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## Identifying Issues Concerning the Conduct of Laboratory Activities in Science in Nigeria Certificate in Education (NCE) Program in Nigeria

**Kenneth Chika Agaba, Mathias Nnadozie Ugwu**

### Abstract

Laboratory activities are part and parcel of learning activities for students studying science subjects in Nigeria Certification in Education (NCE) program in Nigeria. The study focused on identifying issues as it relates to the conduct of practical in science in NCE program in Nigeria. Primarily, the study looked at compliance with safety measures, teachers' instructional approaches, students' attitude towards laboratory activities, and the availability of laboratory facilities. The population of the study consisted of all the students' studying science subjects in NCE program in Nigeria. The sample size was 129 students selected by purposive sampling method. The design was a survey. The data collection instrument was a questionnaire. Four (4) research questions guided the study. Data analysed with mean. The issues identified were students do not comply with necessary laboratory safety measures, and laboratory facilities were inadequate. However, non-issues identified in the study were that students exhibited positive attitudes towards laboratory activities, and teachers apply appropriate instructional strategies in conducting laboratory activities. Based on the issues discovered, the researchers recommended, among others, that science teachers should organise awareness programs on laboratory safety for the students. Also, the authorities of the schools should provide adequate facilities for the science laboratories for a smooth running of laboratory activities.

**Keywords:** Attitude, instructional strategy, laboratory activity, laboratory safety, Nigeria Certificate in Education

### 1. Introduction

Science is both a body of knowledge (product) and a way of knowledge searching (process). One aim of science education is to help learners acquire an understanding of scientific knowledge and to achieve that, learners participate in laboratory activities. Teachers guide the learners to make observations, test hypothesis, laws and theories, analyse data, conduct experiments, draw conclusions and make generalisations. In other words, the students' engage in doing science. However, a school laboratory is not a research laboratory for discoveries of new ideas. Instead, a range of planned activities are undertaken by the learners to acquire a deep understanding of scientific knowledge such as laws and theories. Laboratory activity in a school per se is a teaching and learning process where the science teacher guides the learners to achieve well-defined objectives. <sup>[1]</sup> Opined that laboratory experiences enhance learners understanding of concepts of science, application and acquiring practical skills, as well as understanding science processes and how scientists work. In a study, <sup>[2]</sup> found out that the use of the laboratory helps learners develop scientific attitudes and scientific skills for solving problems.

Learners cannot carry out any meaningful activity in the school laboratory without adequate facilities. A building or an empty room apartment does not constitute a science laboratory, but what makes them a science laboratory is the availability of appropriate facilities. The facilities are necessary to do science. A significant hindrance to the study of science at school level in Nigeria is the inadequacy of facilities. For example, <sup>[3]</sup> found out in a survey that laboratory facilities are not adequate to teach chemistry in schools in Calabar, Nigeria. Similarly, <sup>[4]</sup> discovered in a study that laboratory facilities are not available entirely or where they are available they are not used for the study of biology and chemistry in

secondary schools in Yobe State, Nigeria. Inadequacy of facilities in a school laboratory hinders the smooth running of laboratory activities. It deprives learners the opportunity to acquire the expected skills and knowledge.

The school science laboratory is a potentially dangerous learning environment. Injuries such as burns and cuts or even death may result if users of the laboratory fail to comply with the rules or if appropriate safety precautions not taken. Injuries and death may come from hot apparatus, scalpels or razors, electrical equipment, chemicals, leaking gas cylinders, among others. Teachers of science are worried that students fail to comply with necessary laboratory safety precautions such as wearing safety goggles and face shields, and following teachers instructions while engaged in laboratory activities. [5] showed in a study that there are hazards in the science laboratories in schools in Ekiti State, Nigeria and little or no precautions are taken to prevent them. A school science laboratory is a friendly and safe environment for students, especially when necessary basic safety precautions taken.

A laboratory activity in a school is a teaching and learning process. The teacher guides the students while employing appropriate instructional strategies to achieve the objectives of the activity. Instructional strategy defines the approaches a teacher adopts to accomplish the stated instructional goals. However, teachers' awareness and application of appropriate instructional methods are essential. Problems still arise in the choice and proper utilisation of instructional strategies. [6] found out that science teachers in secondary schools in Benue State, Nigeria are aware of innovative approaches. Still, the teachers effectively utilise only a few of the strategies. Similarly, [7] concluded after a study that some teachers in Nigeria secondary schools find it challenging to use instructional strategies and how the teachers approach the teaching do not promote teaching and learning. The science teacher applies appropriate strategies for instruction and to achieve a meaningful and successful laboratory activity.

The Oxford Advanced Learners Dictionary defines attitude as the way an individual behaves towards something or somebody. The approach of students towards laboratory activities is of much importance to the teaching and learning of science in Nigeria schools. [8] found out that students have a positive attitude towards the theory of practical in WAEC practical chemistry in Zaria Inspectorate Division of Kaduna State, Nigeria. The study, as mentioned above, implies that the students show a positive attitude towards the theory of practice in preference to practical done in the laboratory. In another study, [9] observed that students attitude towards laboratory activities in physics in secondary schools in Ekiti State, Nigeria is related to lack of interest and annoyance during practical classes. Opinions of learners to laboratory activities vary from learner to learner; at the same time, one student may show a positive attitude, another may indicate an adverse reaction. However, a positive attitude promotes learning, while a negative attitude does not.

Colleges of education and some colleges of technology in Nigeria run Nigeria Certificate in Education (NCE) program. In these institutions, students study science like physics, chemistry, biology or integrated science. Laboratory activities are a part of the requirements of the study and to enable students to gain the skills of doing science and in-depth knowledge and understanding of the

contents of the subjects. In the present study issues about laboratory safety, teachers' instructional approaches, availability of laboratory facilities, and attitude of students towards laboratory activities as they concern the conduct of laboratory activities in NCE program identified. Students are active participants and recipients of the teaching-learning process, and they know the current state of affairs in the school science laboratory. Therefore, the researchers relied upon the opinions of students.

## 2. Purposes of the study

The goals of the study are as follows:

- To find out the extent to which science students of NCE program in Nigeria comply with laboratory safety measures.
- To find out the extent to which facilities are available in the NCE program for laboratory activities in science in Nigeria.
- To find out the extent to which science teachers in NCE program in Nigeria apply appropriate instructional approaches for laboratory activities.
- To find out the attitudes science students in NCE program in Nigeria have towards laboratory activities.

## 3. Research questions

The following questions guided the study:

- To what extent do science students of NCE program in Nigeria comply with laboratory safety measures?
- To what extent are facilities available in the NCE program for laboratory activities in science in Nigeria?
- To what extent do science teachers of NCE program in Nigeria apply appropriate instructional approaches for laboratory activities?
- What is the attitude of students of NCE program towards laboratory activities?

## 4. Research methods

**4.1 Design of the study:** The design of the study was a descriptive survey.

**4.2 Area of the study:** The researchers did the study at a college of education in the South East of Nigeria.

**4.3 The population of the study:** Population of the study consisted of all students studying science subjects in NCE program in Nigeria.

**4.4 Sample and sampling techniques:** One-hundred and twenty-nine (129) students constituted the study sample. The students were the third-year students of integrated science education, and they were purposively selected. The third-year students had participated in laboratory activities for six semesters in contrast to first and second-year students. The latter had very few experiences in laboratory activities. Hence, the third-year students were better suited to respond to the questionnaire items. The selected students (sample) were from integrated science education since the students carry out laboratory activities in science subjects like biology, chemistry and physics.

**4.5 The instrument for data collection:** The tool was a structured questionnaire. It was composed of sections 'A' and 'B'. Section 'A' requested for the department and year of the respondents. The department and year of the students

were included to ensure response by the right respondents. Section ‘B’ also organised in clusters. Cluster ‘A’ consisted of twenty (20) question items intended to find out the extent to which science students of NCE program in Nigeria comply with laboratory safety measures. Cluster ‘B’ consisted of twelve (12) question items to determine the extent to which facilities are available for activities in the science laboratories. Cluster ‘C’ contained fifteen (15) question items intended to find out the extent to which science teachers apply appropriate instructional approaches during activities in the laboratory. Cluster ‘D’ comprised thirteen (13) question items meant to find out the attitudes of students towards laboratory activities. Two (2) science educationists and one (1) expert in measurement and evaluation validated the questionnaire. The researchers incorporated all the recommendations of the validations into the final copy of the questionnaire. The researcher prepared the questionnaire instrument according to four-point Likert scale: Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD), with the rankings 4, 3, 2 and 1 respectively.

**5. Data collection procedure (Administration of the questionnaire)**

The researcher distributed the questionnaire to the respondents for a response to the items. Some respondents responded to the questions and handed in the instrument immediately while some handed in theirs later. The researchers collected a total of sixty (60) completed copies of the questionnaire from the respondents.

**6. Methods of data analysis**

The analytic instrument was mean. The researcher calculated the mean using the formula below:

$$\text{Mean } (\bar{X}) = \frac{\text{Total score}}{\text{Number of respondents}}$$

$$\text{Grand mean} = \frac{\text{Total mean}}{\text{Number of items}}$$

The researcher calculated the mean of rankings for SA, A, D, and SD, that is 4, 3, 2, 1. That was done by summing up 4, 3, 2 and 1 to get 10. The number 10 was divided by 4 to get a mean of 2.50. Based on mean of 2.50 decision rules were stated for the four clusters as follows:

Cluster 1: If the mean of a question item is equal to or higher than 2.50 accept, but if less than 2.50 reject. If the grand mean is equivalent to or higher than 2.50, conclude students comply with laboratory safety measures, but if less than 2.50 conclude students do not comply with laboratory safety measures.

Cluster 2: If the mean of a question item is equal to or higher than 2.50 accept, but if less than 2.50 reject. If the grand mean is similar to or higher than 2.50, conclude facilities are adequate for laboratory activities, but if less than 2.50 conclude facilities are inadequate for laboratory activities.

Cluster 3: If the mean of a question item is equal to or less than 2.50 accept, but less than 2.50, reject. If the grand mean is equivalent to or higher than 2.50 conclude teachers apply appropriate instructional approaches, but if less than 2.50 decide that teachers do not use appropriate instructional methods for laboratory activities.

Cluster 4: If the mean of a question item is equal to or higher than 2.50 accept, but if less than 2.50 reject. If the grand mean is equivalent to or higher than 2.50 decide students exhibit positive attitudes towards laboratory activities, but if less than 2.50 conclude that students show negative attitudes towards laboratory activities.

The researchers calculated the mean of the responses for a question item in every cluster. The researchers did this by multiplying the number of responses for SA, A, D, SD by 4, 3, 2, and 1 rankings respectively. The sum of the answers obtained in the calculation above gave a score for a question item. Dividing the score for a question item by the total number of respondents gave a mean score for the item. A decision was taken about the question item by the position of the mean in the scale, either equal to or higher than or less than 2.50. To get the grand mean of a cluster, the sum of all the means of all the question items in a cluster was found by the researchers. This sum gave the total mean score for the cluster. Dividing the total mean score by the number of question items in the cluster gave the grand mean. A conclusion was reached about the research question by the position of the grand mean in the scale, either equal to or higher than or less than 2.50.

**7. Results**

Research question 1: To what extent do science students of NCE program comply with laboratory safety measures?

**Table 1:** Summary of responses to students’ compliance with safety measures in the laboratory.

S/N	ITEMS	SA (4)	A (3)	D (2)	SD (1)	TS	N	$\bar{X}$	D
1	I do not mind eating food in the laboratory during activities	2	4	14	40	88	60	1.47	R
2	I use any equipment, reagent or specimen without teachers’ permission.	6	2	22	30	104	60	1.73	R
3	I see wearing protective equipment like safety goggles unnecessary.	5	7	11	37	180	60	1.67	R
4	I do not mind using broken glassware to perform my activities.	4	4	18	34	98	60	1.63	R
5	I do not report to the laboratory technicians or the teachers when equipment is faulty or broken.	2	5	23	30	97	60	1.65	R
6	Sometimes I taste or smell chemicals directly.	4	5	12	39	94	60	1.57	R
7	I fix my eyes just above the test tube to see what is going on inside the test tube.	3	4	16	37	93	60	1.55	R
8	Sometimes I sit on the benches.	20	18	18	4	174	60	2.90	A
9	I sometimes play in the laboratory, especially when the session is extended too far.	1	4	12	43	83	60	1.38	R
10	I use a beaker for drinking water when I am thirsty in the laboratory.	1	2	6	51	73	60	1.22	R
11	After laboratory activity, I do not remember washing my hands before eating food.	22	14	12	12	176	60	2.93	A
12	Most times, I forgot to wear a laboratory suit.	25	12	13	10	172	60	2.87	A

13	Sometimes I heat materials while facing the test tube directly on another student.	3	2	15	40	88	60	1.47	R
14	I see wearing protective hand gloves for activities in the laboratory as unnecessary.	28	7	14	11	172	60	2.87	A
15	When I am injured while working in the laboratory, I hardly inform the teacher or to any staff.	25	13	10	12	174	60	2.90	A
16	I cannot do without wearing high heels into the laboratory.	1	4	8	47	79	60	1.32	R
17	I do not report any faulty equipment or danger in the laboratory to the teacher.	17	18	13	12	160	60	2.67	A
18	I am aware of safety measures and rules and regulations governing laboratory use.	2	9	9	40	93	60	1.55	R
19	I sometimes perform activities without following teachers' instructions.	22	14	8	16	162	60	2.70	A
20	I can use a chemical even when it is not labelled.	16	20	11	13	159	60	2.65	A
	<b>Total</b>							<b>40.13</b>	
	<b>Grand mean</b>							<b>2.01</b>	

SA: strongly agree; A: agree; D: disagree; SD: strongly disagree; TS: total score; N: number of respondents;  $\bar{X}$ : mean; D: decision.

Table 1 indicated the grand mean is 2.01 (table 1), which is less than 2.50. As such, the conclusion is that science

students of NCE program do not comply with laboratory safety measures.

Research question 2: To what extent are facilities available in the NCE program in Nigeria for laboratory activities in science?

**Table 2:** Summary of responses on availability of facilities for laboratory activities in science in NCE program.

S/N	ITEM	SA (4)	A (3)	D (2)	SD (1)	TS	N	$\bar{X}$	D
1	My department has a laboratory.	18	22	10	10	168	60	2.80	A
2	The departmental laboratory adequately equipped with facilities.	7	10	13	30	114	60	1.90	R
3	Appropriate types of equipment provided for laboratory activities.	9	11	14	26	143	60	2.38	R
4	Sometimes we use improvised equipments for practical.	11	21	23	5	158	60	2.63	A
5	In most cases, we use functional instruments.	6	12	12	30	114	60	1.90	R
6	Reagents and specimen are always provided by the teacher for laboratory activities.	7	12	10	31	115	60	1.92	R
7	Our laboratory is under-equipped.	7	10	20	23	121	60	2.02	R
8	Most of the pieces of equipment are faulty.	17	20	13	10	164	60	2.73	A
9	I find it challenging to manipulate most of the instruments.	33	16	11	0	192	60	3.20	A
10	Most of the instruments we use for practical are outdated.	15	20	15	10	160	60	2.67	A
11	Most of the laboratory instruments are modern.	5	13	23	19	124	60	2.07	R
12	Most of the instruments measure with high precision.	9	8	20	23	123	60	2.05	R
	<b>Total</b>							<b>28.27</b>	
	<b>Grand mean</b>							<b>2.36</b>	

SA: strongly agree; A: agree; D: disagree; SD: strongly disagree; N: number of respondents; TS: Total score;  $\bar{X}$ : mean; D: decision.

The grand mean of the responses (table 2) was 2.36. As the grand mean is less than 2.50, the conclusion is that facilities

are not adequate for laboratory activities in science.

Research question 3: To what extent do science teachers of NCE program in Nigeria apply appropriate instructional approaches for laboratory activities in science?

**Table 3:** Summary of responses to application of appropriate instructional approaches for laboratory activities by science teachers.

S/N	ITEM	SA (4)	A (3)	D (2)	SD (1)	TS	N	$\bar{X}$	D
1	Teachers' use new strategies to conduct laboratory activities.	10	7	25	18	129	60	2.15	R
2	Teachers' approaches make activities interactive.	15	8	21	16	142	60	2.37	R
3	Students carry out enquiry activities in the science laboratory.	8	14	18	20	130	60	2.17	R
4	My teachers often apply traditional lecture method for laboratory activities.	19	10	20	21	177	60	2.95	A
5	The teachers make use of instructional materials for laboratory activities.	10	10	19	21	129	60	2.15	R
6	Teachers' methods make activities dull.	15	20	22	3	167	60	2.78	A
7	The teachers' allow the students' to handle instruments.	10	20	20	10	150	60	2.50	A
8	Teachers' do not encourage cooperation and collaboration among students during activities.	15	10	25	10	150	60	2.50	A
9	Laboratory technologists and technicians guide students when performing activities in the laboratory	20	15	10	15	170	60	2.83	A
10	Students prepare reagents for their activities by themselves.	10	20	15	15	145	60	2.42	R
11	Teachers evaluate students according to their level of participation in laboratory activities.	30	15	10	5	190	60	3.17	A
12	In most cases, students work in groups.	25	15	10	10	175	60	2.92	A
13	Students mainly work individually.	15	20	15	10	160	60	2.67	A
14	Teachers usually demonstrate activity before students carry out the	5	10	25	20	120	60	2.00	R

	operation.								
15	Teachers allow students get guides from the laboratory manual.	20	10	20	10	160	60	2.67	A
	<b>Total</b>							<b>48.25</b>	
	<b>Grand mean</b>							<b>3.22</b>	

SA: strongly agree; A: agree; D: disagree; SD: strongly disagree; N: number of respondents; TS: Total score;  $\bar{X}$ : mean; D: decision.

Table 3 shows the grand mean is 3.22, which is higher than

2.50. This observation implies that science teachers apply appropriate approaches during laboratory activities.

Research question 4: What is the attitude of students of NCE program towards laboratory activities?

**Table 4:** Summary of responses on students' attitudes' towards laboratory activities in NCE program.

S/N	ITEM	SA (4)	A (3)	D (2)	SD (1)	TS	N	$\bar{X}$	D
1	Laboratory activity is unusual to me.	30	15	5	10	185	60	3.08	A
2	I dislike participating in laboratory activities.	9	30	15	6	162	60	2.70	A
3	I regularly attend practical classes.	19	33	0	8	183	60	3.05	A
4	Most of the time, I come late for laboratory activities.	10	18	16	16	142	60	2.37	R
5	Most of the time I come early for practical classes	13	21	20	6	161	60	2.68	A
6	I seldom attend practical classes.	27	13	7	13	174	60	2.90	A
7	I implement teacher's instructions during laboratory activities.	30	5	14	11	174	60	2.90	A
8	I enjoy performing experiments together with fellow students during practical classes.	18	12	16	14	184	60	2.75	A
9	I enjoy performing activities the laboratory.	10	8	22	20	128	60	2.13	R
10	I follow the guides of laboratory technologists and technicians.	20	8	19	13	155	60	2.58	A
11	I dislike handling chemicals for fear of injury.	30	25	5	0	205	60	3.42	A
12	I dislike handling living or dead animal specimen.	33	18	8	4	206	60	3.43	A
13	I hate participating in science laboratory activities as much time is spent in the process.	8	9	24	21	128	60	2.13	R
	<b>Total</b>							<b>35.94</b>	
	<b>Grand mean</b>							<b>2.76</b>	

SA: strongly agree; A: agree; D: disagree; SD: strongly disagree; N: number of respondents; TS: Total score;  $\bar{X}$ : mean; D: decision.

As indicated in table 4, the grand mean of the responses was 2.76, which is higher than 2.50. Based on this result, the conclusion is that science students at NCE level have positive attitudes towards laboratory activities.

### 8. Discussion

The discussion is according to the themes of the research questions.

- Compliance with laboratory safety measures and practices: The result of the study, as shown in table 1, suggests that science students at NCE level in Nigeria do not comply with safety measures and precautions during laboratory activities. The result obtained is similar to the findings of.<sup>[5]</sup> Awareness and negligence are two factors that influence students' laboratory use. Most students are ignorant of basic rules and precautions before making use of the laboratory. As such, they act ignorantly and acquire avoidable injuries or even death. In another circumstance, students fail to comply with the rules or take appropriate precautions even when they are already aware of what they ought to do. The teachers and other laboratory staff are directly responsible for instructing the students about the rules and regulations as well as the necessary safety precautions. Unfortunately, these staffers neglect their duties and the students are left exposed to dangers and injuries.
- Availability of laboratory facilities: The study concluded in table 2 that facilities are inadequate for laboratory activities in science in NCE program in Nigeria. The above result is similar to the findings of

<sup>[3]</sup> and <sup>[4]</sup>. However, even though their populations of study were different from that of the present study. The school laboratory is the students' workshop for doing science, and it provides a suitable environment for teaching and learning science. The laboratory plays essential roles in students' performance in science. <sup>[4]</sup> found out that there is a significant relationship between laboratory availability and utilisation and students academic achievements in biology and chemistry. In the same vein, the findings by <sup>[10]</sup> revealed that students exposed to the use of laboratory performed better than those not exposed to the use of the laboratory in physics. Also, <sup>[11]</sup> found out that there is a significant difference between the performances of biology students exposed to an adequately equipped laboratory and those exposed to an inadequately equipped laboratory. In other words, the inadequacy of facilities for laboratory activities in science in NCE program will affect the teaching and learning of science and students achievements in their subjects of study.

- Application of appropriate instructional strategies: The study concluded (table 3) that teachers apply appropriate instructional approaches for laboratory activities. This observation is similar to the findings of <sup>[7]</sup>. However, the difference with the present study lies in the population type. Application of appropriate instructional approaches by the teachers motivates the students to acquire the skills and knowledge of science expected of them by participation in laboratory activities. It also enables them to develop more interest in laboratory activities as well as in their science subjects of study.

- The attitude of students towards laboratory activities: As concluded in table 4, science students at NCE level exhibit positive attitudes towards laboratory activities. The finding, as described above, is similar to the results of [8]. However, [8] study targeted secondary school students, while the present study targeted NCE program students. Attitude influences learners' interest and participation in learning activities. [12] found out that the approach of students to chemistry practical positively correlate with students' performance and practical skills. In other words, as long as students show a positive attitude towards laboratory activities, they acquire more profound scientific knowledge, develop skills and ultimately make achievements in science.

### 9. Conclusion and recommendations

The study revealed two issues about the conduct of laboratory activities in science in NCE program in Nigeria. Firstly, laboratory facilities were inadequate for the conduct of laboratory activities. Secondly, students do not comply with laboratory safety measures. The study also found out that the teachers' apply appropriate instructional approaches in laboratory activities and also students show positive attitudes towards laboratory activities. Based on the issues found in the study, the researcher made the following recommendations:

1. Non-compliance with laboratory safety measures:
  - The science teachers should hold awareness programs on laboratory safety for the students.
  - Laboratory rules, regulations and safety measures should be boldly written and conspicuously placed at the laboratory.
  - A handbook on laboratory safety should be prepared and circulated among the students.
  - The science teachers and other laboratory staff should enforce discipline among students while working in the laboratory.
2. Inadequacy of laboratory facilities:
  - The authorities and the proprietors of NCE awarding institutions should equip the science laboratories with modern and functional facilities.
  - Where possible, the teachers should improvise facilities to supplement the available ones.

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