Extent of Safety Compliance in Secondary School Science Laboratories in Abakaliki Education Zone of Ebonyi State.

Oko, Kingsley Ikechukwu, Okpube, Nnaemeka Michael, Enyi, Paul Onyebuchi & Nwovu, Sunday Osmond

Department of Science Education, Faculty of Education Ebonyi State University, Abakaliki – Nigeria

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ABSTRACT

The focus of this study is to investigate the extent of safety compliance, in secondary school science laboratories in Abakaliki Education Zone of Ebonyi State. Two research questions and one hypothesis guided the study. The study employed descriptive survey design. This is to enable the researcher describe the extent of safety compliance and make decisions based on empirical evidence. The researcher used a total number of seventy-two (72) public secondary schools, out of 78 public secondary schools in the zone. This is because, six secondary schools out of 78 public secondary schools in the zone do not have science laboratory at the time of this research data collection. The researcher did not sample since, the number of secondary schools in the zone was not high. A four-point scale structured questionnaire developed by the researcher was used to collect data on the safety compliance. The instrument is made up of fourteen (22) items. Mean and standard deviation were used in answering the research questions while, Analysis of variance (ANOVA) was used to test the hypothesis at 0.05 level of significance. The results revealed that the extent of safety compliance in secondary school science laboratories in Abakaliki Education Zone of Ebonyi State was high. Based on the findings of the study, the researcher therefore, recommended that Government of Ebonyi State and school authorities should keep up the present level of laboratory safety compliance in secondary school science laboratories in the state by collaborating with curriculum developers to review the existing curriculum and integrate the basic tenets of laboratory safety measures in the curriculum.

Keywords: safety, safety compliance, science and science laboratory.

INTRODUCTION

Science makes life easy and improves the standard of living. For science to strive well, it requires well equipped and standard laboratories. The study of nature and natural phenomena is referred to as science. Mbajiorgu (2021) stated that the study of nature and natural phenomena deals with experimental approach of physical measurable and observable quantities. Science is a vital tool to every developing country or nation as supported by Nwana, Bajah and Obioha (2021); that professions such as agriculture, dentistry, engineering, geology, medicine, astronomy, space, exploration and pharmacy would be difficult to develop without science education. Science education subjects include physics, biology and chemistry. Instruction that is student-centered and emphasizes the role of laboratory demonstrations and experiments is the best method to ensure students develop the essential skills of science (Mbajiorgu, 2021).

Allen, Henry, Albert and Donald (2021) described laboratory as a building or room fitted up for conducting scientific experiments, analysis or similar works. Laboratory is thus a workshop for scientists. Igwe (2023) stated that, science laboratory is a facility for learning what science is and its application by scientists. It can be in-door like well-designed and equipped rooms found in most secondary schools or out-door involving places such as riverside, work shop, field and even market. This means that laboratory experience could be attained either in-door or out-door, which implies providing opportunity for students to develop the understanding of practical and theoretical concepts through solving problems by participation in series of experimental, observational and demonstrating activities. Therefore, science laboratory is a special facility for teaching science through research evidence in secondary school science in general (Igwe, 2023). The laboratory serves as the basic practical

framework for carrying out laboratory activities (that is, the study of science concepts, using the scientific method of problem definition, theorizing, testing and so on).

Nwanuma (2021) opined that laboratory activities are expected to enable students obtain the scientific methods of doing science as well as to help them develop more favorable attitudes. Nwanuma (2021), further states that such science laboratories should be relatively safe for those using it as well as the materials, chemical and tools which are stored and used in the science laboratories. Thus, a laboratory is safe if it does not in any way constitute hazard to health, life and property while being used for teaching and learning.

The use of laboratory requires extreme carefulness in order not be involved in accident or hazard. Ibam, Ibrahim and Idoko (2021) stated that the use of laboratories is liable to hazards due to the presence of chemicals and dangerous equipment not properly handled by laboratory users. Laboratory hazards and risks are many and varied as reported by Nkwegu (2023) and include exposition to poison, burns, infection, explosion and stains. Other causes of laboratory accidents he outlined include the following; distraction, poor storage of materials and equipment, failure to use protective items for safety, the use of worn-out equipment. Adigun (2022) reported that laboratory accidents are in some cases inevitable; they may in most other cases be minimized or completely avoided if adequate emphasis is placed on correct laboratory safety measures.

Working with safety ensures achieving purpose without damage of any kind, injury or accident. Ali (2023) stressed that safety implies that students, teachers and other laboratory users are not injured or killed, stating that materials and equipment in the laboratory are not damaged during use. Allen, Henry, Albert and Donald (2021) posited that safety refers to the state of being protected from or unlikely to cause danger, risk or injury. Okorie (2023), opined that appropriate safety measures to prevent hazards while making use of the laboratory should be uppermost in priority. Stating that, laboratory users who are not conscious of safety in the laboratory may expose themselves to dangers, hazards or accidents. For laboratories to be safe, it must have safety measures put in place and enforced. Ikoku, Ahmed and Joju (2023) observed that lack of qualified and dedicated teachers and lack of safety facilities such as fire extinguishers, protective eye glass or goggle, safety shoes, fume cupboards among others threaten the safety of those who use the laboratory. Igwe (2023) reported that cases of accidents in Nigerian secondary schools are inevitable during laboratory activities.

To prevent continuous exposure of laboratory users to laboratory hazards, Hayble (2021), opined that laboratory safety measures must be utmost in priority. The teacher should take note of possible accidents which could occur in a given situation and appropriate action to be taken to avoid any unfortunate event, when planning practical for science laboratory work. Hayble (2021), maintained that most reagents and dangerous instruments should have hazard signs placed on them and the safety measures or precautions of usage clearly enumerated in the manual to assist the user.

Despite the various sources of hazards in the laboratory, Duru (2023) believed that working in the laboratory is a very safe place to work. He opined that, making use of laboratory safety wears like gloves, safety glasses and laboratory coat could prevent contamination of the body with chemicals. Science teachers have the responsibility to develop safety conscious attitude in the students by creating awareness of the hazards involved in any laboratory as well as the rules and procedures guiding a particular activity. Nadino (2022), posited that science teachers must be knowledgeable on the required safety measures needed in each laboratory activity, know procedures and potential hazard associated with the use of laboratory materials. Also, Ibam, Ibrahim and Idoko (2021), advised that science students and teachers should acquire the skills for safety measures in the laboratory. Such skills include the skill of proper storage of chemicals, skill on the use of various safety instruments, skill in the disposal of laboratory wastes, skill in the management of emergency situations, personal practices in the laboratory. Ibam, Ibrahim and Idoko (2021), also pointed out that every laboratory should have safety instruments.

Safety is the state of being protected from harm or danger. Safety can also refer to the control of known hazard in order to minimize the rate of risk. Flinn (2022) is of the view that laboratory safety deals with the development of skills and responsibility involving every laboratory user which must be integrated into science laboratory curriculum. This implies that safety measures must be integral part of each laboratory course including research with increasingly broader scope at more advanced levels.

Safety compliance refers to the act of adhering to established safety standards, regulations, and laws to protect students, teachers, and other laboratory users from harm including its environment (Aniodoh, 2022). It involves implementing policies, procedures, and training programs to ensure a safe and healthy work environment.

The development of laboratory safety compliance involves total commitment from all levels of the educational sector. At the administrative level, this will include putting a decision or plan into effect such as execution of a chemical hygiene plan which must address the safe handling, storage, and disposal of chemicals. Eye wash and showers should be available and also, in good working condition. A conducive laboratory working environment were risks and accidents, such as loss of life, fire hazard, electrocution among others, are avoided through carefulness and total safety compliance should be a concern to all users. Hence, the need for this investigation.

Statement of the Problem

A lot of risks are involved during laboratory practical class, which needs to be addressed. Otherwise, there would be casualty of students and teachers in the laboratory. When safety rules are not obeyed, laboratories are not safe; they pose danger to teachers and students and other laboratory users. Surely, not much will be achieved if our present and future scientists are expected to work in laboratories that safety is neglected. Amber (2019), reported that research assistant died from burns sustained in a university science laboratory in California, when the plunger popped out of the syringe, she was using to transfer tert-buty lithium. This ignites spontaneously in air, causing her gloves and jumper to catch fire. He also recorded that, another research assistant, died in Yerkes Regional primate research center in Georgia due to a chance splash of primate fluids. Because he did not use safety glasses, a piece of material contaminated with herpes B virus (probably urine or feces) got into her eye and she died six weeks later. Nwanuma (2021), reported that Ikwo High School science laboratory of Ebonyi State was once partially burnt as a result of carelessness, improper lighting of the Bunsen burner and lack of fire safety equipment. For laboratory users and equipment to be free from all these hazards, safety compliance must be in place and enforced.

Objectives

To ascertain the extent of safety compliance available in Secondary school Laboratory in Abakaliki Education Zone?

To ascertain the extent of safety compliance available based on subject area in Secondary school Laboratory in Abakaliki Education Zone?

Research Questions

The following research questions guided the study

What is the extent of safety compliance available in secondary school laboratory in Abakaliki Education Zone?

What is the extent of safety compliance available based on subject area in Secondary school Laboratory in Abakaliki Education Zone?

Hypotheses

Ho_1: The extent of safety compliance available in secondary school laboratory in Abakaliki Education Zone is not significantly different based on subject areas.

Research Method

The study employed descriptive survey design. The research was carried out at Abakaliki Education Zone of Ebonyi State. The population of the study is 78 science laboratories consisting of 335 science teachers in secondary schools in Abakaliki Education Zone of Ebonyi State. Statistical data available based on 2018/2019 academic year, Biology has 153 teachers; Chemistry has 112 teachers, while Physics has 70 teachers. The researcher did not sample but, made use of 72 schools which have science laboratory. This means 6 out of the

78 secondary schools did not have science laboratory. The instrument used for the collection of data for this study is structured questionnaire and an observational schedule developed by the researcher. The instrument is titled Safety Compliance Assessment Questionnaire (SCAQ). The Instrument has 14 items. The instrument was face validated by five experts from the department of science education, one from measurement and evaluation, one from biology education, one from chemistry education and two from physics education. The face validation scrutinized the items in terms of standard, format, clarity as well as content coverage. Cronbach Alpha statistics was used for the computation of the reliability of the instrument which yielded a coefficient of 0.71.

From the data generated, mean and standard deviation were used in answering the research questions, while the entire hypotheses were tested at an Alpha level of 0.05 using analysis of variance (ANOVA).

RESULTS

Research Question 1

Table 6: Mean extent of compliance to safety measures in Secondary school Laboratory in Abakaliki Education Zone

N=72

SN	Safety Measures	Mean	SD	Remarks
30	Avoid playing in the laboratory	2.65	0.89	HE
31	Avoid running in the laboratory	2.81	0.78	HE
32	Avoid fighting in the laboratory	2.93	0.78	HE
33	Avoid eating in the laboratory	2.75	0.87	HE
34	Avoid high heeled shoes	2.47	0.86	HE
35	Avoid wearing of dangling jewelry	2.65	0.81	HE
36	Avoid sitting on lab benches	2.89	0.66	HE
37	Avoid unauthorized experiments	3.53	0.53	VHE
38	Use of safety goggles	2.90	0.73	HE
39	Use of hand gloves	3.10	0.65	VHE
40	Use of laboratory coats	3.32	0.67	VHE
	Grand Mean	2.90	0.74	HE

Summary of result presented in table 6 above, shows that item 30, 31, 32, 33, 34, 35, 36, and 38 are at high extent while, item 37,39 and 40 are at very high extent in secondary school laboratory in Abakaliki Education Zone, Ebonyi State. The grand mean of 2.9 and SD of 0.74 indicate that compliance to safety measures in Secondary school Laboratory in Abakaliki Education Zone is at high extent.

Table 7: Mean extent of compliance to safety measures based on subject areas in Secondary school Laboratory in Abakaliki Education Zone

SN	Safety Measures	Subject Areas	N	Mean	SD	Remarks
30	Avoid playing in the laboratory	Biology	30	2.80	0.76	HE
		Chemistry	20	2.60	1.14	HE
		Physics	22	2.50	0.80	HE
31	Avoid running	Biology	30	3.07	0.74	VHE

		Chemistry	20	2.70	0.86	HE
		Physics	22	2.55	0.67	HE
32	Avoid fighting	Biology	30	3.30	0.65	VHE
		Chemistry	20	2.80	0.77	HE
		Physics	22	2.55	0.74	HE
33	Avoid eating	Biology	30	3.00	0.91	VHE
		Chemistry	20	2.70	0.92	HE
		Physics	22	2.45	0.67	HE
34	Avoid high heeled shoes	Biology	30	2.67	0.80	HE
		Chemistry	22	2.15	0.81	HE
		Physics	22	2.50	0.91	HE
35	Avoid wearing dangling jewelries	Biology	30	2.83	0.65	HE
		Chemistry	20	2.45	0.94	HE
		Physics	22	2.59	0.85	HE
36	Avoid sitting on lab benches	Biology	30	2.90	0.61	HE
		Chemistry	20	2.90	0.72	HE
		Physics	22	2.86	0.71	HE
37	Avoid unauthorized experiments	Biology	30	3.50	0.57	VHE
		Chemistry	20	3.40	0.50	VHE
		Physics	22	3.68	0.48	VHE
38	Use of safety goggles	Biology	30	3.00	0.59	VHE
		Chemistry	20	2.75	0.85	HE
		Physics	22	2.90	0.81	HE
39	Use of hand gloves	Biology	30	3.27	0.52	VHE
		Chemistry	20	2.85	0.75	HE
		Physics	22	3.09	0.68	VHE
40	Use of laboratory coats Grand Mean	Biology	30	3.43	0.57	VHE
		Chemistry	20	3.25	0.72	VHE
		Physics	22	3.23	0.75	VHE
				2.98	0.74	HE

Based on the results in table 7, item 30 have it that Biology, Chemistry and Physics are all present at high extent. In item 31 Biology is at very high extent while, Chemistry and Physics are all present at high extent. In item 32 Biology is at very high extent while, Chemistry and Physics are all present at high extent. In item 33 Biology is at very high extent while, Chemistry and Physics are present at high extent. In item 34, 35 and 36 Biology, Chemistry and Physics are all present at high extent. In item 37 and 40 Biology, Chemistry and Physics are all present at very high extent. In item 38 Biology is at very high extent while, Chemistry and Physics are present at high extent. In item 39 Biology and Physics are present at very high extent while, Chemistry is at high extent. This cluster yielded a grand mean of 2.98 and SD of 0.74 which indicate that compliance to safety measures based on subject areas in Secondary school Laboratory in Abakaliki Education Zone is at high extent.

Hypothesis Testing

H0: The level of compliance to safety measures in secondary school Laboratory in Abakaliki Education Zone is not significantly different based on subject areas

Table 10: test of significance of difference of levels of compliance to safety measures based on subject areas in Secondary school Laboratory in Abakaliki Education Zone

SN	Safety Measures	Source	DF	Sum of Squares	Mean Squares	F.ratio	F. prob	Decision
30	Avoid playing in the laboratory	Between Group	2	1.22	0.61	0.76	0.47	Not Sig.
		Within Group	69	55.10	0.80			
		Total	71	56.32				
31	Avoid running	Between Group	2	3.76	1.88	3.28	0.43	Not Sig.
		Within Group	69	39.52	0.57			
		Total	71	43.28				
32	Avoid fighting	Between Group	2	7.70	3.85	7.60	0.00	Significant
		Within Group	69	34.94	0.51			
		Total	71	42.65				
33	Avoid eating	Between Group	2	3.85	1.92	2.67	0.76	Not Sig.
		Within Group	69	49.65	0.72			
		Total	71	53.50				
34	Avoid high heeled shoes	Between Group	2	3.23	1.61	2.29	0.11	Not Sig.
		Within Group	69	48.72	0.71			
		Total	71	51.94				
35	Avoid wearing dangling jewelries	Between Group	2	1.88	0.94	1.46	0.24	Not Sig.
		Within Group	69	44.43	0.64			
		Total	71	46.32				
36	Avoid sitting on lab benches	Between Group	2	0.02	0.10	0.02	0.98	Not Sig.
		Within Group	69	31.09	0.45			

		Total	71	31.11				
37	Avoid unauthorized experiments	Between Group	2	0.87	0.44	1.58	0.21	Not Sig.
		Within Group	69	19.07	0.28			
		Total	71	19.94				
38	Use of safety goggles	Between Group	2	0.75	0.38	0.69	0.51	Not Sig.
		Within Group	69	37.57	0.54			
		Total	71	38.32				
39	Use of hand gloves	Between Group	2	2.08	1.04	2.55	0.09	Not Sig.
		Within Group	69	28.23	0.41			
		Total	71	30.32				
40	Use of laboratory coats	Between Group	2	0.67	0.34	0.75	0.48	Not Sig.
		Within Group	69	30.98	0.45			
		Total	71	31.65				
	ANOVA Value					2.15	0.38	Not Sign

Summary of data analysis presented in table 10 indicates that item 30,31, 33,34,35,36,37,38,39 and 40 were not significant because their individual F. Probability value is greater than Alpha level 0.05. While, item 32 is significant because its F. Probability value is less than 0.05 Alpha levels. This cluster yielded AVOVA value of 0.38. this implies that levels of compliance to safety measures based on subject areas in Secondary school Laboratory in Abakaliki Education Zone is significant.

DISCUSSION OF FINDINGS

Findings on level of compliance to safety measures show that laboratory users in secondary schools in Abakaliki Education Zone, of Ebonyi State comply with required safety measures at high extent in the use of safety goggles, hand gloves, laboratory coats and avoiding of unauthorized experiments. While, comply at high extent with not playing, fighting, eating, sitting on laboratory benches, wearing of high heeled shoes and dangling jewelry.

This is in line with the recommendations of Adigun (2015) that science teachers should ensure strict adherence to laboratory rules and regulations. It is also in line with Nwanna, Baja and Obioha (2010) that science teachers should ensure that safety rules and regulations in science laboratories are observed by students. On the other hand, it is contrary with the findings of Ibiam, Ibrahim and Idoko (2008) that there are poor laboratory safety practices or non-compliance to safety measures in secondary schools in Nsukka Local Government Area of Enugu State.

Also, findings on level of compliance to safety measures based on subject areas in Secondary school Laboratory in Abakaliki Education Zone reveal that laboratory users in secondary schools in Abakaliki Education Zone, Ebonyi State comply with required safety measures based on various subject areas at high extent in the use of safety goggles, hand gloves, laboratory coats and avoiding of unauthorized experiments. While, compliance is at high extent with avoiding playing, wearing of high heeled shoes, dangling jewelry and sitting on lab benches

in Biology, Chemistry and Physics laboratories. Avoiding running and eating in the laboratory is at very high extent in Biology laboratory while is at high extent in Chemistry and Physics laboratories.

SUMMARY OF FINDINGS

The extent of compliance of laboratory users in secondary school science laboratories Abakaliki Education is at high extent.

The extent of compliance of laboratory users based on subject areas in secondary school science laboratories in Abakaliki Education is at high extent.

CONCLUSION

Safety is very necessary in all human activities to safeguard lives and property. Therefore, laboratory safety compliance are essential for the safety of both teachers and students during laboratory activities. Though, the study showed high laboratory safety compliance, but not same with other schools in different areas. Since, laboratory safety compliance deals with the safety of lives and property, it should be a must in all science laboratories.

RECOMMENDATIONS

Based on the findings of this study, the researcher made the following recommendations:

The state government in collaboration with curriculum developers and science teachers should review the existing curriculum and integrate the basic tenets of laboratory safety compliance and enforcement in the curriculum. Science teachers and administrators should ensure laboratory safety procedures and precautionary measures are followed during laboratory activities. Both teachers and students should be encouraged and sponsored for in-service science laboratory safety training.

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