
Impact of Laboratory activities and acquisition of process skills on attitude and academic performance in science among Senior Secondary School Students in Zaria, Kaduna State

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ABSTRACT

The Introduction of science as a compulsory subject in school curriculum was done with the view to develop scientific attitude, scientific temperament, critical thinking, active inquiry, independent work, science process skills and understanding the physical world from different perspectives. In line with this, this study seeks to establish the impact of laboratory activities on students' acquisition of science process skills. In this study the sample consisted of 60 senior secondary school science students'. The research methodology is quasi experimental design where a pre-test and post-test was conducted on 30 students who served as the experimental group and another 30 students who served as the control group. Science Process Skills Achievement Test (SPSAT) was developed to test the null hypothesis which states that; there is no significant difference between the acquisition of science process-skill of students that have prior exposure to laboratory apparatus and those taught using lecture methods. The result of the analysis done using t-test, it was found that the students exposed to laboratory activities performed significantly higher than those taught using lecture method. The researchers therefore recommend among others, that laboratory activities should be used consistently in teaching science as it enhances scientific attitude, retention and science process skills acquisition.

INTRODUCTION

Science is a dynamic, expanding body of knowledge covering ever new domains of experience. How is this knowledge generated? What is the so called Scientific Method? As with many complex things in life, the Scientific Method is perhaps more easily discerned than defined but broadly speaking, it involves several interconnected steps: observation, looking for regularities, making hypothesis, devising qualitative or mathematical models, deducing their consequences; verification or falsification of theories through observation and controlled experiments and thus arriving at the principles. Science is one of the components of the school curriculum. That is why, science as a separate subject has been incorporated in school curriculum which includes; Language, Mathematics, Social Science and Natural Science (Badri and Mishra, 2013).

The Introduction of science as a compulsory subject in school curriculum was done with the view to develop scientific attitude, scientific temperament, critical thinking active inquiry, independent work and understanding the physical world from different perspectives. So it is a powerful means of developing attitudes of critical inquiry, respect for truth, adaptability and systematic work which are a pre-requisite for initiating the process of social change and of national development (Badri and Mishra, 2013).

However, the globally emerging goals in the context of social and economic reforms have led to redefining of the nation's priorities in order to enhance productivity. Development of basic process skills is important as well as development of proper scientific attitude and values. Science Education aims to train students to think like scientists and emphasis would be expected on the development of attitude that good scientists are able to display (Opulencia, 2011). One of the purpose of teaching is inculcation of desirable attitudes and values (Pacia, 2014). Shaping students' attitudes, behaviours, and motivations is necessary today for without these broader skills and strengths, students will be unprepared for the challenges they will face (Miller, 2017).

Recent studies done in Nigeria by (Oludipe Awokoya, 2010; Ameh, Muhammed, 2014 and Opara, 2014) suggest that teachers are in a hurry and tend to rush through the scheme of work to enable them cover the topics in the curriculum within the given period paying little or no time on the use of the laboratory and its resources. Science process skills allow students to be active, developing a sense of responsibility, increasing the permanence of learning and providing research methods (Erturk and Kaptan, 2010). It is a building blocks from which suitable science tasks are being constructed and must be considered by the new national science curricula and the way they are expressed in textbooks. To develop science process skills, science content taught in science classrooms should be used (Nyakiti, Mwangi, & Koyier, 2010 and Opulencia 2011). In addition, promoting the acquisition of the process-skills, practical work in science facilitate the necessary learning environments such as active participation, integration to life and meaningful learning (Karamustafaoglu, 2011). The interaction with process-skills is evident throughout the students' daily lives and also in science lessons when they engage in practical activities.

This century is witnessing rapidly changing developments in information, science and technology in all works of life. To cope with these developments, proper teaching methods for applied subjects requiring laboratory scientific experiments need to be adopted. This perspective should be firmly established in the minds of curriculum designers and educational decision-makers, especially when they design, develop the curricula, and consider activities and experiments related to the teaching material. Recent years have also witnessed numerous discoveries and inventions through experimentation, which is a vital element of science basics. Despite different methods and strategies adopted by teachers to assist students in the process of learning science, poor performance of students in the subject is still recorded at the WAEC results, West African School Certificate Examinations (WAEC, 2017). Active involvement of learners could add an impetus to the much needed paradigm shift from a producing continent of raw materials for western factories to a manufacturing one of finished products. Therefore, the study seeks to elucidate the impact of students' prior exposure to laboratory apparatus on the acquisition of science process-skills.

Objectives of the Study

The study has formulated following objectives:

1. To determine the effect of laboratory approach on developing process skills among science students in secondary school.
2. To determine the effect of process skills achieved through laboratory approach.

Research Question

Is there any significant difference in the mean score performance of students taught science using prior exposure to laboratory apparatus and those taught using lecture method?

Null Hypothesis

There is no significant difference in the mean performance score of student taught process skill via prior exposure to laboratory apparatus and those taught using lecture methods.

RESEARCH METHODOLOGY

The research design is quasi experimental in nature. It is a pre-test and post-test experimental and control group design. The control and experimental groups were pre-tested to determine their group equivalence and entry level. Later, a post-test was administered after four weeks of the treatment to the experimental and control groups. Intact sections of SS₁ were used for the study.

The population of the study comprised of SS₁ science students in five (5) selected public senior secondary schools in Sabon Gari local government educational area of Kaduna state. The population comprised of single sex and coeducational schools. There were one (1) male School, two (2) female Schools and two (2) coeducational schools in the population.

Table x: Population of the Study

S/N	NAME OF SCHOOL	SEX		TOTAL NUMBER OF STUDENTS
		M	F	
1	GSS Chindit (boys)	350	-	350
2	GSS Dogon Bauchi (girls)	-	350	350
3	GSS Chindit (girls)	-	235	235
4	GSS Aminu (coeducation)	198	98	296
5	GSS Muchia (coeducation)	157	99	256
Total		705	782	1487

(Source; Ministry of education Kaduna state 2015)

Sixty students served as sample for the study from two of the public schools (GSS Aminu and GSS Muchia) within Sabon Gari local government educational area of Kaduna state. These schools were randomly selected and grouped into experimental (GSS Aminu) and control (GSS Muchia) groups respectively. Thirty students from each School sample of SS₁ science students were selected by random sampling. The technique was in accordance with that of Freankle and Wallen (2000),

The instrument used for the study was Science Process Skills Achievement Test (SPSAT), which was developed by the researchers and validated by experts in the department of Science Education, Ahmadu Bello University, Zaria. The test was developed in accordance with curriculum

objectives. It is comprised of activities that tests students' level of acquisition of science process skills. The face and content validity of the test was determined through expert opinion. The data was analysed using t-test statistical analysis to determine the level of significance at $P \leq 0.05$.

RESULT

The t-test analyses of the pre-test scores of experimental and the control groups are presented as follows.

Table1: t-test Analyses of Pre-Test (SPSAT) scores of experimental and control groups.

Group	N	Mean	S.D	S.E	df	t-value	p-value
Experimental	30	5.08	2.665	0.487	58	-0.240	0.981
Control	30	5.10	2.440	0.446			

*significant level ($p \leq 0.05$)

The table 1, showed that the p-value of the SPSAT is 0.98, which is above the 0.05 level of significance. This shows that the two groups (experimental and control groups) had equal strength in science process skills before the commencement of the treatment.

Testing of Hypothesis

H_0 : There is no significant difference in the mean performance score of students taught process skill via prior exposure to laboratory apparatus and those taught using lecture methods.

Table2: Summary of the Mean Scores, standard deviation and mean difference of experimental and control groups post-test (SPSAT) scores.

Group	N	Mean	S.D	Mdf
Experimental	30	14.53	2.515	5.500
Control	30	9.030	2.977	

Table 2, shows that there is difference in the mean score of those students exposed to laboratory apparatus and those not exposed.

To test if there is a significant difference in their mean score, the data was subjected to t-test statistical analysis which is summarised in table 3 below.

Table 3: t-test Analyses of Post-Test (SPSAT) scores of Experimental and control group.

Group	N	Mean	S.D	S.E	df	t-value	p-value
Experimental	30	14.530	2.515	0.459	58	9.669	0.000
Control	30	9.030	2.977	0.543			

*significant level ($p \leq 0.05$)

The p -value = 0.000, this value is less than 0.05 at 5% alpha level with $df = 58$. This means that there is a significant difference between the SPSAT mean scores of the experimental and the control groups in favour of the experimental group. Thus the null hypothesis is rejected. This implies that the experimental group taught science using prior exposure to laboratory apparatus acquired more science process skills than the control group taught same concepts using lecture method.

DISCUSSION

Analysis of data to test the null hypothesis showed that there is a significant difference in the mean scores of the experimental group and control group in favour of the experimental group. This implies that prior exposure to laboratory apparatus enhances the acquisition of process skills than conventional lecture method. From the data collected and analysed, the experimental group had significantly higher mean scores in science process skills acquisition than the control group.

The finding is in line with that of Aladejana and Aderibigbe (2007) who stated that laboratory method promotes curiosity in students, reward creativity, encourages the spirit of questioning among students, avoid dogmatism and promotes meaningful learning and recalling (retention). Morgil, Gungor, Seyhan and Seeken (2009) opined that laboratory practices generally improve the students' science process skills, cultivate interest in science, develop team workability in problem solving and help students understand and retain complex and ambiguous empirical work. According to Babafemi, (2014) students taught using experimental method perform better academically, acquire more science process skills and retain better the concepts learnt than those taught using lecture method. Yadav and Mishra (2013), opines that students taught by prior exposure to laboratory apparatus show better academic performances than those taught using conventional methods. Ranpura's (2013) also pointed out that memories can be reinforced independently of context by paying careful attention and by consciously attempting to remember. This may imply that memories start with what you observe and the first way to increase your memory is to make sure that you experience the world as clearly and meaningfully as possible.

The finding is also in line with Chebii (2011) which states that students exposed to experimental method of learning acquires more process skills which they applied in problem solving situations. The results may imply that in order for the students to form new product or point of view, they should master the Science basic process skills. This is supported by the study of Aktamis and Ergin (2008) concluding that Science process skills improve scientific creativity and students' overall performance. The research result is also consistent with that of Afif & Majdi (2015) who conducted a research on Palestinian secondary school students and observed that the traditional methods of teaching cannot develop the integrated science process skills needed to bring about an all-round improvement in the teaching and learning of science.

Hofstein and Naaman, (2007) also demonstrated in their study that science process skills are not improved in cases where laboratories are not used efficiently. Students expressed that exposure to laboratory activities helped them analyse complex situations deeply while playing an important role in their ways of taking responsibilities or displaying reactions (Pallisera, Fullana, Palaudarias & Badosa, 2013). These changes observed in thoughts of students about themselves are believed to improve their scientific process skills. Experiential learning process is found to improve

students' comprehension of knowledge in depth (Groves, Bowd & Smith, 2010). Experiential learning both provides learning opportunities by thinking and internalizing deeply and ensures learning the knowledge in a more meaningful way (Wu, He, Weng & Yang, 2013). Experiential learning also gives the individuals the opportunity of reviewing the meanings of their experiences and questioning their professional contributions and effects in a critical way (Armsby, 2012). Therefore, the activities and experiments participated by students and teachers during the experiential learning practice are seen as the reasons for their scientific process skills, which consist of identifying variables in the problem, establishing and defining hypothesis, making operational predictions, designing required analysis for the solution of the problem along with drawing and interpreting graphs.

CONCLUSION

The results showed that there is statistical significant difference in the mean score of the experimental and control groups in favour of the experimental group. This indicates that students who have been exposed to laboratory strategy acquired more science skills than those taught using lecture method. Therefore, it can be concluded that the use of laboratory resources in the teaching and learning of science brings about an improvement in the acquisition of scientific process skills as well as an improvement in the all-round academic achievement of science students.

RECOMMENDATIONS

Based on the findings, the following recommendations are proffered;

1. The teaching of science subjects should be done using laboratory method as it develops scientific process skills, enhances meaningful learning, retention, attitudes and behaviour that will enable students function effectively as scientist.
2. The school administrators and curriculum planners should emphasis on the use of laboratory method of teaching by the science teachers.
3. Ministry of Education should ensure that both public and private secondary schools are equipped with relevant science materials that will enhance the acquisition of process skills.

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