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ANALYSIS OF SAFETY PRACTICES DURING BIOLOGY PRACTICAL'S IN SENIOR SECONDARY SCHOOLS IN ABUJA MUNICIPAL AREA COUNCIL, NIGERIA

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Abstract

This study conducted an analysis of safety practices during biology practical's in senior secondary schools in Abuja Municipal area council, Nigeria. The research aimed to evaluate the availability of approved safety equipment and materials in biology laboratories and assess the extent to which safety practices are adopted by teachers. The sample comprised 165 respondents, including 25 biology teachers and 140 students from urban and rural secondary schools. The data were collected using the Biology Practical's Class Safety Practices Questionnaire (BPCSPQ) and analyzed through mean scores, standard deviations, and independent samples t-tests. The findings revealed a low availability of approved safety materials in senior secondary school biology laboratories in Abuja. The mean score of 2.05, with a standard deviation of 0.98, indicated inadequate safety resources. The study also highlighted a low extent to which safety practices are adopted by biology teachers, with a mean score of 2.24 and a standard deviation of 0.97. These results underscore systemic issues, including budget constraints, lack of awareness, and insufficient training in laboratory safety. Also, the hypothesis testing indicated no significant difference in the mean ratings of urban and rural schools on the availability of safety equipment and materials. This suggests a uniform deficiency in safety infrastructure across different school settings. The t-test results (t=0.156, p=0.877) emphasized the absence of a significant difference in mean ratings, affirming the lack of distinction between urban and rural schools concerning safety equipment and materials. This study revealed a pressing need for increased financial allocation, comprehensive teacher training, and heightened awareness to enhance safety practices in senior secondary school biology laboratories. The study recommended collaborative efforts, regular monitoring, and a safety-conscious culture to foster a safer learning environment. Implementing these measures can contribute to the improvement of safety standards and, consequently, the overall quality of biology education in Abuja's senior secondary schools.

Keywords: Safety Practices, Biology Laboratories, Secondary Schools, Urban and Rural Federal Capital Territory (Abuja)

Introduction

Science is a methodical endeavour that constructs and arranges knowledge into testable explanations and predictions regarding the universe. It is a dynamic human activity dedicated to comprehending the workings of our world. According to Ali (2012b), the term "science" encompasses a range of information, abilities, and operations related to the natural environment. Science, as highlighted by Ali, is primarily concerned with various investigative processes and activities aimed at developing, acquiring, and managing knowledge, skills, acceptability, and attitudes related to the natural elements of the environment. The study and comprehension of science involve various components such as observation, hypothesis formulation, experimentation, data analysis, inference, and drawing conclusions, collectively constituting the scientific method (Ali, 2012). Recognizing the dual nature of science, Mbajiorgu (2014) defines it as an organized body of knowledge derived through investigation and experimentation, emphasizing both its procedural and resultant aspects.

Mbajiorgu's perspective aligns with the idea that science is an ongoing series of empirical observations leading to the formulation of concepts, laws, and theories, subject to continuous refinement through the acquisition of knowledge. Science is an activity-oriented discipline, involving research, discovery, invention, experimentation, exploration, and hypothesizing. Students' interest in science grows as they aspire to investigate and explore more about their environment, fostering scientific attitudes outlined by Attiji (2018), including curiosity, open-mindedness, objectivity, intellectual honesty, rationality, willingness to suspend judgment, humility, and reverence for life. Adeyemi (2018) asserts that science comprises three major branches: physics, chemistry, and biology. Biology, one of the core science subjects in Nigeria's secondary education system, revolves around the study of living things, their characteristics, and their interactions with the environment. It plays a pivotal role in explaining complex life processes, structures, functions, origin, evolution, and the distribution of living organisms, contributing significantly to fields such as Medicine, Agriculture, Physical and Health Education, and environmental studies.

The Science Teacher's Association of Nigeria (STAN 2012) defines biology as a subject encompassing contents from microscopic organisms to the biosphere, studying living things and their interactions within the environment. The objective of studying biology in secondary schools' centers on hands-on activities and active learning, typically conducted in the laboratory. Safety practices in the laboratory, defined as the process of averting danger, are crucial and involve the use of safety materials and equipment such as goggles, eyewash stations, safety showers, fire extinguishers, chemical fume hoods, first aid kits, lab coats, protective gloves, fire blankets, and lab-safe refrigerators. To ensure safety, individuals, both teachers and students, must be well-informed about safety practices and how to operate safety materials and equipment during emergencies. Regular checks of safety materials are essential to ensure proper functioning. Safety in the science laboratory requires common sense, knowledge of the physical, chemical, and physiological effects of substances, and an understanding of human behavior. Nnamonuh (2013) advocates for the predominant use of laboratory methods in teaching biology to avoid reducing it to mere memorization. Effective use of the laboratory correlates with better science performance in schools. Teachers' techniques in imparting information can influence students' perceptions of biology, as highlighted (Atagana, 2016). Kuren, Zonntja, Navelle, and Jeanne (2015) emphasize that students express greater interest and enthusiasm in practical's exercises, and enjoyment of science

practical's correlates with better performance in the subject.

Despite the educational background and training of science teachers in safe laboratory techniques, there is a need to instill safety practices in students. The science laboratory is an ideal place to teach and reinforce fundamental safety procedures, as students bear the responsibility to learn and observe safety practices during science activities. Positive attitudes toward safety in a laboratory setting are crucial to avoid capricious and careless actions. Biology practical's are integral to the education of senior secondary school students, providing hands-on experiences that deepen their understanding of scientific concepts. However, these practical sessions pose potential risks to the safety of students and teachers. This study focuses on assessing safety practices in biology laboratories to create a safer learning environment. It underscores the importance of incorporating specific safety practices and instructions as an integral part of every science classroom procedure. Safety in the laboratory should be an ongoing focus throughout the year, running concurrently with practical works and teaching activities. This aligns with the objective of practical teaching in biology science, which aims to teach the public how to handle potentially dangerous safety materials. The student-centered or activity method is recognized as one of the effective teaching methods in biology.

Statement of Problem.

The mastery of biology has become a challenging yet rewarding endeavour, especially in the rapidly advancing scientific landscape. A pivotal factor contributing to the successful acquisition of biology knowledge lies in the provision of well-equipped laboratories. This significance stems from the crucial role that biology education plays in driving scientific and technological progress within a nation. Despite the anticipated high performance in the subject due to its importance, the educational system in Nigeria has witnessed a disparity. The West African Examinations Council (WAEC) chief examiners report from 2017 to 2022 highlights that students' underachievement in biology can be attributed to their unfamiliarity with fundamental safety practices and equipment in biology laboratories. Additionally, there is a noted deficiency in their knowledge of essential safety precautions during biology practical classes. This implies that senior secondary school students lack sufficient exposure to biology laboratory equipment through practical exercises prior to their senior school certificate examinations. The identified problem revolves around inadequate safety practices and a lack of availability of equipment in senior secondary school biology laboratories in the Federal Capital Territory of Nigeria. This issue is intricately linked to students' underperformance in biology, stemming from factors such as their limited familiarity with safety practices, insufficient exposure to laboratory equipment, and a lack of understanding of essential safety precautions. The research's primary objective is to assess the current status of safety practices among both teachers and students during biology practical classes. The emphasis is placed on recognizing the importance of addressing these challenges to facilitate effective teaching and learning in the field of biology.

Objectives of the Study

The main focus of this study is to conduct analysis of safety practices during biology practical's in senior secondary schools in Abuja Municipal area council, Nigeria. The specific objectives of the study include:

1. To find out the extent to which approved safety equipment and materials are available in senior secondary school biology laboratories in Federal Capital territory

2. To find out the extent to which safety practices are adopted by biology teachers in the senior secondary School biology laboratories

Research Questions

The following research questions guided the study:

1. What are the approved safety equipment and materials available in senior secondary school biology laboratories in Federal Capital territory?
2. To what extent is safety practices adopted by the teachers in the senior secondary School biology laboratories?

Statement of Hypotheses

The following null hypotheses guided the study

HO1: There is no significant difference in the mean rating of urban and rural secondary schools on approved safety equipment's and materials available in senior secondary school biology laboratories.

Methodology

The design of the study is a descriptive survey design was used for the study. The population of the study consists of 265 senior secondary biology teachers and 1540 biology students from the 32 public senior secondary of the Abuja Municipal Council of Federal Capital Territory, as at the time of this study (2022/2023) academic school year. Purposive sampling technique was used to select 165 respondents (25 biology teachers and 140 students) from all the public senior secondary school with biology laboratory to ensure that the target biology laboratory safety practices data would be obtained as this can be achieved from the responses of biology teachers that are involved in biology practical's. Biology practical's class safety practices questionnaire (BPCSPQ) with a reliability index of 0.92 was used for data collection in this research. Mean and standard deviation were used to answer the research question and t-test statistics was used to test the hypothesis at 0.05 level of significance.

Results

Research Question One

What are the approved safety equipment and materials available in senior secondary school biology laboratories in the Federal Capital territory?

Data to answer this research question is presented in Table 4.1.

Table 4.1: Mean Scores and Standard Deviations of Approved Safety Equipment and Materials Available in Senior Secondary School Biology Laboratories in Abuja Municipal Area Council

NO		HA	MA	A	NA	*Mean*	*SD*
1.	Fume cupboard/chamber	20	40	80	25	2.33	0.88
2.	Enough windows for ventilation	40	25	85	15	2.55	0.96
3.	Hand gloves, safety lenses and laboratory coat	45	22	80	18	2.57	1.00
4.	Balanced demonstration bench	20	35	60	50	2.15	0.99
5.	Gas and water services	13	10	56	86	1.70	0.90
6.	Combustion bench	8	11	65	81	1.67	0.80
7.	Fire blanket	10	15	45	95	1.64	0.88
8.	Hospital emergency telephone number	10	11	41	103	1.56	0.86
9.	Store for chemicals	10	15	55	85	1.70	0.87
10.	Fire extinguishers	45	20	21	79	2.19	1.29
11.	First aid box	65	30	20	50	2.67	1.27
12.	Separate stores for electrical apparatus	25	21	30	89	1.89	1.12
				2.05			**0.98**

Table 4.1 shows the Mean Scores and Standard Deviations of Approved Safety Equipment and Materials Available in Senior Secondary School Biology Laboratories in the Federal Capital Territory. Results show that at the sample size of 165 respondents, the average mean value is 2.05 and a standard deviation of 0.98. The average mean of 2.05 is lower than 2.50 implying there is a low availability of safety in Senior Secondary School Biology Laboratories in Abuja Municipal Area Council.

Hypothesis One

Ho_1: There is no significant difference in the mean rating of urban and rural secondary schools on approved safety equipment and materials available in senior secondary school biology laboratories.

The data to test this hypothesis is presented in Table 4.2.

Table 4.2: Independent Samples test of the Mean Rating of Urban and Rural Secondary Schools on Approved Safety Equipment and Materials in Senior Secondary School Biology laboratories.

	Location	N	Mean	Std. Deviation	t-test for Equality of Means		
					t	df	Sig. (2-tailed)
Mean Scores	Urban	12	2.0617	.41637	0.156	22	0.877
	Rural	12	2.0350	.42116			

Table 4.2 shows the Independent Samples Test of the mean rating of urban and rural secondary schools on approved safety equipment and materials in senior secondary school biology laboratories. The p-value of 0.877 of the t-test at ($t=0.156$; $p=0.877 > \alpha =0.05$) was greater than 0.05 level of significance, the hypothesis was not rejected implying that there is no significant difference in the mean rating of urban and rural secondary schools on approved safety equipment and materials in senior secondary school biology laboratories.

Research Question Two

To what extent are safety practices adopted by the teachers in the senior secondary school biology laboratories?

Data to answer this research question is presented in Table 4.3.

Table 4.3: Mean Scores and Standard Deviations of the Extent of the Safety Practices Adopted by Teachers in Senior Secondary School Biology Laboratories

NO		SA	A	DA	SD	*Mean*	*SD*
13.	Record of stock is kept and secured for all chemicals periodically	24	21	77	43	2.16	0.97
14.	The storage cabinet is inspected periodically by the teacher	25	21	79	40	2.19	0.97
15.	Corrosives are stored below shoulder height	20	26	89	30	2.22	0.88
16.	Appropriate containers are used to store Hazardous substances	30	45	79	11	2.57	0.86
17.	Containers are labelled correctly	25	21	70	49	2.13	1.01
18.	Chemicals are stored according to the compatibility	10	15	69	71	1.78	0.85
19.	Flammables and corrosives are stored in approved cabinets. Toxics are stored in a locked cabinet	15	30	49	71	1.93	0.99
20.	Refrigerators are suitably labelled (e.g. no food, no drink, nonflammables, bio-hazard).	10	20	59	66	1.72	0.87
21.	Poisons are stored in separate locked and secured cupboards	54	59	21	31	2.82	1.08
22.	Special cabinets are created for flammables and combustibles	20	40	61	44	2.22	0.97
23.	All chemical bottles and containers are sealed with a lid	40	20	60	43	2.32	1.11
24.	Gas cylinders are capped and supported to prevent rolling	20	31	60	54	2.10	0.99
25.	Broken glasses are disposed of in special waste bins	35	60	31	39	2.55	1.07
26.	Emergency stops are working	79	52	21	13	3.19	0.94
27.	Fume cupboards and biosafety cabinets have been tested and are in date and empty if no experiments are being conducted	15	30	61	59	2.01	0.95
28.	Frequently used / heavy items are stored between knee and shoulder height	20	19	65	61	1.99	0.98
				2.24			**0.97**

Table 4.3 shows the Mean Scores and Standard Deviations of Mean Scores and Standard Deviations of the extent to which safety practices are adopted by teachers in the senior secondary school biology laboratories in Federal Capital Territory, Abuja. Results show that at the sample size of 165 respondents, the average mean value is 2.24 and a standard deviation of 0.97. Since the average mean of 2.24 is lower than 2.50, it therefore implies there is a low extent to which safety practices are adopted by biology teachers in the senior secondary school

biology laboratories in Federal Capital Territory, Abuja

Discussion of Findings

The findings of this study revealed the extent to which safety practices are adopted and practiced among teachers and students in senior secondary school biology laboratories in the Federal Capital Territory. The findings reveal that: There was a low availability of safety in Senior Secondary School Biology Laboratories in the Federal Capital Territory, this study is in agreement with the findings of Adebayo and Daramola (2022); Limboo, Waiba, Giri, and Rinchen (2021); Azubuike and Azubuike (2014); Nwachukwu (2012); and Emendu (2012) who found that there is low availability of laboratory safety apparatus, this was confirmed from hypothesis one that showed that there is no significant difference in the mean rating of urban and rural secondary schools on approved safety equipment's and materials in senior secondary school biology laboratories. This implies that senior secondary schools both the urban and rural schools are not well equipped with the required safety resources. This could be as a result of factors such as poor budget which might have served as a limitation that has made Schools not allocate sufficient funds for purchasing and maintaining safety equipment, School administrators, teachers, or authorities might not be fully aware of the importance of safety equipment in laboratory settings. This can lead to a lack of prioritization, also teachers and laboratory staff may not have received proper training on laboratory safety or the correct use of safety equipment. This lack of knowledge can lead to underutilization or neglect of safety resources.

The study also revealed that there is poor adherence to the extent to which safety practices are adopted by teachers in the senior secondary school biology laboratories in the Federal Capital Territory, Abuja. The result of this study is in agreement with the findings of Adebayo and Daramola (2022); Limboo, Waiba, Giri, and Rinchen (2021); Ndirika and Akhigbe (2019); Azubuike and Azubuike (2014); Atagana (2016); and (Emendu, 2014) who all have found that biology teachers show poor adherence to the extent to which safety practices are adopted by teachers in the laboratory. Lack of access to vital safety tools may hinder teachers' ability to effectively implement safety practices. Additionally, the absence of adequate supervision in laboratory activities may result in teachers and students neglecting safety protocols.

Conclusion

This study provided analysis of safety practices during biology practical's in senior

secondary schools in Abuja Municipal area council, Nigeria. The findings of this study showed that there is a low availability of approved safety materials in biology laboratory in FCT Abuja. The research highlighted a low extent to which safety practices are adopted by biology teachers in senior secondary school in FCT Abuja, both urban and rural schools appear to suffer from this deficiency, indicating a systemic issue that extends beyond geographical location. This deficiency can be attributed to factors such as budget constraints, inadequate awareness among school administrators, teachers, and authorities, as well as a deficiency in training concerning laboratory safety.

Recommendations

Based on the findings of the study, the following recommendations have been made:

1. Educational authorities and school administrations need to allocate ample financial resources for the purchase and upkeep of safety equipment and materials in biology laboratories. Sufficient funding is crucial to guarantee that every school, whether in urban or rural areas, has the required safety resources.
2. Teachers and laboratory personnel should participate in regular and thorough training on laboratory safety practices. Training initiatives should encompass identifying hazards, ensuring proper utilization of safety equipment, and understanding emergency response protocols. Incorporating this training as a mandatory component of teacher preparation and ongoing professional development is essential

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