

## Extent of Awareness of Safety Measures in the Layout/Organization of Science Laboratories in Secondary Schools

<sup>1</sup>Dr Iheanyi O. Igwe  
(Mstan, Mcon & Fcai) &  
<sup>2</sup>Celestine N. Nwele  
<sup>1</sup>*Department of Science  
Education, Ebonyi State  
University, Abakaliki*  
<sup>2</sup>*Department of Chemistry,  
Ebonyi State College of  
Education, Ikwo*

### Abstract

The research work investigated the extent of awareness of safety measures in the layout/organisation of secondary school science laboratories in Ebonyi State of Nigeria. The researchers used 45 secondary schools selected through stratified random sampling technique while 135 science teachers and 45 laboratory attendants were selected from the schools using purposive sampling technique. Descriptive survey design was adopted for the study. 14-item four-point scale structured questionnaire was developed and used by the researchers to collect data. The data collected were analysed using mean and standard deviation to answer the research questions while t-test was used to test the hypothesis at 0.05 alpha level of significance. Results of data analysis revealed that the extent science teachers are aware of safety measures required in the layout/organisation of science laboratories is very high while the laboratory attendants are aware of required safety measures to a high extent. The result also revealed that there is a significant difference in the mean responses of science teachers and laboratory attendants on the extent of awareness of safety measures in science laboratories in secondary schools in Ebonyi State. The implication is that awareness of safety measures is not a problem to ensuring that science laboratories in secondary schools in Ebonyi State are safe for laboratory activities. The government should ensure that laboratories are constructed for each science subject and that each laboratory should have safety facilities in place and properly organised.

Keywords: *Safety, Science, Laboratory,  
Awareness and measures*

### Background to the Study

Experiments are very important and essential in the teaching and learning of sciences in secondary schools. These experiments are carried out mainly in the science laboratories. Since laboratory experiments expose users to hazards, risks and accidents. The laboratories need to be laid out and organized in such a way that accidents are reduced to the barest minimum. For the laboratories to be organised in this way, the science teachers, laboratory assistants or attendants should be sufficiently aware of the safety measures required in the layout/organisation of science laboratories. Ali, (1998) explained laboratory as a place where experiments in science are carried out. Igwe (2003) described it as a facility for learning what science is and how scientists work, while Allen, Henry, Albert and Donald, (2003) stated that laboratory is a building or room fitted up for conducting scientific experiments.

Archenhold, Jenkins and Wood- Robson, (1978) explained laboratory organisation as an orderly arrangement of water source, heat source, electric source, laboratory furniture, science teaching equipment and materials. They maintained that the plan to make a science laboratory safe for users begins with the proper layout of such laboratory. They outlined some important factors which the science teachers should be sufficiently aware of in planning the layout of the laboratories. These include: linear bench space, circulation space, space for cupboards and shelves for storage of apparatus and other materials, space for apparatus which needs to be fixed in vertical plane, demonstration table for the teacher. Bullon (2005) described layout as the way in which something such as building is arranged.

Ibam, Ibrahim and Idoko (2008) stressed that teachers should be aware that a well designed laboratory is built in accordance with the kind of work to be done in it and the number of users. Teachers should also be aware that laboratories should have at least two exit doors and that these doors should be open when laboratory activities are going on. They should be aware that laboratories should have emerging exit lights and that these lights should be activated on power failure. Adigun (1999) emphasised that laboratories users should be aware that laboratories should not be overcrowded and that arrangement of benches should allow for free movement of users; there should be adequate ventilation, adequate lighting and general good construction in the laboratory.

The National Commission for Colleges of Education Minimum Standard of 2012 recommended a general laboratory space of between 10x8 and 12x9m for a laboratory for a maximum of 40 students; one stockroom and a preparatory room. Archenhold, Jenkins and Wood-Robinson (1978) observed that rectangular shaped laboratories which are in vogue in most schools, have the disadvantage of a large distance between the teacher and some students, making the far distance students not to be participants of the teachers demonstration activities. They recommended a laboratory of near-square shape. The science teachers and the school administrators should be quite aware of this.

Teachers should be aware that each laboratory should have master switches for gas, water and electricity respectively and that these switches should be located where they are accessible to the laboratory users, (Aniodoh, 2001) and (Laboratory Safety,2012). Teachers should also be aware that electrical appliances, equipment, sockets and switches must not be installed close to taps, sinks or other areas where water may splash on them as this may cause electric shocks. Each laboratory should have alarm bell or button to be pressed when there is fire outbreak, (Ezeliora, 2003). Teachers should be aware that in arranging laboratories, each student according to Ikoju, Ahmed and Joju (1984) should be assigned to a locker in the laboratory and that each of the lockers should contain routine equipment which the students would be using for routine experiments.

The layout/organisation of some laboratories in secondary schools in Ebonyi State seems to indicate that the teachers and the school authorities are not adequately aware of the need for safety of users. Gas cylinders are placed inside the laboratory halls of some schools while in others, one room seem to serve as store, preparatory room and experiment hall. Many of the laboratories seem to have only one door to serve both as entrance into and exit from the laboratory; in some others water pipes are lacking. Sand buckets are not found in some school science laboratories. All these seem to suggest lack of awareness of safety measures in such schools, which this study is out to investigate.

The researchers presume that, the science teachers and the laboratory attendants may not be quite aware of the safety measures required in the layout/organisation of science laboratories in secondary schools in the state. The users of the laboratories and materials there in could therefore be exposed to danger, risks and accidents.

#### Objective of the Study

This research is set out to investigate the extent of awareness of safety measures in the layout/organisation of science laboratories in secondary schools in Ebonyi State.

It is uncertain whether there are empirical data on the extent of awareness of science teachers and laboratory attendants of safety measures required in the layout/organization of science laboratories in secondary schools in Ebonyi State.

#### Purpose of the Study

The main purpose of the study was to investigate the extent of awareness of safety measures in the layout/organisation of science laboratories in secondary schools in Ebonyi state. Specifically the research work sought to:

1. Investigate the extent of science teachers who are aware of safety measures in the layout/organisation of science laboratories in secondary schools in Ebonyi State.
2. Determine the extent laboratory attendants; aware of safety measures in the layout/organisation of science laboratories in secondary schools in Ebonyi State.

### Significance of the Study

The results of this study will be of great importance to the government of Ebonyi State, the school authorities, science teachers and users of the laboratories. It would make the government and school proprietors to be aware of safety measures in the layout of laboratory buildings in the schools to ensure the safety of users. It would make the science teachers and laboratory attendants to be aware of safety measures in the organization of equipment and materials in the science laboratories. It would also make the students to be aware of arrangement in the laboratories to ensure their safety.

### Scope of the Study

The study focused on secondary schools in Ebonyi State that have existing science laboratories. It covered the layout of the laboratory buildings and the organisation of furniture and equipment on the laboratories to ensure safety. Science teachers and science laboratory attendants were the subjects of this study.

### Research Questions

In order to ensure the attainment of the objectives of the research study and to guide the researchers in the research work, the following research questions were posed.

1. To what extent are the science teachers aware of safety measures in the layout/organisation of science laboratories in secondary schools in Ebonyi State?
2. To what extent are laboratory attendants aware of safety measures in the layout/organisation of science laboratories in secondary schools in Ebonyi State?

### Hypothesis

A null hypothesis was formulated and tested at 0.05 level of significance:

$H_{01}$ : There is no significant difference in the mean responses of science teachers and laboratory attendants on the extent of awareness of safety measures in the layout/organisation of science laboratories in secondary schools in Ebonyi State.

### Methodology

A descriptive survey design was used for the study. The study covered science laboratories in secondary schools in the three education zones of Abakaliki, Onueke, and Afikpo in Ebonyi State. It was restricted to senior secondary schools, because the science teachers used for the study were all senior secondary school teachers.

### Population and Sampling Techniques

The population of the study consisted of all secondary schools in Ebonyi State that have science laboratories. The sample consisted of 45 secondary schools. The secondary schools were selected using stratified random sampling technique. Stratified random sampling was used to ensure that the survey is spread among the secondary schools in the three education zones of the state. 15 secondary schools were selected from each zone using simple random sampling technique. A total of 135 science teachers

(consisting of 45 of each of biology, chemistry, physics teachers) and 45 laboratory attendants of each school were selected using proportional and purposive sampling techniques. Purposive sampling technique was used so as to select the science teachers and laboratory attendants with the highest experience in laboratory activities.

#### Instrument for Data Collection

The instrument for the collection of data for this research study was: the structured questionnaire developed by the researchers. The instrument is titled Safety Measures Awareness Questionnaire (SMAQ). The questionnaire had 14 items initially and was organised in two sections: Section A sought background information of the respondents such as qualification, area of specialization, status in the school while section B consisted of items that sought information on the extent of awareness of a wide range of safety measures in the layout/organisation of science laboratories in secondary schools.

The instrument was a four-point scale questionnaire with the response options as follows: 4= Very High Extent (VHE), 3 = High Extent (HE), 2 = Low Extent (LE), 1 = Very Low Extent (VLE). The instrument was face-validated by three Science Education experts from the Department of Science Education, Ebonyi State University, Abakaliki, Nigeria. The reliability of the instrument was established using Cronbach Alpha Statistics and a coefficient of 0.81 was obtained showing that the instrument was reliable.

#### Method of Data Collection

The researchers made use of a research assistant for one education zone in the administration of the instrument because the researchers handled the administration in two education zones. The research assistant was trained by the researchers to explain to the respondents what to do and the need for them to answer honestly to the items. The research assistant visited and administered the instrument in schools in Abakaliki Education Zone, while each of the two researchers visited and administered the instrument in Onueke and Afikpo Education Zones respectively. The questionnaire was collected on the spot immediately after completion to save time, avoid improper filling and non return of some questionnaire.

#### Method of Data Analysis

The researchers used mean and standard deviation in answering the research questions. The mean and the standard deviation of each scaling item were calculated for the respondents. The value obtained was interpreted in relation to scale code. A mean value of 0.10 - 1.00 was regarded as VLE, a mean value of 1.10-2.00 was regarded as LE, a mean value of 2.10- 3.00 was regarded as HE, while a mean value of 3.10-4.00 was regarded as VHE. T- test was used to test the hypothesis at 0.05 alpha level.

## Results

The results of the research study on the research questions and the hypothesis are shown in Tables 1 and 2:

### Research Question 1

To what extent are the science teachers aware of safety measures in the layout/organisation of science laboratories in secondary schools in Ebonyi State?

Data collected in respect of this research question were analysed descriptively on individual item basis. The summary of the analysis is presented in Table 1.

Table 1: Mean results on the extent of science teachers' awareness of safety measures in the layout/organisation of science.

SN	Item	No	X	SD	Interpretation
1.	I am aware that there should be separate laboratory for separate science subjects.	135	3.61	0.79	VHE
2.	I am aware that a laboratory should have a separate store/ preparatory rooms/ activity halls	136	3.65	0.79	VHE
3.	I am aware that there should be pipes for the flow of water in the laboratory	135	3.62	0.78	VHE
4.	I am aware that benches/lockers in the laboratory should allow for free movement of people	135	3.57	0.82	VHE
5.	I am aware that there should be space for cupboards in the laboratory	135	3.57	0.79	VHE
6.	I am aware that all power points for electricity in the laboratory should be earthed	135	3.40	0.96	HE
7.	I am aware that there should be alarm bells/telephones in the laboratory	135	3.49	0.86	HE
8.	I am aware that gas cylinders should be located outside the laboratory hall	135	3.60	0.78	VHE
9.	I am aware that a laboratory should be adequately lighted	135	3.57	0.88	VHE
10.	I am aware that a laboratory should have emergency exit doors	135	3.37	0.91	HE
11.	I am aware that a laboratory should have adequate provision of windows	135	3.55	0.87	VHE
12.	I am aware that there should be adequate provision of shelves in the laboratory	135	3.53	0.86	VHE
13.	I am aware that electrical appliances/sockets/ switches should not be installed close to water taps / sinks	135	3.24	1.11	HE
14.	I am aware that there should be a locker / bench space per student in the laboratory	135	3.59	0.79	VHE
	Grand mean		3.52	0.85	VHE

Summary of the results presented on table 1 above indicates awareness of most items to a very high extent. Grand mean of 3.52 and SD of 0.85 show that the science teachers in secondary schools in Ebonyi State are aware of safety measures in the layout/organisation of science laboratories to a very high extent.

#### Research Question 2

To what extent are laboratory attendants in secondary schools in Ebonyi State aware of safety measures in the layout/organisation of science laboratories?

Data collected with respect to this research question were analysed descriptively on individual item bases. The summary of the data analysis is presented in the Table 2:

Table 2: Mean results on the extent of laboratory attendants' awareness of safety measures in the layout/organization of science laboratories.

SN	Item	No.	$\bar{X}$	SD	Interpretation
1	I am aware that there should be separate laboratory for different science subjects.	45	2.97	0.62	HE
2	I am aware that a laboratory should have a separate store/preparatory room/activity hall.	45	3.62	0.62	VHE
3	I am aware that there should be pipe for the flows of water in the laboratory.	45	3.04	0.47	HE
4	I am aware that benches/lockers in the laboratory should allow for free movement of people..	45	2.91	0.66	HE
5	I am aware that there should be a space for cupboards in the laboratory.	45	3.00	0.56	HE
6	I am aware that all power points for electricity in the laboratory should be earthed.	45	2.91	0.90	HE
7	I am aware that there should be alarm bells/telephones in the laboratory.	45	3.02	0.58	HE
8	I am aware that gas cylinders should be located outside the laboratory hall.	45	3.97	0.65	VHE
9	I am aware that laboratory should be adequately lighted.	45	2.86	0.69	HE
10	I am aware that a laboratory should have emergency exit doors.	45	2.88	0.61	HE
11	I am aware that a laboratory should have adequate provision of windows.	45	2.84	0.63	HE
12	I am aware that there should be adequate provision of shelves in the laboratory.	45	2.97	0.45	HE
13	I am aware electrical appliances/sockets/switches should not be installed close to water taps/sinks.	45	3.00	0.36	HE
14	I am aware that there should be a locker/bench space per student in the laboratory.	45	2.93	0.58	HE
	Grand Mean		3.06	0.59	HE

Summary of results shown in the above table indicates awareness of most items at a high extent. Grand mean of 3.06 and SD of 0.59 shows that laboratory attendants in secondary schools in Ebonyi State are aware of safety measures in the layout/organisation of science laboratories to a high extent.

HO<sub>1</sub>: There is no significant difference in the mean responses of science teachers and laboratory attendants on the extent of awareness of safety measures in the layout/organisation of science laboratories in secondary in Ebonyi State.

Table 3: T- test results based on awareness of safety measures in the layout/organisation of science laboratories

S/N	Variables	NO	$\bar{X}$	SD	DF	T.Cal	T.crit	Decision
1	Science teachers	135	3.61	0.79	178	4.91	1.96	Reject
	Laboratory attendants	45	2.97	0.62				
2	Science teachers	135	3.65	0.79	178	4.91	1.96	Reject
	Laboratory attendants	45	3.62	0.62				
3	Science teachers	135	3.62	0.78	178	4.74	1.96	Reject
	Laboratory attendants	45	3.04	0.47				
4	Science teachers	135	3.57	0.82	178	4.86	1.96	Reject
	Laboratory attendants	45	2.91	0.66				
5	Science teachers	135	3.56	0.76	178	4.36	1.96	Reject
	Laboratory attendants	45	3.00	0.56				
6	Science teachers	135	3.40	0.90	178	3.38	1.96	Reject
	Laboratory attendants	45	2.91	0.58				
7	Science teachers	135	3.49	0.86	178	3.38	1.96	Reject
	Laboratory attendants	45	3.97	0.65				
8	Science teachers	135	3.60	0.78	178	3.69	1.96	Reject
	Laboratory attendants	45	3.02	0.58				
9	Science teachers	135	3.24	1.11	178	4.54	1.96	Reject
	Laboratory attendants	45	2.86	0.69				
10	Science teachers	135	3.37	0.91	178	3.30	1.96	Reject
	Laboratory attendants	45	2.88	0.61				
11	Science teachers	135	3.51	0.88	178	3.95	1.96	Reject
	Laboratory attendants	45	2.97	0.45				
12	Science teachers	135	3.55	0.87	178	4.12	1.96	Reject
	Laboratory attendants	45	3.00	0.36				
13	Science teachers	135	3.53	0.86	178	4.35	1.96	Reject
	Laboratory attendants	45	2.93	0.58				
14	Science teachers	135	3.59	0.79	178	5.73	1.96	Reject
	Laboratory attendants	45	2.84	0.63				
	t-test value					4.14	1.96	Reject



Summary of data analysis shown in Table 3 indicates that all items were rejected as their t-calculated were greater than t-critical of 1.96 at 0.05 level of significance. Also the calculated t-test value of 4.14 is greater than t-critical of 1.96.  $H_0$  is therefore rejected, which implies that there is a significant difference in the mean responses of science teachers and laboratory attendants on the extent of awareness of safety measures required in the layout/organisation of science laboratories in secondary schools in Ebonyi State.

#### Discussion

Results of data analysis as presented in Tables 1 and 2 show that grand mean for science teachers and laboratory attendants are 3.52 and 3.06 respectively. Thus, they are quite aware of safety measures required in the layout of secondary school science laboratories. They are aware among others that there should be separate laboratory for various science subjects, that there should be pipes for flow of water, that lockers/benches should allow for movement of people, that power points for electricity should be earthed, that alarm bells/telephones should be in the laboratory, that gas cylinders should not be in the laboratory hall, that electrical appliances/sockets/switches should not be installed close to water taps/sinks. The implication of this is that awareness is not a hindrance to ensuring safety of people and materials in science laboratories in secondary schools in Ebonyi State. The finding is in line with Adigun (1999) who opined that science teachers should have a good knowledge of safety measures in the organisation of science laboratories.

On the test of hypothesis, the study also explored the extent to which the mean responses of science teachers and laboratory attendants differ in their awareness of safety measures required in the layout/organisation of science laboratories. The result in Table 3 indicates that the t-test-calculated of 4.14 is greater than t-critical of 1.96.  $H_0$  is therefore rejected. This means that there is a significance difference in the mean responses of science teachers and laboratory attendants on the extent of their awareness of safety measures required in the layout/organisation of science laboratories in secondary schools in Ebonyi State. The difference could be because of the difference in the education/training of science teachers and laboratory attendants. The science teachers are more educated or trained than the laboratory attendants.

#### Recommendations

The researchers recommended that the State Government should build on this high level of awareness to construct laboratories with the safety facilities in place. Each science subject should have its own laboratory while each laboratory should have separate store, preparatory room and activity hall. All the layout/organisational arrangement required for making science laboratories safe for users and the materials therein, should be put in place. Re-training of laboratory should be mounted increase the level of awareness of laboratory attendants to the need of safety. In these ways, the risks, danger and accidents will be highly minimized if not eliminated in the science laboratories across the secondary schools in Ebonyi state.

## Conclusion

Based on the results obtained on the extent of awareness of safety measures in the layout/organisation of science laboratories in secondary schools in Ebonyi state, the researchers concluded that science teachers and laboratory attendants in science laboratories in secondary schools in Ebonyi State are quite aware of safety measures required in the layout/organisation of science laboratories.

## References

- Adigun, A.O. (1999). *Evaluating adequacy of safety facilities in conducting secondary school/technology and science practicals*. 40<sup>th</sup> Annual Conference Proceeding of Science Teachers Association of Nigeria, 262-265.
- Allen, W.B., Henry, A.M., Albert, C.B., & Donald, C.B.(2003). *The new international Webster comprehensive dictionary of English language*. Columbia: Typhoon International Corps
- Ali, A. (1998). *Strategic issues and trends in science education in Africa*. Onitsha: Cape Publishers International Ltd.
- Aniodoh, H.C.A. (2001). *Modern aspect of integrated science education*. Enugu: Hacotam Educational Books
- Archenhold, W.F., Jenkins, E. , & Wood-Robinson, C. (1978). *School science laboratories. A handbook on design management and organisation*. London: John Murrah
- Bullon, (2005). *Longman dictionary of contemporary English*. Edinburgh: Pearson Education Publishers
- Ezeliora, B. (2001). *A guide to practical approach to laboratory management and safety precautions*. Enugu: Snaap press.
- Ibam, J.M., Ibrahim, M., & Idoko, E.A. (2008). *A survey of laboratory safety practices in secondary schools in Nsukka L.G.A*. An unpublished B.Sc (Ed) Project of the Department of Science Education University of Nigeria Nsukka.
- Igwe, I.O. (2003). *Principles of science and science teaching in Nigeria. (An introduction)*. Enugu: Jones communication publishers
- Ikoku, C., Ahmed M., & Joju E. (1984). *Laboratory exercises in chemistry*. Enugu: Fourth Dimension publishers
- Laboratory Safety, (2012) retrieved March 23, 2012 from <http://www.sesk/12./g/scs/curriculumgates>
- National Commission for Colleges of Education, (2012). *Minimum standards Nigeria certificate in education in sciences*. Abuja: N.C.C.E.