

Comparative Assessment of Laboratory Safety Practices Among Biology Students and Teachers in Abeokuta, Nigeria

Abigeal Anuoluwapo Otemuyiwa^{*1,2}, Joy Abiola Onipede¹, Victoria Oluwasayo Ogunsola¹

¹General Studies in Education Department, Federal College of Education, Abeokuta, Nigeria

²Biology Department, Federal College of Education, Abeokuta, Nigeria

*Correspondence to: olasunkanmi.adeleke@aaua.edu.ng

Abstract: The objective of this research was to evaluate the level of laboratory safety practices among biology students and their teachers. The study was carried out in selected public and private senior secondary schools within Abeokuta, Nigeria. Data collection was facilitated through questionnaires titled "Students Laboratory Safety Practices (SLSP)" and "Teachers Laboratory Safety Practices Implementation (TLSPI)." A total of 256 participants, comprising 240 students and 16 teachers, were randomly selected using a simple random sampling method. The data obtained were analyzed employing T-test and Analysis of Variance (ANOVA), with a significance level set at $p < 0.05$. The results indicated that both students and teachers in the public and private secondary schools adhered to safety precautions and implemented safety practices during laboratory practical sessions. Consequently, it is recommended that teachers persist in their efforts to reinforce laboratory safety practices among students and utilize instructional posters or flex materials that outline the necessary safety protocols to be followed in the laboratory.

Keywords: biology students; comparative assessment; laboratory; safety practices

© Universitas Negeri Semarang. This is an open access article under the CC BY license

Submitted: December 18, 2025; **Revised:** April 03, 2026; **Accepted:** September 29, 2026

DOI: <https://doi.org/10.15294/jse.v4i2.34286>

INTRODUCTION

The field of biology encompasses a comprehensive scientific investigation of life and the vast array of living organisms, focusing on their anatomical features, functional mechanisms, developmental processes, evolutionary history, and spatial distribution. This discipline is marked by its rich diversity and dynamic nature, integrating knowledge from various sub-disciplines, including genetics, ecology, microbiology, and physiology (Olatunji et al., 2024). The central aim of biology is to clarify the complex interactions that take place within and between living systems, thereby providing significant insights into the essential processes that sustain life on Earth (Ibrahim & Musa, 2022). Additionally, biology serves as the foundation for numerous applied scientific domains, including medicine, agricultural science, and biotechnology (Bello & Adeyemi, 2025). By combining theoretical concepts with empirical research methods, biology equips students and researchers with the necessary tools to explore the intricacies of living organisms and to contribute meaningfully to scientific advancements.

A laboratory is a specialized environment equipped with the necessary tools and materials for conducting scientific experiments, research projects, or practical educational activities. Laboratories are essential to the teaching of science, as they provide students with hands-on learning experiences, allowing them to explore scientific concepts through systematic observation, experimentation, and analysis (Olatunji et al., 2024). A biology laboratory is a designated space, whether a room, building, or section of a building, specifically constructed and organized for the purpose of conducting experiments, research, and practical activities associated with the study of living organisms and biological phenomena. This environment is essential for students and researchers to explore various concepts, including genetics, ecology, physiology, and microbiology, through experiential learning (Bello & Adeyemi, 2025). Equipped with instruments such as microscopes, dissection tools, and chemical reagents, biology laboratories offer a controlled setting for the observation, analysis, and comprehension of the intricate nature of life (Olatunji et al., 2024).

The importance of a biology laboratory lies in its capacity to promote scientific exploration, critical thinking, and the development of practical skills. Research indicates that laboratory experiences are vital for connecting theoretical knowledge with practical biological applications, thereby transforming abstract ideas into tangible

understanding, which enhances students' grasp of complex concepts (Ibrahim & Musa, 2022). It is widely accepted that regular practice contributes to the mastery of classroom learning, encapsulated in the adage "practice makes perfect." The effectiveness of teaching and learning is influenced by the adequacy of laboratory facilities in educational institutions and the instructor's proficiency in utilizing these resources to facilitate meaningful learning experiences for students (Pareek, 2019). Furthermore, adherence to safety protocols within the laboratory is crucial for maintaining a secure and supportive environment for both learning and experimentation.

In the context of scientific practice within the laboratory, students should operate under the supervision and guidance of their instructors as they manipulate, examine, and conduct experiments on the organisms being studied. Through these activities, students can cultivate fundamental scientific skills, including observation, classification, and communication, measurement, inference, and prediction (Mbonu & Okoli, 2019). The acquisition of relevant scientific skills through practical engagement in biology laboratories underscores their vital role in the teaching and learning of science, particularly at the secondary school level. This assertion is supported by Fagihi (2018), who posits that the laboratory serves as the nucleus of science education.

However, numerous biology laboratories have been established without adequate attention to safety considerations during their design and construction. Essential facilities such as preparatory rooms, plant and animal rooms, and storerooms are often neglected. In certain educational institutions, there is a lack of proper chemical storage, absence of safety equipment, and insufficient first aid and waste disposal resources. Furthermore, the absence of established laboratory rules and regulations poses significant health risks to individuals working within these environments. Additionally, the increasing number of students pursuing science may lead to constraints in available space for laboratory expansion.

Safety is characterized as the condition of being protected from harm, injury, or adverse effects that may arise from environmental, mechanical, chemical, or biological hazards. It encompasses the practices, policies, and strategies implemented to mitigate risks and enhance the well-being of individuals in various settings. As noted by Adebajo et al. (2024); Sani et al. (2024) safety represents a proactive approach to identifying potential threats and establishing protocols to prevent accidents and injuries. Safety procedures typically include a chemical hygiene plan, waste disposal protocols, and an assessment of significant physical and health hazards pertinent to specific research activities. A biology laboratory must be meticulously organized to foster an environment conducive to exploring scientific principles, thereby ensuring safety for all users. Given that laboratory settings are designed for human interaction, the occurrence of accidents and injuries is inevitable. Consequently, biology educators bear the responsibility of instructing students on the proper handling of living specimens, preserved samples, and equipment to achieve successful outcomes while ensuring the safe preservation of life. Recent studies have highlighted the importance of stringent safety regulations in creating a safe and effective educational environment in secondary schools (Adewale & Okeke, 2023; Ngoako et al. 2024) The growing disparity in the enforcement of laboratory safety protocols between public and private educational institutions has become a matter of significant concern. Public schools often face challenges due to limited financial resources, which can result in a lack of essential safety equipment and properly maintained laboratory settings. In contrast, private schools generally have access to better resources; however, they may struggle to recruit adequately trained staff or to implement effective safety protocols (Ibrahim & Musa, 2022). These differences can significantly affect the enforcement of safety measures and, consequently, the quality of practical biology education provided to students. This lack of attention to safety protocols has resulted in various accidents, including the breaking of glassware, skin exposure to hazardous substances such as acids, and contact with preserved or live specimens that may pose health risks, potentially leading to severe injuries or fatalities. Given these concerns, it is imperative to conduct a comparative assessment of laboratory safety practices among biology students and teachers in public and private schools within Abeokuta, Nigeria.

H₀₁: There is no significant difference between the mean rating scores of Public and Private secondary school teachers on the safety equipment in the Biology laboratory.

H₀₂: There is no significant difference between the mean rating scores of Public and Private secondary school teachers on the extent of implementation of safety practices in Biology laboratory.

H₀₃: There is no significant difference between the mean rating scores of Public and Private secondary school students on the safety equipment in Biology laboratory.

H₀₄: There is no significant difference between the mean rating scores on the extent of implementation of safety practices in the Biology laboratory.

H₀₅: There is no significant difference between the mean rating scores of Public and Private secondary school teachers on the safety equipment and implementation of safety practices in Biology laboratory

METHODS

The research employed a descriptive survey methodology and was carried out in senior secondary schools within Abeokuta Metropolis, Nigeria. A simple random sampling technique was utilized to select a sample of two hundred and fifty (250) students, while a purposive sampling method was applied to choose sixteen (16) teachers for participation in the study. The primary data collection instrument was a questionnaire entitled “Students Laboratory Safety Practices (SLSP) and Teachers Laboratory Safety Practices Implementation (TLSPI).” The response format included a modified two Likert-type 4-point scale for the first two research questions, with options of Strongly Agree (SA), Agree (A), Disagree (D), and Strongly Disagree (SD). For research questions three to five, the response options were Always, Sometimes, Rarely, and Never, corresponding to ratings of 4, 3, 2, and 1, respectively. To evaluate the reliability of the instrument, the Cronbach Alpha method was employed, yielding reliability coefficients of 0.701 for student respondents and 0.651 for teachers, indicating a high level of reliability. To further ensure the instrument's reliability, a pilot test was conducted involving 50 respondents (40 students and 10 teachers) who were not included in the main sample but shared similar characteristics. The data collection instrument was administered directly by the researcher to the students. Data analysis was performed using both descriptive statistics and inferential analysis.

RESULT AND DISCUSSION

H₀₁: There is no significant difference between the mean rating scores of public and private secondary school teachers on the safety equipment in Biology laboratory

Table 1. The independent t-test showing the difference between school type and the safety equipment in Biology laboratory in school

School type	N	Mean	Std. Deviation	df	t	Sig
Public	8	17.125	1.356	14	3.123	.002
Private	8	15.875	1.552			

Table 1 above shows that there is significant difference in the mean rating scores of public and private secondary school teachers on the safety equipment in Biology laboratory, $t(14) = 3.123$ at $P < 0.05$ level of significance. Public school teachers ($= 17.125$, $S.D = 1.356$) to Private school teachers ($= 15.875$, $S.D = 1.552$). Consequently, the hypothesis which states that no significant difference between the mean rating scores of public and private secondary school teachers on the safety equipment available in Biology laboratory was therefore rejected.

H₀₂: There is no significant difference between the mean rating scores of public and private secondary school teachers on the extent of implementation of safety practices in the biology laboratory.

Table 2. The independent t-test showing the difference between School type extent of implementation of safety practices in the biology laboratory

School Type	N	Mean	Std. Deviation	df	t	Sig
Public	8	15.750	.462	14	.651	.121
Private	8	15.250	2.121			

The result presented in table 2 above shows that there is no significant difference between the mean rating scores of public and private school teachers on the extent of implementation of safety practices in the biology laboratory, $t(14) = 0.651$, $p = .121$ at $P < 0.05$ level of significant. Public school teachers had the mean rating score of $= 15.750$, $S. D = 0.462$ while private school teachers had the mean rating score of $= 15.250$, $S.D = 2.121$. Therefore, the hypothesis which states that there is no significant difference between the rating scores of public and private school teachers on the extent of implementation of safety practices in the biology laboratory was accepted.

H₀₃: There is no significant difference between the mean rating scores of public and private secondary school students on the safety equipment in Biology laboratory

Table 3. The independent t-test showing the difference between school type and availability of safety equipment in Biology laboratory

School type	N	Mean	Std. Deviation	df	t	Sig
Public	120	16.500	2.106	.238	3.931	.001
Private	120	15.266	2.715			

Table 3 above revealed that significant difference was found between public students' mean rating scores and private students' mean rating scores on the safety equipment available in biology laboratory, $t(238) = 3.931$, at $P < 0.05$ level of significant. Public school students ($= 16.500$, S. D= 2.106) to Private school Students ($= 15.266$, S. D= 2.715). Hence, the hypothesis was therefore rejected.

H₀₄: There is no significant difference between the mean rating scores of public and private secondary school students on the extent of implementation of safety practices in the biology laboratory.

Table 4. The independent t-test showing the difference between students' School type and the extent of implementation of safety practices in the biology laboratory

School Type	N	Mean	Std. Deviation	df	t	Sig
Public	120	13.250	2.661	238	1.413	.028
Private	120	13.708	2.356			

Table 4 above shows that there is no significant difference between the mean rating scores of public-school students and private school students on the extent of implementation of safety practices in the biology laboratory, $t(238) = 1.413$, $p = .028$ at $P < 0.05$ level of significance. Therefore, the hypothesis which states that there is no significant difference between the rating scores of public and private school students on the extent of implementation of safety practices in the biology laboratory was accepted.

H₀₅: There is no significant difference between the mean rating scores of public and private secondary school teachers on the safety equipment and implementation of safety practice in biology laboratory.

Table 5. One way of Analysis of Variance (ANOVA) of Safety Equipment and Implementation Practices

School Type		Sum of Squares	Df	Mean Square	F	Sig.
Public	Between Groups	7.375	2	3.688	3.352	.119
	Within Groups	5.500	5	1.100		
	Total	12.875	7			
	Between Groups	.250	2	.125	.500	.634
	Within Groups	1.250	5	.250		
	Total	1.500	7			
Private	Between Groups	9.375	3	3.125	1.667	.310
	Within Groups	7.500	4	1.875		
	Total	16.875	7			
	Between Groups	13.500	3	4.500	1.000	.479
	Within Groups	18.000	4	4.500		
	Total	31.500	7			

Table 5 revealed the summary of analysis of variance (ANOVA) of the safety equipment availability and implementation of practices. From the table it was revealed that there is no significance in the mean rating scores of public and private school teachers on the safety equipment and implementation of safety practice in biology laboratory. The report of Popoola and Adeyinka, (2024) supported that a notable disparity was identified between the average rating scores of teachers from public and private secondary schools regarding the availability of safety equipment in Biology laboratories. Aliyo & Edin, (2021) findings stands in contrast which indicated a lack of adequate safety equipment in the teaching laboratories of a health institute, a deficiency that could lead to health risks and environmental contamination. Furthermore, the absence of a significant mean difference in the safety practices of biology students from both public and private schools corroborates the findings of Nwune et al. (2023), which stated that science laboratory accidents do not occur in secondary schools within the Awka Education Zone, regardless of the type of institution. They also noted no significant variation in the preventive measures against laboratory

accidents employed by students in both public and private secondary schools in the region. This suggests that safety practices in science laboratories are similarly executed across both types of institutions.

The significant difference observed between the mean rating scores of public and private students concerning the availability of safety equipment in biology laboratories, $t(238) = 3.931$, at $P < 0.05$, contradicts the findings of Trisna (2021), who reported that students lacked awareness of the safety equipment present in their laboratories. Awareness was high there were deficiencies in the areas of hazard identification and emergency response (Walters et al. 2017). Additionally, the results indicated no significant difference in the mean rating scores of teachers from public and private schools regarding safety equipment and the implementation of safety practices in biology laboratories. This finding aligns with the research conducted by Ndirika & Akhigbe in 2021, which demonstrated that both public and private schools exhibited comparable levels of safety practices in their biology laboratories. (Abu-Siniyeh and Al-Shehri 2021)

CONCLUSION

The results of this investigation indicate that both students and teachers possess awareness of the safety equipment present in the laboratory. However, it was found that students lack understanding of the safety and security protocols necessary within the laboratory environment. Consequently, it is crucial to enhance students' education regarding the importance of implementing safety and security measures in the laboratory. Well-structured safety and security protocols should serve a clear purpose, which must be effectively communicated to students. These protocols should emphasize the scientific process as a means of delivering content, and regular discussions should be held to foster the development of safe and responsible laboratory practices among students. The findings from this study contribute significantly to scientific knowledge by revealing disparities and consistencies in laboratory safety practices across public and private secondary schools in Abeokuta, Nigeria. Interestingly, no significant difference was found in the implementation of safety practices, suggesting that having more equipment does not necessarily lead to better safety behaviour. This highlights a potential gap in training or enforcement of safety protocols, pointing to the need for standardized safety education across both school types. Overall, the study offers valuable data for policymakers, educators, and curriculum developers aiming to improve science education and laboratory safety in Nigeria and similar contexts.

DECLARATION OF GENERATIVE AI

The authors declare that no generative AI or AI-assisted technologies were used in the writing process of this manuscript.

DECLARATION OF COMPETING INTEREST

We are thankful to our entire Solara team for giving their inputs and suggestion, which has helped us writing this article.

FUNDING STATEMENT

This research received no external funding.

REFERENCES

- Ayodele, R. B. Akinbiola, O. O. Mamudu, M. M. Fasugba, I. D. (2018). Effect of a Two-Day Awareness Programme on the Safety Knowledge of Primary School Pupils in Modakeke, Osun State, Nigeria. *European Journal of Physical Education and Sport Science* 4(11) 1-12
- Alamgir, H., Jalal, S., & Nasrullah, M. (2022). Gender differences in burn prevention knowledge among caregivers in Pakistan. *Burns*, 48(2), 412–419.
- Amoah, P. A., Jørgensen, S. H., & Abane, A. M. (2021). Effectiveness of participatory workplace safety training in the construction sector: Evidence from Ghana. *Safety Science*, 133, 105003.
- Chalya, P. I., Kanumba, E. S. Mabula, J. B., Giiti, G. & Gilyoma, J. M. (2011). Aetiological Spectrum, Injury Characteristics and Treatment Outcomes of Head injury Patients at Bagada Medical Center in North-Western Tanzania. *Tanzania Journal of Health Research*. 13: 93 – 102
- Fakeye, J. K., Oyinlola, A. I. & A. A. Salaam (2017). Determinants of School Accidents among Secondary School Students in Oyo West Local Government Area of Oyo State. *Nigeria School Health Journal*.29 (1) 50 – 56

- Fowode, K.V., Nwaogazie, I.L. and Anyanwu, B.O. (2023) Effect of Safety Education Intervention on Knowledge of Road Accident Prevention among Drivers in Lagos State, Nigeria. *Open Journal of Safety Science and Technology*, 13, 89-100. <https://doi.org/10.4236/ojsst.2023.133005>
- Ibhafidon, A., Nuzulike, N. M. & Ewuzie, M. A. (2017). Disaster Management Awareness among Students of Alvan Ikoku College of Education, Owerri. Imo State. *Nigeria School Health Journal*. 29 (1) 72 – 7
- Kibona, L. & Mgaya, K. (2022). Gendered responses to motorcycle safety interventions in Dar es Salaam. *Accident Analysis & Prevention*, 175, 106779.
- Nkere, E. I. D., C. A. & Ajibola, R. T. I. (2017). Epidemiology of Injuries at Accident and Emergency Units of University of Calabar Teaching Hospital, Calabar, Nigeria. *Nigerian School Health Journal* 29 (2) 44 – 52
- Njenga, A., Karanja, S., & Mberia, H. (2021). Integrating gender-transformative approaches in farm safety education for Kenyan women. *Agriculture and Human Values*, 38(3), 789–802.
- Osei-Boateng, K., & Amoako, P. (2019). The impact of church-based road safety education in Ashanti Region, Ghana. *African Safety Promotion Journal*, 17(1), 24–41
- Patel, V., & Kumar, R. (2022). Karmic beliefs as barriers to industrial safety training effectiveness in Gujarat, India. *International Journal of Occupational Safety and Ergonomics*, 28(2), 1123–1132.
- Rahman, A., Alonge, O., & Bhuiyan, A.-A. (2020). Gender differences in childhood poisoning knowledge among parents in Bangladesh. *Injury Prevention*, 26(5), 458–463.
- Smith, J. R., & Kolevski, B. (2021). Gendered knowledge of workplace hazards in male-dominated industries. *Safety and Health at Work*, 12(2), 234–241.
- Toluse, A. M., Idowu, O. T., Ogundele, O. O. & Egbewole, A. (2016). Injury Epidemiology at a Trauma Center in South-Western, Nigeria. *African Journal of Trauma* 5 (1) 1 – 4
- Zhang, M., Chan, A. H. S., & Zhang, Y. (2020). Retention of safety knowledge after training: A systematic literature review. *Safety Science*, 127, 104694.