2024), who reported that awareness alone does not automatically translate into improved student outcomes.

This is because knowledge without consistent implementation has a limited practical impact. Teachers may understand laboratory management principles theoretically but fail to apply them systematically because of constraints such as overcrowded classrooms, inadequate laboratory facilities, insufficient materials, time limitations, or lack of administrative support. Therefore, awareness in isolation does not significantly affect students' performance.

5 Conclusion

Biology teachers in the sampled Ondo State Senior Secondary Schools demonstrated a high level of awareness of laboratory management techniques across safety, records, maintenance, waste disposal and organizational domains. The findings showed that teachers' level of awareness of laboratory management techniques does not have a statistically significant influence on students' academic achievement in biology. This pattern indicates that, although the broad awareness base is positive,

awareness alone is insufficient; it highlights the need for deeper, more consistent professional knowledge and its practical application to enhance student learning outcomes.

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