



## The problems of laboratory management and safety practices in selected secondary schools in Ikwerre Local Government Area, Rivers state, Nigeria

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### Abstract

The study examined the problems of poor laboratory management and safety practices in secondary schools in Ikwerre Local Government Area of Rivers State. Three (3) research questions were stated to guide the study and three hypotheses were formulated. The research design used was descriptive design. The population of the study consists of 11,917 public senior secondary school biology and chemistry students in Ikwerre Local Government Area. The sample size of the study was 200 biology and chemistry students. The sampling technique used for the study was stratified random sampling technique. The instruments used for data collection was a self-structured questionnaire patterned on four point likert rating scale. The data collected were analyzed using mean and standard deviation for the research questions while hypotheses were tested using t-test statistical tool at 0.05 level of significant. The findings from the research questions showed high level of awareness of laboratory safety hazards and very high level of adherence to safety protocols among secondary school students. Also, the result revealed significant management challenges related to the availability and use of science teaching equipment. The results related to the hypothesis revealed no significant difference in mean rating between male and female students on understanding of laboratory safety hazards. It also showed no significant difference in compliance with safety protocols between male and female students and no significant difference between male and female students in issues related to the maintenance of science teaching equipment in the laboratory. The study therefore urges continued improvements in laboratory management, additional safety training, and a commitment to maintaining high safety standards in schools. It is recommended among others that Government and other stakeholders in education should ensure they organize seminars, workshop, so as to acquaint their Science students with the appropriate laboratory safety rule, skills and attitude.

**Key words:** Laboratory, safety practices, science equipment, hazards, management, secondary, school

### Introduction

Science in Latin, "Scientia" meaning "knowledge" is an organized method of building up information about nature to the understanding of man in such a way to the benefit of man and other inhabitants in the universe. According to Abimbola and Omosewo (2016) [2] defined science as a way of organizing of knowledge, a way of finding out and a way of reasoning when undertaking a process about understanding of natural phenomena. Science is a organize study about nature and the events that occur as its inhabitants interact one with the other. As these interactions go on various changes occur which are unveil only through the knowledge in science, and that is why science is always involve in research applying what it refers to as the scientific methods including hypothesizing, experimenting, observing, measuring, analyzing, synthesizing etc. While engaging in the scientific processes using the scientific methods a lot of substances are handled some biological, and others chemical meaning that living objects and their chemistry are been studied in science. Science has been widely applied in many facets of life to improve the living conditions of man in society. Due to the many important benefits of science to life and the environment, science is studied in schools curriculum in most parts of the world. Therefore learning science in the school is part of the educational and pedagogical decisions that should be regarded of most interest to all stakeholders in the educational system. It then means that the school environment should be built in such a manner to

accommodate learning of science in a welcome atmosphere. Learning of science without the science laboratory is like beating about the bush and such learning is not expected to bring about needed a result which is contrary to the aim of learning science in the schools. The science learning environment is plan in such ways that accommodate applying the scientific teaching approach whereby, the instructor decides learning goals to be achieved, determine what would show that the students actually achieve of the learning goals, designs activities to measure the achievements and finally plans the learning activities which should facilitate students' learning through scientific discovery. Science teachers need essential facilities in the teaching of science which are conducive laboratories atmosphere, instructional materials, including laboratory equipment and reagents etc. Since the school laboratory is the most important learning environment and the most widely used in teaching science, the attention of specialists in science education has been drawn up to study how to activate and utilize its content to effectively contribute to achieving the goals of teaching science.

Many scholars have attempted giving concise but comprehensive definition of particularly the school science laboratory. Ezeliora (2001) defines science laboratory as a conducive and secure space or place where scientific equipment are stored and utilize by the science teacher, learner and researcher for scientific practices. Laboratory can be solely for teaching-learning of science and other times for research purposes only. Sanchez *et al* (2021),

defined the learning laboratory as a physical structure with space and equipment for observation, experimentation and evaluation, and improve teaching and learning cultures by the teacher and his students. Laboratory is a place where students learn to identify problems, think of their solution, and set-up experiment to carry out investigation on them (Ado, 2020) <sup>[5]</sup>. Laboratory learning can take place in any space where learning and research materials are provided for students to carry out experiment on the subjects or materials of learning, phenomena and ideas; such could be in outdoor learning or within a well-structured and equipped place like the school and research laboratories. Omiko, (2015) <sup>[46]</sup> sees the laboratory as central to scientific learning that allows the learner in the school to have experiences through scientific activities to achieve the goals of scientific literacy and that the learner through engagement learns scientific attitudes skills to carry out scientific investigations to find solution to man's numerous problems. Hence, science laboratory is not merely a room with equipment and materials for experiment but that it can equally be any place in the field, stream near school, garden or workshop specially equipped and set aside for the scientific inquiry intended to solve man's problems (Danazumi, 2019). The school laboratories are classified according to the various purpose they are structured for, these include: Chemistry, Physics, Biology and Geography laboratories. Science laboratory can also be virtual or remote laboratory but no matter the class, they all serve the same purpose, which is for teaching and learning and research about natural phenomena for the well-being of mankind and his environment. Science laboratory provides multiple benefits which include: skills development, discovery and inquiry learning, critical thinking abilities and problem solving attitudes etc. Because the science laboratory contains both equipment and chemical of which most are hazardous, toxic and in other cases corrosive, fragile, and delicate nature of the materials and chemicals involve during the study it tends to be unsafe to work in the science laboratory. Therefore danger from the equipment and activities are very likely to occur at any point in time. To this end, good standard in the management and organization and the general rules for maintenance is inevitable. Babajide (2016) <sup>[12]</sup> assumed that if necessary laboratory management skills are acquired by laboratory users and put into practice during laboratory hour, it will certainly insure laboratory safety, and reduce if not eradicate risks and hazards associated with laboratory practices and experimentation. At the secondary school levels, sometimes science laboratories are utilized for generally science activities especially at the junior secondary level where the science study is basic science but in other cases, subject-specific laboratories are utilized for the various science subjects especially at the senior secondary school level but whatever be the case, the science laboratories have to be managed by each subject teacher irrespective of gender or role. Some studies have identified some likely causes for accidents in the science laboratories. Accidents occur with different hazards causing damages to equipment and inflict injuries to both staff and students. As a way of reducing or eradicating dangers to life and properties in the science laboratory, rules and regulations and precautions are put in place and this must be obeyed otherwise a lot of accidents, damages to life, equipment and facilities will occur in the laboratory (Ngozi, 2017) <sup>[40]</sup>. Science laboratories are regarded as a dangerous place

where many accidents appear to be consequences of special laboratory activities either carried out by students or staff. If one takes a retrospective look at the number of those who have been seriously injured or disabled or the number of equipment and laboratory materials seriously damaged and has increased losses to the school management all due to laboratory accident, then you will realize how important, it is for every student and staff to have knowledge on the laboratory safety in various science laboratories. To prevent continuous exposure to laboratory hazards and thereby endangering the lives of the scientists, laboratory safety must be regarded as a positive undertaken by every scientist and science students. Therefore, when planning lesson for science laboratory work, the teacher should take note of every possible accident which could occur in a given situation and appropriate action to be taken to avoid any unfortunate event. In most reagents and dangerous instruments, hazard signs are always drawn and the precautions (at times) may be clearly enumerated in the manual to assist the user. It is therefore necessary for the science teachers and students to read and study the user's manual to have good knowledge of laboratory hazard signs and how safety rules can be ensured so that common mistakes could be avoided before starting any laboratory work. Enactment of precautionary safety laws to safe-guide laboratory users against accidents and to ensure the safety of life and properties in school science laboratories should be a great concern to well-meaning individuals and groups. Due to the liable accidents occurrences especially to students in the school science laboratory, it is good reason for apt precaution measures to avoid, or minimize accident occurrences by proposing and application of laboratory management and safety practices.

Safety practice can be explained as the process of averting or freedom from danger (The Merriam-Webster Dictionary, 1998). The importance of safety measure in every science laboratory especially during science practical sessions cannot be over emphasized. It behooves that serious attention be given to safety first by all concerned in the education sector. Let it be emphasized that science laboratory activities demand adequate safety measures put in place in order to overcome danger. Aminu (2018) <sup>[11]</sup> assert that most of the accidents that occur in the science laboratory can be avoided or reduced by reasonable thinking, careful operating of equipment and materials, proper supervision, and most of all the knowledge of proper handling of the safety material or device present in the laboratories. It is obvious that anyone who is not alert or safety conscious stands the greater risk of turning a minor hazard into an accident which might be fatal. To ensure safety in our science laboratories, students and teachers should be given appropriate knowledge of the safety practice and how to operate simple safety gadgets during emergency. Also there is the need that these safety gadgets be regularly checked to ensure proper functioning especially emergency. Laboratory safety involves the development of skills and responsibility and must be an integrated into every aspect of teaching of science subjects including biology and chemistry. This means that safety orientation must be given at the beginning of every school session and echo at each laboratory practical sessions so that students will be protected from injuries that could result from handling laboratory equipment and reagents. A Laboratory is a place where students learn how to manipulate equipment, gain

cognitive understanding of how scientist work and know about risk associated to science laboratory and think reasonable precautions measures to eradicate or minimize the occurrences of these dangers (Owoyemi, 2022) <sup>[48]</sup>. It is in the laboratory that experiments and practical activities are conducted. Practical activities can be described as the activities which students undertake using chemicals and equipment in a laboratory. Practical works and safety practices run concurrently in laboratories. This is reflected in one of the objectives of the adequate practical teaching in science, which is to teach public how to handle safety materials that could be dangerous.

### Statement of the Problem

Inadequate safety procedures and laboratory management at secondary schools within the Ikwerre Local Government Area pose a severe risk to staff, students, and faculty health as well as the standard of science instruction. Ineffective safety procedures and management of the laboratory can result in a number of problems that endanger people's health, safety, and educational opportunities in the laboratory. The research is intended to investigate the problems of poor science laboratory management and safety practices in some secondary schools in Ikwerre Local Government Area. This investigation intended to find solution and recommendation to the problems which can be responsible for the disparity in science laboratory management and safety practices in secondary schools in Ikwerre Local Government Area.

### Aim and Objectives of the study

This study was aimed at assessing the problems of poor science laboratory management and safety practices in secondary schools. Specifically, the study sought to:

1. Determine the level of awareness of science laboratory safety hazards in secondary school
2. Assess the current level of compliance with safety protocols and procedures in secondary school science laboratories.
3. Ascertain the problems associated with management of science teaching equipment in the laboratory in senior secondary schools

### Research Questions

1. What is the level of awareness of science laboratory safety hazards among secondary school students?
2. What is the extent of adherence to safety protocols in secondary school science laboratories?
3. What are the problems related to the management of science teaching equipment in the laboratory?

### Research Hypotheses

**H<sub>01</sub>:** There is no significant difference in the level of awareness of science laboratory safety hazards among male and female secondary school students.

**H<sub>02</sub>:** There is no significant difference in the level of compliance with safety protocols in secondary school science laboratories between male and female secondary school students.

**H<sub>03</sub>:** There are no significant problems associated with the management of science teaching equipment in the

laboratory between male and female secondary school students.

### Methodology

The research design adopted for this study was a descriptive design. This is research design in which an individual or item from the entire population is studied by collecting and analyzing data obtained from the sample. The population of this study consisted of all the eleven thousand nine hundred and seventeen (11, 917) science students from 16 public senior secondary schools in Ikwerre Local Government Area of Rivers State (Rivers State Ministry of Education, Department of Statistics, 20--). The study used a simple random sampling technique due to some inconveniences that were faced if the total population was to be taken, such as geographical location, time factors, and resources. The sample used for this study was drawn from four (4) out of the several senior secondary schools in Ikwerre Local Government Area. Taro Yamen's formula was used to determine the sample size of 200 senior secondary science students from public senior secondary schools in Ikwerre Local Government Area. Four public senior secondary schools were selected using the proportionate stratified random sampling procedure. In each of the selected schools, fifty (50) students were chosen using a stratified random sampling procedure. A questionnaire titled "Problems Associated with Poor Laboratory Management and Safety Practices in Secondary Schools" (PAPLMSP) was administered to SS2 science students to elicit information from the respondents. The questionnaire consists of 15 item statements. The instrument was divided into two sections (A & B). Section A comprised personal information of the respondents, such as age, gender, and class. Section B consisted of questionnaire items constructed based on the research questions of the study. A four-point Likert scale of Very High Extent (VHE) – 4 points, High Extent (HE) – 3 points, Low Extent (LE) – 2 points, and Very Low Extent (VLE) – 1 point was employed. The instrument used for this study was validated and the instrument's reliability ensuring that it effectively captured the information needed for the study and credibility of the research instrument. The reliability coefficient of 0.914 was obtained using Cronbach's Alpha reliability statistics from the pilot test, which involved SS2 students who possessed similar characteristics to the population of interest. This high coefficient indicated a strong internal consistency of the instrument, suggesting that the items within the questionnaire were measuring the same underlying construct effectively. The questionnaires were distributed to students selected at random from a list provided by each school. The researcher collected the completed questionnaires on the spot, ensuring a 100% retrieval rate. This method not only enhanced participation but also contributed to the overall reliability of the data collected. The descriptive statistics (mean and standard deviation) were employed to address the research questions. Also, a t-test was used for the statistical testing of hypotheses.

### Results

The gender of sampled students was obtained and presented as shown in the Table 1 below:

**Table 1:** Gender of students

	Frequency	Percentage (%)
Male	108	54.0
Female	92	46.0
Total	200	100%

From the table 1 above, it is evident that majority of the students were male with 54% while female students 46%.

**Research Question 1:** What is the level of awareness of science laboratory safety hazards among public senior secondary school students in Ikwerre local government area in Rivers State, Nigeria?

**Table 2:** Mean and standard deviation showing level of awareness of science laboratory safety hazards among senior secondary school science students

S/N	Items	N	Mean	Std. Deviation	Decision
1.	I am familiar with the potential dangers posed by chemicals used in science laboratory experiments.	200	3.58	0.79	VHE
2.	I always wear appropriate personal protective equipment during laboratory activities, such as goggles and gloves.	200	3.43	0.73	HE
3.	I am aware of the emergency procedures to follow in case of accidents or spills in the science laboratory.	200	3.50	0.86	VHE
4.	I properly handle hazardous materials in the science laboratory.	200	3.37	0.86	HE
5.	I have received sufficient training on science laboratory safety practices and precautions.	200	3.52	0.89	VHE
6.	I properly dispose hazardous materials in the science laboratory	200	3.29	0.94	HE
	Grand Mean		3.45	0.85	HE

Table 2 above presents information on the level of awareness and understanding of science laboratory safety hazards among public senior secondary school students. Items 1, 3, and 5 were accepted to a very high extent, indicating that students are familiar with the potential dangers posed by chemicals, are aware of emergency procedures in case of accidents or spills, and have received sufficient training on laboratory safety practices and

precautions. Items 2, 4, and 6 were accepted to a high extent, showing that students frequently wear appropriate personal protective equipment, properly handle hazardous materials, and dispose of hazardous materials appropriately. A grand mean of 3.45 indicates that students adhere to laboratory safety practices to a high extent.

**Research Question 2:** What is the extent of adherence of safety protocols in secondary school science laboratories?

**Table 3:** Mean and standard deviation showing the extent of adherence of safety protocols in senior secondary school science laboratories

S/N	Items	N	Mean	Std. Deviation	Decision
7.	I always wear the required personal protective equipment (PPE) during science experiments.	200	3.64	0.76	VHE
8.	I follow proper procedures for handling and disposing of chemicals in the science laboratory.	200	3.56	0.69	VHE
9.	I feel confident in my ability to identify safety hazards in the science laboratory	200	3.58	0.75	VHE
10.	I regularly participate in safety training sessions related to laboratory procedures and protocols.	200	3.13	0.64	HE
11.	I am aware of the emergency protocols to follow in case of accidents or spills in the science laboratory	200	3.59	0.76	VHE
	Grand Mean		3.50	0.72	VHE

Table 3 above presents information on the extent of adherence to safety protocols in secondary school science laboratories. Items 7, 8, 9, and 11 were accepted to a very high extent, indicating that students consistently wear the required personal protective equipment (PPE), follow proper procedures for handling and disposing of chemicals, feel confident in identifying safety hazards, and are aware of emergency protocols in case of accidents or spills. Item 10 was accepted to a high extent, showing that students

regularly participate in safety training sessions related to laboratory procedures and protocols. A grand mean of 3.50 indicates that safety protocols are adhered to in secondary school science laboratories to a very high extent.

**Research Question three:** What are the problems related to the management of science teaching equipment in the laboratory?

**Table 4:** Mean and standard deviation showing the problems related to the management of science teaching equipment in the laboratory

S/N	Items	N	Mean	Std. Deviation	Decision
12.	Budget constraints impact the acquisition of new equipment and maintenance of existing tools.	200	3.56	0.80	VHE
13.	Budget constraints impact the maintenance of existing tools	200	3.47	0.86	HE
14.	Difficulties in tracking the inventory of science teaching equipment	200	3.43	0.91	HE
15.	Difficulties in ensuring that items are not lost or misplaced in the laboratory	200	3.47	0.91	HE
16.	Difficulties in ensuring the availability of essential science teaching equipment	200	3.58	0.79	VHE
17.	There are challenges in providing adequate training for laboratory staff on the proper	200	3.43	0.87	HE

handling and maintenance of science teaching equipment					
18.	Difficulties in ensuring safety of science teaching equipment with regulations.	200	3.52	0.86	VHE
19.	Difficulties in ensuring the accessibility of essential science teaching equipment	200	3.46	0.88	HE
20.	Difficulties in ensuring compliance of science teaching equipment with regulations.	200	3.51	0.91	VHE
Grand Mean			3.49	0.87	HE

Table 4 above shows information on the problems related to the management of chemistry teaching equipment in the laboratory. Items 12, 16, 18, and 20 were accepted to a very high extent, indicating that budget constraints significantly impact the acquisition of new equipment, ensuring the availability of essential tools, and maintaining compliance with safety regulations. Items 13, 14, 15, 17, and 19 were accepted to a high extent, showing that challenges also exist

in maintaining current tools, tracking inventory, preventing loss of items, providing adequate staff training, and ensuring accessibility of essential equipment. A grand mean of 3.49 suggests that these management issues occur to a high extent in the laboratory.

**Ho1:** There is no significant difference in the level of awareness of laboratory safety hazards among male and female secondary school students.

**Table 5:** t-test analysis of the mean rating of male and female students on the level of awareness of laboratory safety hazards among secondary school students

Gender	N	Mean	Std. Deviation	Df	Sig.	Decision
Male	108	20.45	3.45	198	.314	NS
Female	92	20.96	3.58			

From the result in Table 5, a p-calculated value of 0.314 was observed. The mean score of male students is 20.45, while that of female students is 20.96. A p-value of 0.314 tested at  $p > 0.05$  significance level with  $df = 198$  was also obtained. Since the p-value of 0.314 is greater than  $p = 0.05$ , this indicates that there is no significant difference in the mean rating of male and female students on their level of understanding of laboratory safety hazards among senior secondary school students.

**Ho2:** There is no significant difference in the level of compliance with safety protocols in secondary school chemistry laboratories between male and female secondary school students.

**Table 6:** t-test analysis of the mean rating of male and female students on the level of compliance with safety protocols in senior secondary school science laboratories among secondary school students

Gender	N	Mean	Std. Deviation	Df	Sig.	Decision
Male	108	17.30	2.37	198	.196	NS
Female	92	17.72	2.18			

From the result in Table 4.6, a p-calculated value of 0.196 was observed. The mean score of male students is 17.30, while that of female students is 17.72. A p-value of 0.196 tested at  $p > 0.05$  significance level with  $df = 198$  was also obtained. Since the p-value of 0.196 is greater than  $p = 0.05$ , this means there is no significant difference in the level of compliance with safety protocols in secondary school science laboratories between male and female students. Therefore, the null hypothesis ( $HO_2$ ) is accepted.

**Ho3:** There are no significant problems associated with the management of science teaching equipment in the laboratory between male and female secondary school students.

**Table 7:** t-test analysis of the mean rating of male and female students on the problems associated with the management of science teaching equipment in the laboratory.

Gender	N	Mean	Std. Deviation	Df	Sig.	Decision
Male	108	31.06	5.10	198	.304	NS
Female	92	31.80	5.13			

Observed from the result in Table 4.7 was a p-value of 0.304. Male students have a mean score of 31.06, while female students have a mean score of 31.80. At the  $p > 0.05$  significance threshold, a p-value of 0.304 with  $df = 198$  was found. The fact that the p-value of 0.304 is higher than  $p = 0.05$  indicates that male and female secondary school students do not significantly differ in the issues related to the maintenance of science teaching equipment in the lab. As a result, the null hypothesis ( $HO_3$ ) is accepted

### Discussion of findings

The findings from research question 1 indicated a high level of awareness and understanding of laboratory safety hazards among secondary school students. With a grand mean of 3.45, the results showed that students are familiar with potential chemical dangers, emergency procedures, and the proper handling of hazardous materials. These findings suggest a strong adherence to laboratory safety protocols within secondary school settings. When compared to other empirical studies, these results highlight both similarities and differences in safety practices and awareness across various educational and industrial contexts. Also, the result for hypothesis one revealed that there is no significant difference in the mean rating of male and female students on their level of understanding of laboratory safety hazards among secondary school students in Ikwerre Local Government Area. The findings of this study is in alignment with Birma *et al.* (2022) [15] who revealed that tertiary education laboratories maintained a high level of safety culture, with a mean value of 3.69, similar to the awareness levels seen in secondary school students in the present study. However, Birma *et al.* found a significant difference between private and government-owned laboratories, with

private laboratories exhibiting better safety performance. This contrast was not observed in the current study, which focuses solely on secondary school students and does not differentiate between types of institutions. Both studies, however, underscore the importance of a strong safety culture in educational settings.

In contrast, Limboo *et al.* (2021) [6] revealed good safety awareness and emergency preparedness, but also noted significant practical challenges, such as a lack of trained safety practitioners, inadequate safety gear like gloves and goggles, and improper disposal of hazardous materials. These practical issues are not reflected in the current study, where students reported high levels of compliance with safety protocols, including proper disposal of hazardous materials.

Findings related to research question two revealed a very high level of adherence to safety protocols in secondary school science laboratories, particularly in areas such as wearing personal protective equipment (PPE), proper handling and disposal of chemicals, identifying safety hazards, and following emergency procedures. The grand mean of 3.50 reflects a strong commitment to safety measures in the schools assessed. This finding is in partial agreement with Gongo *et al.* (2018) [20], who assessed compliance with laboratory safety in secondary schools in Kitui County, Kenya. While Gongo *et al.* found that most schools adhered to certain safety standards, such as the presence of emergency doors, their study also revealed significant non-compliance in critical areas, such as the presence of windows with grills and a lack of refresher safety training. This contrasts with the findings of the current study, where adherence to safety protocols is high. The present study's stronger compliance suggests that secondary schools in the current research are more vigilant about safety practices compared to those in Gongo's study, where partial compliance was noted. This reflects a difference in safety culture and implementation between the two regions. Also, the results of this study are in contrast to Isola *et al.* (2022) [25], who investigated chemical safety in tertiary institutions in Nigeria. While both studies emphasize the importance of safety procedures, the level of compliance in Isola *et al.*'s study was notably lower. Isola *et al.* found that although safety procedures such as the use of warning symbols, safety charts, and PPE were effective in reducing accidents, actual compliance by laboratory users was poor. This study, by contrast, shows a very high level of adherence to safety protocols in secondary schools. The discrepancy may be attributed to the difference in educational levels and settings, where secondary schools seem to have a more structured or enforced safety system compared to the tertiary institutions studied by Isola *et al.* This study is in line with some of the findings from Liziwe *et al.* (2021) [32], who investigated safety practices in postgraduate laboratories at Sefako Makgatho Health Sciences University in South Africa. Both studies emphasize the importance of PPE and safety training. However, Liziwe *et al.*'s research revealed inconsistent adherence to safety protocols, with fewer students regularly using PPE or understanding warning signs. In contrast, the current study reports a much higher level of adherence to safety measures in secondary school science laboratories. While both studies underscore the importance of continuous training, this study demonstrates stronger compliance,

indicating that safety practices may be more consistently enforced at the secondary school level.

This study's findings are not fully in agreement with those of Ntulo *et al.* (2023) [41], who explored laboratory safety compliance in secondary schools in Tanzania. While Ntulo *et al.* found improvement in safety compliance over time, especially in schools with lower initial rankings, their study also revealed declines in compliance in some schools. The variability in compliance observed by Ntulo contrasts with the consistently high level of adherence reported in this study. Whereas Ntulo *et al.*'s research shows fluctuations in safety protocol enforcement, this study indicates a more stable and high level of compliance in the schools surveyed. The findings related to research question three presented in Table 4 revealed significant management challenges related to the availability and use of science teaching equipment in secondary school laboratories. The grand mean of 3.49 implied that these issues occur to a high extent within the laboratory environment. This study is in alignment with the findings of Jofrshal and Munandar (2020) [42], who analyzed problems in utilizing school laboratories for chemistry learning in Aceh Barat Daya district. Their research identified that the use of laboratories in chemistry education has not been optimal due to inadequate facilities, infrastructure, and the absence of competent laboratory assistants. Similarly, the current study highlights that budget constraints and challenges in equipment management are significant barriers to effective laboratory utilization. Both studies agree that providing training for teachers and laboratory assistants in laboratory management and techniques could help mitigate these issues. Therefore, both studies emphasize the importance of enhancing laboratory management practices to improve science education. This study is also in line with the findings of Aloys *et al.* (2023) [9], who investigated the effectiveness of hands-on chemistry practical activities in teaching and learning. While their study focused on student engagement, they identified barriers such as insufficient chemicals, lack of laboratory apparatus, and limited laboratory space, which hinder the effectiveness of practical activities. These challenges align with the current study's findings, where issues such as budget constraints and insufficient equipment were also noted as problems. Both studies agree on the need for adequate resources and equipment to enhance the learning experience in science laboratories. This study is in agreement with Kizito (2023), who explored the barriers faced by science teachers in teacher training colleges (TTCs) in Rwanda. Kizito found that material scarcity and lack of improvisation skills were major barriers to effective laboratory activities. These findings resonate with the current study, which also highlights issues related to maintaining and acquiring laboratory tools due to budget constraints. Both studies agree on the importance of equipping teachers with skills and resources to improvise in situations where laboratory equipment is scarce. The focus on addressing the gaps in material availability and management is a common theme across both studies.

The result of testing hypothesis one showed that there was no significant difference in the mean rating of male and female students on their level of understanding of laboratory safety hazards among secondary school students. The finding of this study is in line with those of Ngozi (2020) [40], Abbas (2018). This finding is in line with that of Iwuji (2015) and Stanley (2017) in Samala, (2013) who said that,

understanding and retention are products of meaningful learning, when teaching is effective and meaningful to the students whether male or female. This also is in line with the findings of Samaila (2014). Thus, Level of Laboratory Safety Awareness and Practices is the product of students' involvement in the act of laboratory work effectively.

The result of testing hypothesis two revealed that there is no significant difference in the level of compliance with safety protocols in secondary school science laboratories between male and female students. This also was supported by the research of Ado, (2000) and Amos (1981). Hypothesis three indicated that male and female secondary school students do not significantly differ in the issues related to the maintenance of science teaching equipment in the l

### Conclusion

Safety in school laboratories is not merely concern with precautionary measure; but equally important in the way about effective learning in science education. This study has revealed challenges of laboratory management e.g. challenges related to the management of science teaching equipment and safety practices as gaps exist in safety training and awareness among both students and staff in secondary school science laboratories within Ikwerre Local Government Area, and had shown important insights into the state of safety awareness, protocol adherence, and equipment management. Though there is commendable level of compliance with safety protocols, particularly in the use of personal protective equipment (PPE) and emergency preparedness, the study underscores the need for continued vigilance, the significance of cultivating a safety-conscious culture in educational settings by tackling these obstacles.

### Recommendations

Based on the findings of the study, several recommendations can be made to improve safety and management in secondary school science laboratories in the Ikwerre Local Government Area.

1. Schools may conduct regular and maintain safety training programs to ensure students are abreast with up-to-date safety protocols and also be informed as new hazards emerges.
2. All stakeholders in education including government may ensure that seminars, workshop, conference and related avenues to acquaint science students with the appropriate laboratory safety rules, skills, and attitudes be regularly organized.
3. There could be an arrangement ensuring that at every strategic position in the science laboratory posters indicating signs and symbols for impeding danger are well-positioned.
4. All equipment and reagents use in the science laboratory need to be well-labeled.
5. Schools should continue to maintain gender-neutral safety programs. These programs should ensure equal access to safety resources and training for all students, promoting a safe and inclusive environment in the laboratory for everyone.

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