AVAILABILITY AND UTILIZATION OF BASIC SCIENCE LABORATORY FACILITIES IN JUNIOR SECONDARY SCHOOLS: A PANACEA FOR REFORM IN STEM EDUCATION

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Abstract

The study investigated the availability and utilization of basic science laboratory facilities in junior secondary schools as a panacea for reform in STEM Education. Three research questions were posed to guide the study. The data were collected using a checklist and a teacher questionnaire and the data obtained were analysed using frequencies and percentages. The result showed that most junior secondary schools do not have laboratory equipments and materials needed for teaching basic science and moreover, there were no existing basic science laboratories. It was also found that most basic science teachers do not utilize even the few available facilities in teaching. Some of the teachers' reasons for not using the equipments and materials include lack of adequate laboratory facilities, lack of teachers' guide and practical manuals. The implications of this non availability and low utilization of basic science laboratory facilities were discussed. It was then concluded that for the objectives of the new reform in basic science education to be achieved, basic science laboratory facilities be made available and should be always utilized by our basic science teachers.

1. Introduction

In response to the Millennium Development Goals (MDGs) and the Education for All (EFA), the Nigerian government came out with a new reform that has recently been spelt out. The new reform is the 9-year basic education. The adoption of the 9-year continuous basic education from 2006 implies that the offerings of STM should be systematically developed in such a manner that there should not be any disjoint between what is taught at the primary and junior secondary levels. This has been achieved through the introduction of Basic science and Basic Technology and the scrapping of primary science at the lower and middle basic levels and the replacement of integrated science with basic science at the upper basic level of basic education among others.

The Basic science curriculum which is in use in Nigeria for science teaching and learning in Junior Secondary School had built in strategies where learners are required to be involved in inquiry and related activities that can develop critical thinking skills. This is seen in the objectives of basic science curriculum of Nigerian Educational Research and Development Centre (NERDC, 2007) which includes enabling students to:

(a) develop interest in science and technology
(b) acquire basic knowledge and skills in science and technology
(c) apply their scientific and technological knowledge and skills to meet societal needs
(d) take advantage of the numerous carrier opportunities offered by science and technology
(e) become prepared for further studies in science and technology.

Science is very important 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" (Hoftein and Lunetta (1992). Laboratory activities avail students the opportunity to think logically, ask reasonable questions, seek appropriate answers and solve problems. Moreover, the availability and utilization of laboratory equipments and facilities in teaching makes science lessons concrete and stimulating and helps to enhance the achievement of students.

The basic science curriculum for junior secondary schools is filled with lots of activities and experiments which are meant to help the students understand the theory more and also provide continuous experience in process skill development. Examples of such contents in the basic science curriculum, the teachers and students activities are summarized to include the following: In teaching the topic. Uniqueness of man: The teacher is expected to use appropriate instruments to guide students to take measurements of length, time, weight and volume. The students activities are to carry out the listed measurements.

Kinetic theory: the teacher's activities is to provide charts of molecular structure of solids, liquids and gases; guide students to carry out activities on boiling and evaporation and to deduce some factors that can affect evaporation. The students' activities are to discover molecular spacing; use water and other respectively for activities on evaporation and boiling and deduce the factors that affect evaporation.

Force: Some of the teacher's activities is to guide students to set up balanced and unbalanced forces; direct illustrations of frictional forces. The student's activities are to practice setting up balanced and unbalanced forces.

Changes of Matter: Some of the teachers activities is to lead the students to recognize the differences between temporary and permanent changes. The students activities is to carry out the experiments to demonstrate the process of change in groups and also to report their observations during the demonstration.

Digestive System: The teachers activities are to use charts or models or preserved specimens to describe alimentary system for students observation; provide materials for simple food tests etc. The students are to examine the charts or models or the specimens displayed and write down some points. They are also to carry out simple food tests.

These activities and experiments are better performed in the laboratories using appropriate equipments and materials. Considering the importance of laboratories in STM education, Obioma (2006) recommend that there should be:

- The establishment of laboratories and or resource rooms for learning Basic science and Technology in the Lower and middle basic education levels.
- The reactivation and restructuring of the existing integrated science laboratories to suit the purpose of teaching and learning basic science in the upper basic level.
- The establishment of Basic science and Basic Technology laboratories where they do not presently exist.

In promoting the use of laboratory facilities for teaching Basic Science in Junior Secondary Schools, the National Agency for Science and engineering Infrastructure (NASENI) recently organized a workshop for training its workers across the country on how to use the laboratory science kit supplied to Junior Secondary School in Nigeria. These trained workers will in turn go out to Junior Secondary Schools to educate the teachers of basic science on how to use the contents of the kit in teaching topics in the basic science curriculum (NASENI, 2011).

The new Basic science for Junior Secondary Schools stresses that instructional strategies that are activity based and ICT driven be adopted (NERDC, 2007). In view of the foregoing, the problem of this study is to investigate the availability of Basic science laboratories in junior secondary schools in Enugu State. The study is also carried out to determine the utilization of the available equipments and materials in basic science laboratories in teaching basic science. When these laboratory facilities are adequately available and well utilized by Basic science teachers in their teachings, it will help students to acquire the basic knowledge and skills in science and technology and thus be able to apply same to meet societal needs. In this way the objectives of basic science education will be achieved hence sustaining the new reform.

2. Research Questions

The three research questions that guided the study are:

1. What is the availability of Basic science laboratory facilities in junior secondary schools?
2. To what extent do Basic science teachers make use of the available equipments and materials in the laboratories in teaching?
3. What reasons do basic science teachers give for not using the equipments and materials in the laboratory for teaching basic science?

3. Method

The study is a descriptive survey. The population comprised of all the 274 public secondary schools of the 6 education zones in Enugu State. four secondary schools were randomly selected from each of the six zones giving a total of twenty four (24) schools. One basic science teacher each (the subject head) were chosen from each of the twenty four (24) schools giving a total sample of 24 teachers. The two instruments for data collection were a checklist of availability of laboratory facilities for basic science teaching and a researcher constructed questionnaire. The instruments were subjected to validation using science educators from the University of Nigeria Nsukka. The questionnaire was designed to find out the extent of use of the available laboratory facilities by basic science teachers in junior secondary schools on four point likert scale of every often, sometimes, Rarely, and Not at all. Data obtained from the two instruments were analysed using simple percentages.

Research Question 1

What is the availability of basic science laboratory facilities in Junior secondary schools?

Table 1: ***The availability of basic science laboratory facilities in J.S.S.***

S/N	Laboratory Facilities	Available		Not available		Quantity	
	General Apparatus	Frequency	Percentage	Frequency	Percentage	Few	Enough
1	Basic science laboratory	0	0	24	100	0	0
2	Wall charts	14	58	10	42	10	4
3	Models	6	25	18	75	6	0
4	Measuring cylinders	12	50	12	50	10	2
5	Cork	15	62	9	38	13	2
6	Beakers	15	62	9	38	13	4
7	Test tubes	20	83	4	17	16	0
8	Bunsen burner	8	33	16	67	8	2
9	Conical flasks	12	50	12	50	10	0
10	Thermometers	11	46	13	54	11	0
11	Indicators	10	42	14	58	10	0
12	Tripod stand	8	33	16	67	8	0
13	Funnels	10	42	14	58	10	4
14	Filter papers	10	42	14	58	6	0
15	Retort stand and clamp	8	35	16	67	8	0
16	Meter rule	20	83	4	17	20	0
17	Stop watch	10	42	14	58	10	0
18	Tongs of magnesium ribbon	2	8	22	92	2	0
19	Safety goggles	0	0	24	100	0	0
20	Candle	16	67	8	33	16	0
21	Spring balance	9	38	15	63	9	0
22	Knife edge	7	29	17	71	7	0
23	Slotted weights	5	21	19	79	5	0
24	Dissecting board	8	33	16	67	8	0
25	Evaporating flask	2	8	22	92	2	0
26	Evaporating dish	2	8	22	92	2	0
27	Liebig condenser	3	13	21	88	3	0
28	Magnifier	5	21	19	79	5	0
29	Pulley	7	29	17	71	7	0
30	Iron fillings	3	13	21	88	3	0
31	Prism	10	42	14	58	10	0
32	Separating funnel	3	13	21	88	3	0
33	Spatula	20	83	4	17	16	4
34	Test tube holders	18	75	6	25	16	2
35	Test tube rack	15	63	9	38	14	1
36	Vernier caliper	4	17	20	83	4	0
37	Wire gauze	7	29	17	71	7	0

38	Tape rule	16	67	8	73	16	0
39	Stove	12	50	12	52	12	0
40	File strips	0	0	24	100	0	0
41	Pictures	0	0	24	100	0	0
42	Films	0	0	24	100	0	0
43	Screw	0	0	24	100	0	0
44	Screw driver	0	0	24	100	0	0
45	Gear	0	0	24	100	0	0
46	Car jack	0	0	24	100	0	0
47	Opener	9	38	15	63	7	2
48	Scissors	11	46	13	54	11	0
49	Wheels and axle	0	0	24	100	0	0
50	Iron rod	2	8	22	92	2	0
51	Painted cans	8	33	16	67	8	0
52	Map of Nigeria showing mineral resources distribution	5	21	19	79	5	0
53	Charts of molecular structure of solids, liquids and gas	3	13	21	88	3	0
54	Battery	3	13	21	88	3	0
55	Connecting wires	10	42	14	58	10	0
56	Rheostat	7	29	17	71	7	0
57	Torch bulbs	14	58	10	42	14	0
58	Ammeter	9	38	15	63	9	0
59	Voltmeter	6	25	18	75	6	0
60	Fuses	11	46	13	54	11	0
61	Electric meter	0	0	24	100	0	0
62	Bar magnets	5	21	19	79	5	0
63	Magnetic compass needle	0	0	24	100	0	0
64	Fehling’s solution	10	42	14	58	6	0
65	Iodine solution	9	38	15	63	7	4
66	Biuret’s reagent	4	17	20	83	4	2
67	Sodium hydroxide solution	15	63	9	38	10	0
68	Sudan III solution	5	21	19	79	5	5
69	Sodium metals stored in paraffin	4	17	20	83	4	0
70	Iodine crystals	12	50	12	50	12	0
71	Preserved animal specimen	6	25	18	75	6	0
72	Specimen of crude oil	0	0	24	100	0	0
73	Soil samples	7	29	17	71	1	6
74	Dilute acids	14	58	10	42	13	3
75	Dilute acids	14	58	10	42	12	2
76	Litmus paper	15	63	9	38	10	5

77	Salts (NaCl, CaO)	7	29	17	71	7	0
78	Sulphur	0	0	24	100	0	0
79	Ethanol	4	17	20	83	4	0
80	Copper sulphate	13	54	11	46	7	6

Table 1 above shows that all the schools sampled do not have basic science laboratory rather the available facilities were found either in the physics, biology or chemistry laboratories. The table also shows that most of equipments and materials are not found in majority of the schools. For example 92% of the schools do not have tongs of magnesium ribbon and iron rod; 88% do not have battery, liebeg condenser, separating funnel etc; 83% do not have vernier caliper, biurett's reagent, sodium metal etc while 79% do not have slotted weights, magnifier, bar magnets etc. Moreover, it can also be seen that the available equipments/materials are present in few quantities thus making it difficult for teachers and students to use them effectively.

Research Question 2

To what extent do Basic science teachers make use of the available equipments and materials in the laboratories in teaching?

Table 2: ***Extent of use of available equipment and materials in the laboratories in teaching of basic science***

S/N	Laboratory Facilities	Very Often		Sometimes		Rarely		Not at all	
		Frequency	%	Frequency	%	Frequency	%	Frequency	%
1	Basic science laboratory	0	0	0	0	0	0	24	100
2	Wall charts	4	21	10	42	9	38	0	0
3	Models	2	8	4	17	1	50	16	67
4	Measuring cylinders	2	8	10	42	3	54	9	38
5	Cork	6	25	9	38	10	22	10	42
6	Beakers	4	17	11	46	5	21	4	17
7	Test tubes	7	29	13	64	2	8	2	8
8	Bunsen burner	0	0	3	13	5	21	16	37
9	Conical flasks	2	8	10	32	5	21	7	29
10	Thermometers	0	0	3	13	8	33	13	54
11	Indicators	1	4	9	38	12	50	2	8
12	Tripod stand	0	0	3	13	11	46	10	42
13	Funnels	3	13	7	29	10	42	4	17
14	Filter papers	2	8	8	33	7	29	7	29
15	Retort stand and clamp	0	0	5	21	15	63	4	17
16	Meter rule	14	58	5	21	5	21	0	0
17	Stop watch	0	0	7	29	3	13	14	58

18	Tongs of magnesium ribbon	0	0	0	0	0	0	24	100
19	Safety goggles	0	13	0	0	0	0	24	100
20	Candle	3	8	12	50	2	8	7	29
21	Spring balance	2	0	5	21	10	42	7	29
22	Knife edge	0	0	0	0	8	33	16	67
23	Slotted weights	0	4	2	8	18	75	4	17
24	Dissecting board	1	0	4	17	16	67	3	13
25	Evaporating flask	0	0	0	0	0	0	24	100
26	Evaporating dish	0	0	0	0	22	92	2	8
27	Liebig condenser	0	0	0	0	21	88	3	13
28	Magnifier	0	0	2	8	18	75	4	17
29	Pulley	0	0	2	8	5	21	17	71
30	Iron fillings	0	0	2	8	1	4	21	88
31	Prism	0	0	3	13	7	29	14	58
32	Separating funnel	0	0	0	0	0	0	24	100
33	Spatula	8	8	6	25	2	8	8	38
34	Test tube holders	0	0	8	33	12	52	4	17
35	Test tube rack	8	8	6	25	4	17	6	25
36	Vernier caliper	0	0	0	0	12	50	12	50
37	Wire gauze	0	0	14	58	6	25	4	17
38	Tape rule	5	5	16	67	3	13	0	0
39	Stove	2	2	10	42	12	50	0	0
40	File strips	0	0	0	0	0	0	24	100
41	Pictures	5	5	2	8	5	21	15	63
42	Films	0	0	0	0	4	17	20	83
43	Screw	0	0	0	0	8	33	16	67
44	Screw driver	0	0	0	0	0	0	24	100
45	Gear	0	0	0	0	5	21	19	79
46	Car jack	0	0	0	0	0	0	24	100
47	Opener	5	21	4	17	15	63	0	0
48	Scissors	2	8	10	42	2	8	10	42
49	Wheels and axle	0	0	0	0	0	0	0	0
50	Iron rod	0	0	0	0	7	29	17	71
51	Painted cans	0	0	3	0	10	42	11	46
52	Map of Nigeria showing mineral resources distribution.	2	8	3	13	6	25	13	54
53	Charts of molecular structure of solids, liquids and gas	1	0	2	8	6	25	15	63
54	Battery	0	0	2	8	3	13	19	79
55	Connecting wires	0	0	9	38	15	63	0	0

56	Rheostat	0	0	0	0	7	29	17	71
57	Torch bulbs	0	0	0	0	4	17	20	83
58	Ammeter	0	0	0	0	3	13	21	88
59	Voltmeter	0	0	0	0	4	17	20	83
60	Fuses	0	0	0	0	10	42	14	58
61	Electric meter	0	0	0	0	0	0	24	100
62	Bar magnets	0	0	5	21	7	29	12	50
63	Magnetic compass needle	0	0	0	0	2	8	22	92

GENERAL CHEMICALS

64	Fehling's solution	0	0	7	29	8	33	9	38
65	Iodine solution	2	8	5	21	0	0	9	38
66	Biuret's reagent	0	0	0	0	3	13	21	88
67	Sodium hydroxide solution	2	8	2	8	10	42	10	42
68	Sudan III solution	0	0	0	0	5	21	19	79
69	Sodium metals stored in paraffin	0	0	0	0	0	0	24	100
70	Iodine crystals	0	0	0	0	10	42	14	58
71	Preserved animal specimen	0	0	2	8	4	17	18	75
72	Specimen of crude oil	0	0	0	0	0	0	24	100
73	Soil samples	4	17	6	25	10	42	2	8
74	Dilute acids	5	21	9	38	5	21	5	21
75	Dilute acids	5	21	9	38	5	21	5	21
76	Litmus paper	7	29	8	33	5	21	4	17
77	SALTS (NaCl, CaO)	0	0	7	29	9	38	8	33
78	Sulphur	0	0	0	0	0	0	24	100
79	Ethanol	0	0	0	0	7	29	17	71
80	Copper sulphate	0	0	3	13	2	15	4	17

Table 2 reveals that most of the available facilities are not being utilized by the basic science teachers. Only 29%, 21% and 17% of the teachers use wall charts, test tubes and beakers often. 54%, 50% and 22% of the teachers rarely use measuring cylinders, indicators, and funnels respectively while 38% of the schools do not use models at all.

4. Conclusion

One of the goals of basic science education is to enable students to acquire basic knowledge and skills in science and technology and also be able to apply them in meeting societal needs. This important objective cannot be fully achieved when basic science which is an activity oriented and experimentally based subject is taught using the traditional method of rote learning and memorization of facts by the students. The government should therefore make for the provision of science kits to JSS and ensure their good storage or rather provide well equipped basic science laboratory in our junior secondary schools. This will be a very important strategy or way forward for proper implementation of the basic science education in Nigeria.

5. Implications for Reform

The discussion in this paper shows that basic science laboratory and its facilities are very vital tools for the proper implementation of the new basic science curriculum if the curriculum is developed without integrating practical and creative skills to the learners, the intention of the 9-year basic education in Nigeria will be a mirage. The provision of adequate laboratory facilities and the proper utilization by the basic science teachers in teaching and learning basic science is therefore very important. The followings therefore constitute the implications of these to reform in basic science education:

- Government should promote science and technology in our country by providing and equipping basic science laboratories for practical work.
- Basic science teachers should develop the spirit of professionalism to use the available facilities in the laboratory in teaching.
- Teacher education programme at the tertiary level should be reviewed to incorporate the utilization of laboratory facilities for science teaching. This will enhance the productivity of teacher as lack of skill and inadequate exposures to the use of the facilities were suspected to be one of the major problems.
- The government together with the school authorities should make for adequate securities of the laboratory facilities to prevent vandalisation as most of the provided facilities were found to have been stolen in most schools.

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