



# Extent of Implementation of Safety and Management Practices in Senior Secondary Schools Biology Laboratory Resources in Enugu State, Nigeria

By

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## Abstract

The study investigated extent of implementation of safety and management practices in senior secondary schools biology laboratory resources in Enugu State, Nigeria. Two research questions guided the study and one null hypothesis was tested at 0.05 level of significance. Descriptive survey research design was adopted for the study. The population of the study comprised 552 biology teachers in public secondary schools in Enugu State. A sample size of 417 biology teachers was drawn for the study using multistage sampling procedure. The researchers developed questionnaires titled "Extent of Implementation of Safety and Management Practices in Senior Secondary Schools Biology Laboratory Resources" (EISMPISSSBLR). The instrument was validated by five experts, one expert in measurement and evaluation unit of the Department of Educational Foundations, one from Department of Guidance and Counselling, two from the Department of Science Education all from NnamdiAzikiwe University, Awka and one secondary school Biology teacher from Community Secondary School, Amansea. Cronbach alpha was used to determine the reliability of the instrument which yielded coefficient value of 0.77. The researchers together, with three research assistants collected data for the study using the direct approach method and 97% return was recorded. Mean statistics was used to answer the research questions while one-tailed independent t-test was used to test the hypotheses at 0.05 statistical level of significance. The findings of the study revealed among others that appropriateness of design and fittings were to a high extent to implement safety practices in biology laboratory. Further results showed that management practices by male and female biology teachers in senior secondary schools biology laboratory resources were to a low extent for teaching secondary school biology in Enugu State, Nigeria. Also, there is no significant difference in the mean ratings of male and female biology teachers in the management of biology laboratory resources for teaching biology in secondary schools in Enugu State. Based on the findings, it was recommended among others that Enugu State government, individuals, science professional bodies and non-governmental, organization should assist improve the safety and management practices in senior secondary schools biology laboratory resources for teaching biology through funding, donations and supply of teaching materials.

## Keywords:

Implementation, Safety, Management, Schools, Biology, Laboratory Resources.



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## Introduction

Secondary education system in Nigeria is described by Federal Republic of Nigeria (2022) as a crucial link between primary school, tertiary education and the labour market. Secondary education is of strategic importance to Nigerian development and capacity building process, given the fact that 60% of Nigerian population are made up of students of secondary school age (Lewin, 2019). This apparently underscores the need for improved secondary education that is closely linked to effective school management. The secondary education is designed to prepare students for higher education and useful living in the society. Secondary education is the second tier of Nigerian education system. The broad goals of secondary education according FRN (2022) shall be to prepare the individual for useful living within the society and higher education.

Science provides a body of knowledge for use in addressing various forms of human, material and environmental problems. Science refers to a system of acquiring knowledge. This system uses observation and experimentation to describe and explain natural phenomenon. Uche and Umoren (2011) were of the view that science is studied and practiced in all parts of the world, including Nigeria.

Nigeria is a developing nation with an increasing demand for science-based skilled manpower. The achievement of this can start with the learning and application of science such as biology, chemistry, basic-science and physics at secondary school level. Among these science subjects, this paper focused on biology. Biology is the science of life as it studies organisms, their interactions with one another and their environments. All living organisms share several key properties such as order, sensitivity or response to stimuli, reproduction, growth, development, regulation, homeostasis and energy. Matazu (2022) was of the view that biology is related to many things in human's daily life, it is a prerequisite for certification at the senior secondary school level and for admission into the tertiary institution for not science related courses that will pursue careers in science related fields such as medicine, nursing, pharmacy, nutrition, medical laboratory among others.

Biology as a science is a very important aspect in the development of any nation. One of the ways of appreciating science teaching and learning is through effective laboratory instruction. The laboratory has long been a distinctive feature in science education. Its introduction has proved successful because students will go out from the laboratories able to "see and do" (Osuafor and Nnorom, 2011). When students are taught in a school with adequate facilities, they tend to perform better than they would have done without these facilities. The availability of teaching facilities makes science lesson concrete and stimulating and helps to enhance the achievement of students in secondary schools. A laboratory has always been conceived as place where scientific activities take place. Osuafor and Nnorom (2011) stated that scientists investigate nature and the environment not only be discussing theoretically or abstractly but mainly through various experiments. Experiment generally requires the use of certain techniques, tools and materials. These may take place in the laboratory or outside it, however, provision of adequate laboratory space is necessary for the science and technology. Similarly, when we teach any of these subjects as it should be taught they emphasized students active involvement in experimentation and practice activities. This is more so as it is known that through manipulation of actual objects, models equipment of living specimens during practical activities, a phenomenon becomes concrete for most students and thus easier to learn.

Laboratory design as a factor in laboratory safety: The primary objective in laboratory design should be to provide a safe, accessible environment for laboratory personnel to conduct their work. A secondary objective is to allow for maximum use. Therefore, health and safety hazards shall be

anticipated and carefully evaluated so that protective measure can be incorporated into the design whenever possible. However, no matter how well designed a laboratory is, improper management of its facilities will always defeat the engineer safety features. Proper education of the facility users is essential. According to Osuafor and Ezeobi (2017) in designing a biology laboratory, certain considerations have to be made. Some of these are discoursed as follows:

**Space:** This is one of the most important considerations in designing a biology laboratory. The biology laboratory should have a large space for free movement during learning activities. The specification of the shape (square, rectangular, circle) and dimension should be such that it provides more than adequate for the proposed or estimated number of users at a given time.

**Laboratory Ventilation:** A biology laboratory should have adequate ventilation that allows free flow of air in and out of the biology. The ventilation of a biology laboratory should be such that air is constantly replaced to prevent an increase and concentration in the air of toxic substances during practical work period.

**Signs and Labels:** Every biology laboratory should bear signs and labels of each item clearly visible and pasted. These labels and warning signs should alert students, teachers and laboratory workers to potential danger inherent in such materials. Safety facilities, chemical use and storage, emergency equipment emergency response personnel and exit should all have signs and labels for easy identification and safety, most especially to guide first time users of the laboratory. Example of such signs are as follows:

1. Where there are gallons of flammable liquid. This should bear a flammable liquid sticker posted on it that is, labels should be identified, showing, contents of containers and associated hazards.
2. In case of emergency, names and numbers of personnel to contact example – fire fighters.
3. Location of signs for safety shower, eye wash stations, first aid equipment, exits and areas where food and beverage consumption and storage are permitted.
4. Warning at areas or equipment where special or unusual hazard exists.

**Storage Area/Store Rooms/Stock Rooms:** In a biology laboratory, there should be storage area sometimes referred to as storeroom. In this storage room, chemicals should be stored according to compatibility and designated by hazard classes for example, flammable, irritants, corrosives, low hazards, oxidizers and poisons. The areas where chemicals are stored should be well identified such chemicals should be properly labelled and stored appropriately in the area designated for it which would be with good ventilation. The chemicals or substances that are highly toxic or other chemicals whose containers have been opened should be in unbreakable secondary containers. In addition, those chemicals are substances stored in the store room should be examined periodically (at least twice in a year) for replacement in ease of deterioration and container integrity. The storeroom should be opened during normal working hours and manned by one person. It should not be used as a repackaging, demonstration or preparation room for experimental activities.

**Preparatory Room:** In addition to the storeroom is another ancillary room where materials, apparatus and chemical substances are prepared and assembled before they are used. This is the preparation or prep rooms. It has been observed that in some schools, a single room functions as the store and the preparatory room. These rooms are supposed to be separate. Iloeje (2008) was of the view that the following components should be included in the preparation room, benches/stools, rack of shelves, cupboard and working platforms. In addition, the following services should be provided functional water supply, electricity supply and gas sources for heating. It is usually advisable that the preparation room and the storeroom should be next to each other.

**Services:** Olubor and Unyimadu (2001) pointed out that in any biology laboratory, the provision of the following services: water drainage, gas and electricity or source of light is essential. Water service points should be installed at demonstration benches and on each side of the laboratory along the periphery of the room. For biology laboratory located in areas where water is scarce, it is advisable to install a storage tank at the roof level outside the laboratory. As an interim measure, water can be provided in large plastic containers. Ideally, electricity is necessary in a biology laboratory to enable activities to be carried out effectively. Where this is not feasible, a generator can be used. Akpan (2013) stated that fluorescent tubes should be installed at strategic points or areas such as demonstration points or benches, in-between areas and at the back of the laboratory should serve the lighting purpose of a laboratory. Where it is possible to have electricity, the natural lighting available in the laboratory should be maximized. Gas supply to biology laboratory is also essential. This should be piped from a central cylinder installed outside the laboratory building. The pipes should be laid where they can easily be repaired. The handling of gas should be laid where they can easily be strictly monitored. It is not possible to have gas lamps that use spirit may be used. Good drainage is essential in biology laboratory. To reduce drainage problems in biology laboratory, the drains should be designed in such a way that they are much wider than the diameter of the holes in the sink that serve them. They should also be built in such a way that all liquid are collected in a central place and removed. Close drainage that are easy to clean are recommended (Akpan, 2013).

**Management Practices in Senior Secondary Schools Biology Laboratory resources:** According to Osuafor and Ezeobi (2017) laboratory resources management entails adequate and proper care of the available resources, services and equipment. The manager of the biology laboratory is the biology teacher who must be prepared to commit his/her professional, creatively technical and ingenious skills readily and intelligently to manage the laboratory effectively. Biology laboratory resources management also involves the management and display of materials, equipment and chemicals and the organization of these in the laboratory procedures and practices are carried out to make the laboratory effective and to minimize the potentials of danger to students, teachers and researchers who use chemical substances that could be hazardous. The laboratory is supposed to be managed on a daily, weekly, monthly or termly and yearly basis.

Osuafor and Ezeobi emphasized that on daily bases, windows and doors should be opened and closed at the end of the day gas and water main taps properly shut off daily, all light and electrical appliances properly switched off, all sinks and waste drains cleared everyday and disinfected, all apparatus not in use put away, broken glasses disposed in special bins and floors cleaned, mopped or dusted daily.

For weekly management, at the beginning of each week, the store room should be checked to see whether materials are adequate and apparatus in good order for experiments and laboratory activities. The labels on the bottles should be checked to determine their effectiveness and replaced if parts are worn out.

**Monthly Management:** The fire-fighting equipment should be checked to determine their effectiveness. Replace any that needs replacement. Delicate equipment should be checked and major repairs effected where necessary. Replace worn-out cleaning materials, like brooms and dusters. Check and effect any repairs necessary of any main services such as water pipes, gas pipes and electricity. Check and ensure that vital fittings inside the laboratory are in order such as laboratory rules and other displayed posters and replenish consumable materials for laboratory experiment.

**Yearly Management:** A careful auditing of all laboratory and material should be conducted at the end of these sessions. This will then enable the teacher to budget for the coming year. The budgeting

should envisage and take care of increased student population and therefore the need to enlarge facilities. It is the duty of the science teacher to be able to persuade the school authorities to ensure that laboratory facilities are constantly refurbished and replenished.

### **Purpose of the Study**

The study determined the extent of implementation of safety and management practices in senior secondary schools biology laboratory resources in Enugu State, Nigeria.

Specifically, it determined:

1. The extent to which general design and fittings of biology laboratories are appropriate for the implementation of safety practices in senior secondary schools in Enugu State, Nigeria.
2. The extent to which biology teachers manage laboratories resources in the teaching of biology in senior secondary schools in Enugu State, Nigeria.

### **Research Questions**

The following research questions guided the study:

1. To what extent do the type of general design and fittings of biology laboratories appropriate for the implementation of safety practices in senior secondary schools in Enugu State, Nigeria?
2. To what extent do biology teachers manage laboratories resources in the teaching of biology in senior secondary schools in Enugu State, Nigeria.

### **Research Hypothesis**

The following null hypothesis was tested at 0.05 level of significance:

1. There is no significant difference between the mean ratings of male and female biology teachers in the management of laboratories resources in the teaching of biology in senior secondary schools in Enugu State, Nigeria.

### **Research Methods**

Descriptive survey design was adopted for the study. The design is appropriate since the study sought to collect data from respondents in order to investigate the extent of implementation of safety and management practices in senior secondary schools biology laboratory resources in Enugu State, Nigeria. The study was conducted in Enugu State, Nigeria. The population of the study comprised 552 biology teachers in public secondary schools in Enugu State, Nigeria. The sample for the study comprised 417 biology teachers in public secondary schools in Enugu State, Nigeria.

The researchers developed questionnaires titled “Extent of Implementation of Safety and Management Practices in Senior Secondary Schools Biology Laboratory Resources” (EISMPISSSBLR). The instrument was validated by five experts, one expert in measurement and evaluation unit of the Department of Educational Foundations, one from Department of Guidance and Counselling, two from the Department of Science Education all from NnamdiAzikiwe University, Awka and one secondary school biology teacher from Community Secondary School, Amansea.

Cronbach alpha was used to determine the reliability of the instrument which yielded coefficient value of 0.77. The researchers together with three research assistants collected data for the study using the direct approach method and 97% return was recorded. Mean statistics was used to answer the research



questions while one-tailed independent t-test was used to test the hypotheses at 0.05 statistical level of significance.

## Results

**Research Question 1:** To what extent do the type of general design and fittings in the biology laboratory appropriate for the implementation of safety practices in senior secondary schools in Enugu State, Nigeria.

**Table 1:** Teachers response on the extent to which the following general designs and fittings are appropriate for the implementation of safety practices in the biology laboratories.

S/N	ITEM STATEMENT	N	$\bar{X}$	DECISION
1.	The laboratory is big enough to allow free movement during practical activities.	417	2.00	Low Extent
2.	The laboratory has enough seats and work benches.	417	1.90	Low Extent
3.	The demonstration table is adequate positioned.	417	3.07	High Extent
4.	Facilities for water, drainage, gas and electricity supply are properly installed at appropriate places in the laboratory.	417	2.80	High Extent
5.	The laboratory has a preparatory room where materials, apparatus and chemicals are prepared and assembled for use.	417	3.00	High Extent
6.	The laboratory has a store room where chemicals are stored.	417	4.00	High Extent
7.	Chemicals are stocked in the storeroom according to their hazard classes for example, flammable, irritants, corrosives, toxic, poisons, etc.	417	2.95	High Extent
8.	The laboratory is ventilated to allow free flow of air in and out of the laboratory.	417	1.79	Low Extent
9.	Storage shelves are securely attached in the wall.	417	3.12	Very High Extent
<b>GRAND MEAN</b>			<b>2.37</b>	<b>High Extent</b>

Table 1, shows the mean response by biology teachers on the extent to which the design and fittings in biology laboratories resources are appropriate for implementation of safety practices in biology laboratories in secondary schools in Enugu State, Nigeria.

Respondents' opinion was that items 6 and 9 were provided to a very high extent region of High Extent. Items 1, 2 and 8 have the mean score of 2.00, 1.90 and 1.79 as the mean with the scale point of low extent. But the grand mean for the fittings of biology laboratory is 2.73 which falls within the region of high extent and is above the decision mean of 2.50. Therefore, respondent's opinion was that the appropriateness of the design and fittings for biology laboratories ensures safety to a high extent.

**Research Question 2:** To what extent do biology teachers manage laboratories resources in the teaching of laboratories resources in the teaching of biology in senior secondary schools in Enugu State, Nigeria?

**Table 2:** Mean Ratings and Standard Deviation Scores on Management of Laboratories Resources for Teaching Biology

S/N	ITEMS	Teachers (n =417)		
		x	SD	Remark
1	Inspect apparatus/equipment before allowing my students to use them	2.57	1.04	High Extent
2	I keep the instructional resources such as charts, reagents in a store or storage unit after use	2.41	1.11	Low Extent
3	I do not carry out regular cleaning of materials e.g charts to shake-off dusts as to improve their visual literacy	2.39	1.02	Low Extent
4	I used the knowledge acquired from workshops, seminars and conferences in the management of structural resources use during biology classroom instructional delivery	2.51	1.03	High Extent
5	I ensure priority placement on instructional resources that are ordered	2.34	1.02	Low Extent
6	I ensure the labelling of all the reagents boldly	2.51	1.01	High Extent
7	I do not ensure the provision and use of stock in he recorded books in my school biology laboratory	2.43	1.01	Low Extent
8	I store chemicals that are susceptible to photolysis in dark colour bottles	2.52	1.06	High Extent
9	I carried out periodic maintenance of the instructional resources used in biology classroom instructional delivery	2.44	1.10	Low Extent
10	I do not use adhesively such as starch, gun, super glue or solatep to maintain the damaged instructional resources for biology teaching.	2.53	1.03	High Extent
11	The laboratory windows and doors are opened and closed on daily bases.	2.39	0.98	Low Extent
12	The laboratory is swept and mopped every day.	2.46	1.09	Low Extent
13	The biology teacher has a comfortable office and laboratory assistants for effective management of the laboratory.	2.28	1.14	Low Extent
14	Gas and water taps and outlets are shut off after laboratory activities.	2.54	1.17	High Extent
15	All electrical appliances are switched off after each laboratory activity.	2.51	1.01	High Extent
16	Sinks and waste drains are cleaned and disinfected after use.	2.33	1.10	Low Extent
17	The store room is checked at least once a week to see whether laboratory materials and chemicals are still adequate and in good order.	2.41	1.15	Low Extent
18	The labels on the bottles are checked regularly and replaced if worn out.	2.32	0.94	Low Extent
19	Inventory of laboratory materials is done on regular bases to replace the ones that have been exhausted.	2.40	0.98	Low Extent
20	Names and phone numbers of personnel to contact in case of emergency e.g. fire fighters are written and posted in the laboratory.	2.43	1.17	Low Extent
<b>Cluster Percentage</b>		<b>2.44</b>	<b>1.06</b>	<b>Low Extent</b>

Result in table 3 shows that the mean ratings of respondents for items 1, 4, 6, 8, 10, 14 and 15 were between 2.50 and 3.49 indicating that there was high extent to which biology teachers manage instructional resources for teaching of biology in connection to the items. The mean ratings of respondents which were between 1.50 and 2.49 for items 2, 3, 5, 7, 9, 11, 12, 13, 16, 17, 18, 19 and 20

indicated that there was low extent to which biology teachers manage instructional resources for teaching of biology.

The pooled standard deviation scores which stood at 1.06 indicated that the mean scores of respondents were clustered and this indicated that a little variation from their responses. The cluster mean value of 2.44 which fell within the decision rule of 1.50-2.49 indicated biology teachers to low extent manage instructional resources for teaching of biology in senior secondary schools in Enugu State.

**Hypothesis One:** There is no significant difference in the mean ratings of male and female biology teachers in the management of laboratories resources for teaching biology in senior secondary schools in Enugu State, Nigeria.

**Table 3:** The Summary of t-test Analysis no Significant Difference in the Mean Ratings of Male and Female Biology Teachers in the Management of Instructional Resources for Teaching Biology (n= 417)

Group	N	X	SD	p-value	Df	$\alpha$	Remark
Male Biology Teachers	136	2.45	1.06	0.24	415	0.05	Not Significant
Female Biology Teachers	281	2.46	1.03				

Table 3 revealed that the p-value of 0.24 is greater than 0.05 level of significance. Thus, the null hypothesis is accepted. Therefore, there is no significant difference in the mean ratings of male and female biology teachers in the utilization of instructional resources for teaching biology in secondary schools in Enugu State.

## Discussion

The findings of the study indicated that the general designs and fittings of biology laboratories are appropriate for implementation of safety practices. The only exception were in the following areas; some of the laboratories were big enough to allow free movement during practical activities, some of the laboratories did not have enough seats and work benches and some of the laboratories were not well ventilated. This is unsafe since the lives of people who work in the laboratory are in danger. This is in agreement with Neboh (2011) who stated that the general design of any safe biology laboratory should include provision for ventilation. As Osuafor and Ezeobi (2017) suggested that biology laboratories should be build in such a way that they are ventilated and enough seats and work benches are provided by the authorities concerned.

Further findings indicated that biology teachers manage laboratories resources to a low extent in the teaching of biology in senior secondary schools in Enugu State, Nigeria. This agreed with the findings of Osuafor and Ezeobi (2017) revealed that biology teachers in Awka South Local Government of Anambra State, Nigeria organize and manage the biology laboratories resources only to a low extent. This was definitely not good enough. The non-organization and management of the laboratories to a low extent implies that laboratories are also not being properly utilized. The importance of good organization, and managing of safety practices in a laboratory resources well cannot be over emphasized because failure to do so could be disastrous. It could lead to various kinds of accidents. It could also lead to usage of expired results. In the long run, it may lead to students not performing well in practical examinations, no wonder Matazu (2022) expressed that laboratory and practical work are indispensable to the understanding of science.



Further result showed that there is no significant difference between the mean ratings of male and female biology teachers in the management of laboratory resources for teaching biology in senior secondary schools in Enugu State, Nigeria.

### **Conclusion**

Based on the findings, it was concluded that general designs and fittings of biology laboratories in senior secondary schools in Enugu State, Nigeria are appropriate for implementing safety practices. It was also concluded that most laboratories resources were mismanaged and managed to a low extent by biology teachers for teaching the subject in secondary schools in Enugu State, Nigeria. Most biology teachers instructional resources in secondary schools.

### **Recommendations**

Based on the findings of the study, the following recommendations were made:

1. The school authority and government should ensure that in building biology laboratory, attention should be placed on the general design and location to ensure expansion and safety.
2. It was found that biology laboratories was managed to a low extent. Teachers should ensure that inventory of the laboratory materials is done on regular basis to replace the ones that have been exhausted. Safety rules should be pasted in all entrances of the laboratory and at strategic positions.
3. Workshops and seminars should be organized by the Enugu State Government for Science teachers to adequately tutor them on the possible hazards in their respective laboratory as well as necessary safety precautions.

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