

Laboratory Hazards and Safety among Biology Students in Colleges of Education in North-West geo-Political Zone of Nigeria

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Abstract

The study titled "Assessment of Laboratory Hazards and Safety among Biology Students and Lecturers in Colleges of Education in North West Geo-political Zone of Nigeria". Two objectives and two Research questions were generated and two Hypotheses were formulated. The study was an empirical research based on descriptive survey. Population of the study comprised 13,822 students, 153 lecturers, and 64 laboratory technologists/assistants. Sample size used was 338 for students, 127 lecturers and technologist. A structured questionnaire and direct observation were used for data collection. Pearson's Product Moment Correlation Coefficient (PPMC) was used to analyze the data with SPSS Analysis Package version 27. The findings revealed that there is a significant relationship between effective implementation of safety measures and magnitude of hazards among NCE Biology students in the Colleges of Education North-West Geo-political zone Nigeria ($r=0.731$; $p<0.05$). There is a significant relationship between increase in students population and frequency of occurrence of hazards among NCE Biology students in Colleges of Education in North-West Geo-political zone Nigeria ($r=0.338$; $p<0.05$). Based on the findings it was recommended that lecturers should participate in workshops to enable them update on their first aid habit and techniques. In case of high population of students, they should be grouped, for effectiveness and to avoid accidents during practical lessons.

Keywords: Laboratory, Hazards, Safety, Students and Education

Introduction

Science is a body of knowledge that has different concepts that connect and are unified with a knowledge-getting process. Neave (2015) defined science as a systematic body of knowledge through observation, identification, measuring, and classification of natural phenomena to learn about them and bring them under general principles of laws. Utilizing careful observation and experimentation, this definition emphasized the process and product nature of science as an organized body of knowledge that describes and attempts to explain

some part of the natural world systematically. The hazards encountered in a laboratory are many and varied, which can be categorized into five viz: chemical, biological physical, electrical/mechanical, and psychological. Examples of chemical hazards are corrosive, flammable, toxic, cleaning agents and disinfectants, drugs, anesthetic gases, solvents, paints, and compressed gases and may result in short-term or long-term health effects if individuals are exposed to these hazards Mcleod, (2017).

When planning any work in a laboratory the risk of exposure to laboratory hazards is an important consideration because harmful chemicals are liable to cause local toxic effects, systemic toxic effects, or both when exposed to the body. In the first place, local effects refer to injury at the site of first contact i.e. the eyes, the skin, the nose and lungs, and the digestive tract. National Academy Sciences (2011) itemized cases of local effects which include (1) hazardous materials inhalation causing toxic effects in the nose and lungs; (2) skin or eyes contact with harmful materials leading to effects ranging from mild irritation to severe tissue damage and (3) caustic substances ingestion causing burns, ulcers or even cancer in the mouth, oesophagus, stomach, and intestines. In Nigeria, many lives have been lost through the lack of proper attention to laboratory safety measures. Owolabi (2003) referred to people involved in laboratory hazards, including many scientists who have lost their lives or part of their bodies in scientific endeavours as lacking proper knowledge of laboratory safety measures in observing hazard signs as scientists. However, there were cases of external and internal poisons and splashes of toxic chemicals which results in accidental deaths, electrical problems may generate sudden high voltage or large currents which may also lead to damages and loss of lives. (Omiwirhiren & Lawal, 2016) stated that practical work in a science laboratory involves the exposure of lecturers, laboratory technicians, and students to something that may have the potential to cause harm or injury i.e, a hazard in particular. However, Voss (2012) illustrated some basic principles to teach the students the applications of the principles so acquired.

A well-equipped biology laboratory would enable students to develop good judgments, self-reliance, critical thinking, and technical personal contact with apparatus and materials present in the laboratories under the direction\supervision of the teacher.

A biology laboratory needs to be well organized so that a climate for investigating scientific concepts will exist such a climate ensures that the laboratory is safe for those using it. Since the laboratory environment is meant for man to handle, accidents and injuries are bound to occur. Therefore, the teacher in the biology laboratory is responsibly committed to teaching his students how to handle chemicals and materials, to bring about good results in a safe manner of preserving life. In this regard, Byrd (2017) posited that most of the accidents and injuries that occur in secondary school biology laboratories mainly result from inadequate knowledge of safety rules, insufficient skill by the laboratory workers, and carelessness.

Statement of the Problem

Running a science laboratory in educational institutions in Nigeria involves the exposure of lecturers/teachers, laboratory technicians, and students to hazards (such as chemical, biological and physical hazards) and risks. This is further compounded due to the upsurge in school enrolment. A science laboratory that is built for about 50 students now is used for three or more times that number. With a such large population of students participating in the various activities that take place in the science laboratory during practical classes such as pipetting, pouring acid, mixing of reagents, lighting of Bunsen burner for different experiments, etc, little attention tends to be placed on precautionary measures; the health hazards and safety of lecturers, technicians and students also are easily overlooked or inadvertently pushed aside.

It is on this background that this study intends to assess the hazards, risks, and steps that can be taken in protecting lecturers, technicians, and students' safety, and health in six (6) Colleges of Education in the North West Zone of Nigeria.

Purpose of the Study

Laboratory Hazards and Safety among Biology Students in Colleges of Education

In North-West Geo-Political Zone of Nigeria.

The following objectives were set for the study:

1. Determine the Biological hazard and the safety measures adopted by the biology laboratory students in Colleges of Education in the North West Geo-political Zone of Nigeria
2. Determine the effects of population of students on the frequency of occurrence of hazards in biology laboratories in Colleges of Education in North West Geo-political Zone of Nigeria.

Research Questions:

- 1 what is the relationship between Biological hazard and the safety measures adopted by the biology laboratory students in Colleges of Education in the North West Geo-political Zone of Nigeria
- 2 What effect has an increase in student population on the frequency of occurrence of hazards in the biology laboratory in North-West Geo-political zone Colleges of Education in Nigeria?

Null hypotheses:

- 1 There is no significant relationship between Biological hazard and the safety measures adopted by the biology laboratory students in Colleges of Education in the North West Geo-political Zone of Nigeria

- 2 There is no relationship between the student population and the frequency of occurrence of hazards among NCE Biology students in Colleges of Education in the North-West Geo-political zone of Nigeria.

Significance of the Study

The findings will make a great input in many ways,

- a. The result of this research will enable the government to realize the urgent need to provide and install safety measures to avoid an accident in Biology laboratories of tertiary institutions.
- b. The outcome of this work will also enable the employers of laboratory assistants to minimize the practice of drafting untrained clerical assistants, typists, and learners to work in the laboratory

Methodology

A descriptive survey research design was used for the study. According to Ali (2006), descriptive survey design is concerned with the documentation and description of what exists or the present status of existence or absence of what is being investigated without any manipulation of what caused the event. It develops a profile on what is and not why it is so. It is considered appropriate for the study because it is based on the views, and opinions of respondents as well as resources available in the area of study.

The study was conducted in six (6) Colleges of Education in North West Geo-political Nigeria. The population of the study comprised 13,822 students. It comprises all biology Nigerian Certificate in Education (NCE) students levels one, two, and three (NCE levels: 1, 2, and 3), in both state and federal Colleges of Education in North West Nigeria. (2021/2022 COEs NCE Academic Session). A structured questionnaire and direct observation were used for data collection. The Questionnaire focuses on hazards and safety measures in the Biology laboratory and is divided into three (3) sections (A-C). Section A was designed to obtain background information from respondents while sections B-C were to elicit information from the respondents to answer the two (2) research questions.

The Researchers collected letter of introduction from Chairman, TETFUND Institution Based Research (IBR) in collaboration with the Deputy Provost; Federal College of Education Zaria., whereby NCE 2 students were used for the study. The Researchers visited all the six (6) Colleges of Education in North West Geo-political Nigeria. To educate them on how to fill the Google forms online. Open Data Kit (ODK) or ODK Collect software was also used as a back up to administered questionnaires to the respondents. All necessary instructions needed for the successful completion of the academic exercises were clearly stated and explained to the students during the orientation before the commencement of the exercise. In collecting the data android/mobile phones were used to send and collect the questions and responses from the lecturers, technologists and students. Data collected from the respondents were analysed, Using Person's Product Moment Correlation Coefficient (PPMC) for research questions and the null

hypotheses at 0.05 level of significance. (SPSS 27 version (Statistical Package for the Social Sciences)).

Results

Null Hypothesis 1: There is no significant relationship between Biological hazard and the safety measures adopted by the biology laboratory students in Colleges of Education in the North West Geo-political Zone of Nigeria

Table 1: Pearson’s Product Moment Correlation

		Biological hazard	safety measures
Biological hazard	Pearson’s Correlation	1	.731**
	Sig. (2-tailed)		.000
	N	338	338
safety measures	Pearson’s Correlation	.731**	1
	Sig. (2-tailed)	.000	
	N	338	338

** . Correlation is significant at the 0.01 level (2-tailed).

Table 1 show that there is a significant relationship between Biological hazard and the safety measures among NCE Biology students in the College of Education North-West Geo-political zone Nigeria. (r=0.338; p<0.05).

Null hypothesis 2: There is no relationship between the student population and the frequency of occurrence of hazards among NCE Biology students in Colleges of Education in the North-West Geo-political zone of Nigeria.

Table 2: Pearson’s Product Moment Correlation

		Student population hazard	frequency of occurrence of hazards
student population hazard	Pearson Correlation	1	.338**
	Sig. (2-tailed)		.000
	N	338	338
frequency of occurrence of hazards	Pearson Correlation	.338**	1
	Sig. (2-tailed)	.000	
	N	338	338

** . Correlation is significant at the 0.01 level (2-tailed).

From Table 2 there is no significant relationship between the student population and the among NCE Biology students in Colleges of Education in the North-West Geo-political zone Nigeria. ($r=0.338$; $p<0.05$). There is no relationship between the student population's safety measures among NCE Biology students in Colleges of Education in the North-West Geo-political zone of Nigeria.

Discussion of Findings

Biological hazard and the safety measures adopted by the Biology laboratory students in Colleges of Education in the North West Geo-political Zone of Nigeria

From table 1, There is a significant relationship between the effective implementation of safety measures and the magnitude of Hazards among NCE Biology students in the College of Education North-West Geo-political zone Nigeria ($r=0.731$; $p<0.05$). This research is similar to the work of AbdulAzeez (2016) who study on investigated total quality management practices in laboratory and quality teacher education in public tertiary institutions in Lagos State. From the findings it was observed that there was a significant, and positive relationship between Total Quality Management practices in laboratory and quality teacher education in public tertiary institutions in Lagos State ($r = 0.695$; $p<0.05$). The study also found that there was a significant positive relationship between Total Quality Management practices and quality teacher education in public colleges of education in Lagos State ($r=0.315$; $p<0.05$), and in public universities too ($r=0.245$; $p<0.05$) One of the recommendations of the study was that an effective quality management was required to be put in place in all the public tertiary institutions in Lagos state.

Ukala and Nwabueze (2016) carried out a study on the application of health and safety management practices for quality education delivery in early childhood centres in Rivers State. Two research questions and two hypotheses guided the study. Descriptive survey design was adopted for the study. The population of the study consisted of 508 head-teachers in the 508 Early Childhood Centres (ECC) in Rivers State. A sample size of 200 head-teachers was drawn using stratified random sampling technique, which represented 39.4% of the population. A questionnaire tagged "Health and Safety Management Questionnaire" (HSMQ) and a checklist developed by researchers were used to generate items based on the variables of the study. The instrument was validated and the reliability established with test-retest method and calculated with Pearson's product moment yielded a value of 0.92. Mean scores and standard deviation were used to answer the research questions, and z-test was used to test the hypotheses. The result showed that health and safety management practices needed in early childhood education for quality education delivery in Rivers State include: (a) putting good safety and health arrangement in place for staff, pupils and any other person affected by the work activities of the school; (b) making well-planned safety and health systems in the centers for teachers and other staff to induce confident in them in carrying out their responsibility properly; (c) and

providing appropriate information, instruction, training and supervision of staff on health and safety related issues. Based on the findings, the work recommended that head-teachers and teachers should constantly keep available health and safety facilities in order after use, while the management should carry out a proper maintenance of the available facilities regularly.

Nwideduh and Adieme (2016) conducted a study on building an effective health and safety management at the work environment of the universities in Rivers state. The purpose of the study was to (a) assess the safety measures that are taken to protect academic staff from hazards at the work environment of the universities in Rivers State and (b) highlight the strategies the school management adopts for promoting health and safety at work environment of the universities in Rivers State. To guide the study, two research questions were raised and one hypothesis was formulated. Descriptive survey design was used for the study. A stratified random sampling technique was used to draw 600 respondents from a population of 3001 academic staff of the three universities in Rivers State. The respondents represent 20% of the entire population. A self- developed questionnaire and a checklist were used to collect data from the respondents. The instruments were duly validated and reliability of the questionnaire was tested using test re-test method which was calculated using the Pearson's Product Moment Correlation and it yielded an index of 0.79. The study employed frequency counts, percentage, mean standard deviation and rank order scores to provide answers to the research questions while z-test was used to test the hypothesis of no significant difference. The findings revealed that the strategies which the university managements adopt for maintenance and promotion of health and safety at work environment include: setting up health and safety committees, turning off all electrical appliances in the offices at the close of work, communication hazards and safety information through signs and symbols, monitoring the health of employees and responding to illness caused by workplace activity, designing working hours in a manner that supports a safe working environment and provision of recreational facilities for staff. The findings also revealed that some safety measures that are being taken to protect the academic staff from hazards at the work environment include: provision of hygienic learning environment, safety and caution signs, recycling and waste reduction practices, mounting of security personnel at strategic places among others. Based on the findings, the researchers recommended that periodic health and safety training programmes should be organized for staff, especially those that are newly employed in the system in order to enable them to be safety conscious at all times.

Population of students on the frequency of occurrence of hazards in biology laboratories in Colleges of Education in North West Geo-political Zone of Nigeria.

Table 2 shows that there is a significant relationship between the increase in student population and the implementation of safety measures among NCE Biology students in Colleges of Education in the North-West Geo-political zone Nigeria ($r=0.338$; $p<0.05$). This

research is similar to the work of Okoli and Osuafor (2010) in a study investigating the status of human and material resources for science education in secondary schools in Anambra state. Eighty eight (88) schools were randomly sampled for the study.

Akano (2006) who opined that the percentage of students in colleges of education outweigh that of lecturers due to excessive enrolment of students into science courses in colleges of education. The finding was in accord with the reports of Imogie (2010) that the number of students (undergraduate teachers) is enormous when compared to the number of lecturers in biology laboratories.

From the findings of the result, it was observed that the only human resource effectively utilized is students. This is because students' enrolment into science courses in colleges of education is always on the increase. Meanwhile, laboratory technologists/assistants are moderately utilized while lecturers are greatly utilized. The findings are in consonance with the findings of Ejionueme (2010) and Imogie (2011) who stated that increase in students' enrolment has creating imbalance in teacher to student ratio. Nwankwo *et al* (2011) equally observed that students do not make effective use of laboratory resources because the resources are inadequate. Oladipo (2008) too noted that students procure personalized dissecting kits or even computers if they want to make effective use of such resources during and after laboratory activities instead of waiting for limited number of departmental dissecting sets and desk-top computers. All the above assertion point to one fact: only laboratory resources that are adequately provided in biology laboratories of colleges of education are effectively utilized.

In the study, it was revealed that proportionate increase in students' enrolment should commensurate with the quantity and quality of human and material resources in biology laboratories. This result is in consonance with Imogie (2010) and Ejionueme (2010) whose earlier findings advocated enrolling the number of students that will equilibriumize the resources available in biology laboratories as stipulated in the NCCE.

The findings also agree with the measures taken by biology departments in colleges of education which mandated students to pay departmental dues. This will help the department to take care of immediate resource needs of the students hence more resources are provided to colleges of education.

Conclusion

Everyone in the laboratory is responsible for their own safety and safety of others. One should be cognisant of potential hazards by conducting all experiments and demonstration prior to their implementation. The study conclude that hazards and safety measures are highly significant relationship ($p < 0.05$) for students and lecturers/technicians in the laboratory. In terms of students population and the frequency of hazards among NCE Biology in College of Education in North West Geo-political Zone, it was observed that there is a low significant

relationship ($p < 0.05$) also it was observed that most of the colleges of education visited have high students ratio to lecturers/technicians facilities available in the college e.g. Laboratory buildings, equipment and chemicals are not sufficient to conduct practical's.

Another aspect noticed was laboratory design, most of colleges visited have their laboratory buildings situated in a way that direct rays from the sun find their ways in to the laboratory. This is hazardous because it could lead to vigorous reaction between the rays and some chemicals. In addition, most of the school visited, their laboratory organisation from the safety point of view was poor, lacked safety gadgets and inadequate first aid contents. Therefore, preventive measures are to be taken to ensure adequate safety of hazards in the laboratory.

Recommendations

1. The students should know where the safety gadgets are kept in biology laboratories and should have free access to them.
2. Teachers should explain to students what is expected in biology laboratories.
3. All schools offering biology should have accident record books. This is necessary for the teachers working in the laboratories. Such book should contain the name of students, class, type of accidents and type of aid treatment given. This would help the teachers from being persecuted by overzealous parents if the accidents eventually turn to death.
4. Students should not be allowed access to places where chemicals, explosive or other apparatus are kept without the knowledge of teachers.
5. Teachers should participate in workshops to enable them update on their first aid habit and techniques
6. In case of high population of students, they should be grouped, for effectiveness and to avoid accidents during practical lessons.

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