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Impact of Prior Exposure to Laboratory Apparatus on Acquisition of Process Skills and Academic Performance in Chemistry at Secondary Schools in GIWA Zone Nigeria

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Abstract The study examined the impact of prior exposure to laboratory apparatus activities on acquisition of process, skills and achievement in Chemistry at secondary level in Giwa Zone Kaduna State Nigeria. A total of 120 Senior Secondary Two (SS II) Chemistry students were in the study from a total population of 996. Non randomized pretest, posttest experimental-control groups research design was used for the study. Chemistry Performance Test (CPT) and Science Process Skills Performance Test (SPSPT) were used as instruments with reliability value of 0.89 and 0.75 respectively. To determine whether students' prior exposed to laboratory apparatus activities on acquisition of science process skills and achievement of different concepts in Chemistry. t-test statistical tool at $P<0.05$ was used to analyse data collected for the study. Generally prior exposure to laboratory apparatus activities on acquisition of process skills was found to be more effective in enhancing students' science process skills and academic performance on difficult concepts than those not prior exposed. The results showed that students' academic achievements are significantly high given the same condition of exposure to prior laboratory apparatus activities on acquisition of science process skills. Therefore recommendations were made among others that science curriculum developers, supervisory bodies of secondary schools, science education and teachers should incorporate prior exposure to laboratory apparatus activities on acquisition of science process skills approach into curricular of Chemistry at secondary school level.

Keywords: *laboratory apparatus, skill aquisition process*

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1. Introduction

Prior exposure to laboratory apparatus can be a powerful tool in learning situation to teach students. Although conventional curricula and achievement test in chemistry in so many countries have not being widely used to support students learning on their prior exposure to laboratory apparatus. Prior exposure to laboratory apparatus can be thought of as student's experimental knowledge which are various forms of knowledge students gain when exposed and working with laboratory apparatus as a form of activities.

Educational research such as [1,2,3] has shown that teaching supported with prior exposure to laboratory apparatus increases students ability to grasp materials taught to them. In addition when students find personal relevance in the material/activities they are learning, they are more apt to retain information. Therefore the first important pedagogical technique is recognition of students' prior exposure to laboratory apparatus which can also be thought of as their prior knowledge.

Students should be prior exposed to laboratory apparatus during chemistry lessons in order to develop the appropriate process skills. But unfortunately students show that the teaching of chemistry in region secondary schools falls short of certain expectations [1,2]. For instance, it has been observed that the present methods used in teaching science in secondary schools not only chemistry do not augur well for the acquisition of science process skills by students.

Madu [7], many researches have been carried out on the use of different teaching methods on student's acquisition of process skills and academic performance in chemistry [8,9]. However, none of these studies tried to examine the laboratory apparatus on acquisition of process skills strategy.

The laboratory is a forum for science teachers and their students within a building to interact with apparatus or equipment under controller condition when seeking answers to problems in nature. House [4], is of the view that science most especially chemistry in its true form can hardly be taught or learnt without appropriate use of Laboratory equipment/materials. House [4], also contents that although a lot of reasoning and though process skills

come into physics, yetscience cannot start and end without facts. In linking practical laboratory apparatus in chemistry with thinking, Florendo [3], has this to contribute: the distinction between theory and practice is to some extent not real. We must argue that both are conductive to thinking practical, work should be a challenge to creative thought and not just a process of looking, drawing and doing. It must be under taken in order to solve problem.

Florendo [3], suggests that students should receive training in using laboratory facilities/ apparatus to approach the solution of problem through a proposed strategy and active involvement in the pursuit of the solution of an average Nigerian secondary school student, which they shall encounter with authorities in different shade within the educational setup. Some of such "authorities" will includes the teachers, textbooks, visual aids among others.

The use of laboratory apparatus could not be effective without proper exposure to science process skills. The science process skills are essentially scientist's method of pursuit of knowledge. The use of tools, aids, laboratory apparatus help the scientists in the research, and such tools may ultimately lead to a break in Wilson's model and consequently the scientists will not obtain the desired results. In the same vein, the use of laboratory apparatus in secondary schools assists the students to be familiar with the science process skills and to achieve good results within the scope of his ability and competences. [5], observes that in schools where laboratory apparatus are inadequate, chemistry is usually taught theoretically. They further observed that this approach does not assist students to develop the science process skills approach to the study of chemistry. Moreso, lack exposure to laboratory apparatus is scale and relatively new [6]. Therefore, there is need to carry out study in this area to see whether or not prior exposure of students to laboratory apparatus will enhance their science process skills acquisition and academic performance in chemistry at secondary schools.

In this study, prior exposure to laboratory apparatus means any teaching and learning activity which involves students in the opportunity to observe and manipulate laboratory apparatus. The term "laboratory apparatus" is used in preference to "laboratory work" because location is not a salient feature in charactering this kind of activity. The observation and manipulation of objects could take place in a school laboratory, in the classroom setting when studying aspect of chemistry. As earlier defined in this research work, prior exposure to laboratory apparatus on acquisition of science process skills in any teaching and learning activity involves students observing and manipulating the laboratory apparatus. It is clear from this discussion and also widely recognized by science educators that much of the learning associated with practical activity take place through the process of talking, about the acquisition of process skills that have been made, and what they might mean; both other learners in the class and with the teacher. Prior exposure to laboratory apparatus was followed by a period of manipulation of the science process skills and of how they night be interpreted and explained. Even if for practical reasons, the discussion takes place in sub sequent lesson. Therefore in this study prior exposure to laboratory apparatus on acquisition of process skills and academic achievement among SSS chemistry students was investigated.

1.1. Purpose of the Study

The purposes of this study are to

i. determine the impact of prior exposure to laboratory apparatus on acquisition of process skills and achievement in chemistry at secondary level which are to determine the impact of prior laboratory apparatus exposure on the science process skill acquisition among senior secondary school students in chemistry.
ii. Investigate the impact of prior laboratory apparatus exposure or academic performance among secondary school chemistry students.

1.2. Research Questions

Two research questions are formulated for this study:

i. What is the difference in the mean academic performance of secondary school chemistry student's prior exposure to laboratory apparatus compared to those not so exposed?
ii. How would the performance of students prior exposed to laboratory apparatus on acquisition of process skills of chemistry different from those not so exposed?

1.3. Hypothesis

The following null hypothesis were tested at $P \leq 0.05$ level of significance

Ho: 1 There is no significant difference between the mean academic performance of chemistry student prior exposed to laboratory apparatus and their counterpart not so exposed.

Ho: 2 There is no significant difference between the acquisition of process skills of chemistry students prior exposed to laboratory apparatus on their performance and their counterpart not so exposed.

2. Methodology

2.1. Research Design

A quasi-experimental-control group involving pre, and post-tests design was used for the study. The inferential statistic of students t-test was employed to determine the mean significant difference between the two samples variables of the two group i.e experimental and control groups

2.2. Population of the Study

The population for this study consists of all the secondary schools (SS II students) in Giwa and it environ. It was made up of over 14 secondary schools with a population of about 996. Government schools with similar manpower, students population, quality teacher, staff and laboratories was considered appropriate as sample for the study. Two government secondary schools were deeply involved in the research (Government Secondary School, Bomo) as the control group and Dr. Aliyu Yusuf Aboki Secondary School as experimental group. The two schools

were selected as they recorded the highest Chemistry students in Giwa Educational Zone. The whole SS II Chemistry students from both schools were used for the experiment. A total of 120 students were used for both control and experimental groups.

2.3. Sample

The sample for this study were SS2 chemistry students in the two Government Secondary Schools Bomo and Shika established in the same year by government with the same similar manpower, students population quality chemistry teacher, staff and their laboratories. The researcher used stratified random sampling techniques by employing balloting method in which one hundred and twenty (120) students were selected. The researcher selected sixty (60) students from both schools totality one hundred and twenty (120) students for the study which is in line with Tuckman (1975) and Sambo (2008) that central theorem recommended sample size of minimum of 30 subjects in variable for experimental study of this nature. Among the selections, female students constitute 60 and male students 60 making a total of 120 study students.

Table for the Sampling

S/No	School	Location	No of Students Male	Female	Total	Remark
1	G.S.S.	Bomo	30	30	60	Control
2	Dr. Y.A.G.S.S	Shika	30	30	60	Experimental
	Total		**60**	**60**	**120**	

From the above table 120 study subjects were used, 60 were males and 60 were females respectively selected from Bomo and Shika as stated previously and they were grouped into experimental and control study subjects respectively using balloting method involving picking from the chart procedure as shown in the above table.

2.4. Instrumentation

The instrument used for the research study involve Chemistry Performance Test (CPT) which has to do with the measuring of students competence in chemical concepts so that students academic achievement and science process skills in chemistry will be determine. Forty items objectives test involving multiple choices of A-D test was used. Chemistry Performance Test (CPT) was used for pre, post and post test. The topics selected for instruments constructions are from WAEC and NECO syllabus (2010-2014). The duration for examination was based on pilot test study for the administration. The instruments were subjected to validity reliability test as well as the item analysis for the purpose of standardization.

Before the commencement of the mean treatment the subjects in the experimental and control groups were given the CPT based on the selected topics for the study. This is to determine the equivalence of both group and the result is shown in the table below:

Table 1a. Result of Mean and Standard Deviation Scores of Experimental Group and Count

Variable	N	X	SD	MND F
Expgp	60	9.46	4.98	
				0.52
Control gp	60	9.98	4.99	

Table 1b. Result of t-test analysis of Process Skills Acquisition Mean Scores of Experimental and Control Groups

Variable	N	X	SD	SE	DF	t-val	P	R
Expgp	60	9.46	4.98	0.64				
					118	0.53	0.00	S
Control gp	60	9.98	4.99	0.64				

• Significant at P≤ 0.05.

The result from Table 1a reveals that there is little or no difference with mean academic performance of secondary school chemistry students prior exposed to laboratory apparatus (9.46) compared to those not prior exposed (9.98) which mean the academic achievement of experimental group is lower than control group in the beginning in prior exposure to has laboratory apparatus.

In Table 1b the result shows that the t-calculated of 0.53 at p-value 0.05 is less than t-critical of 1.98 at p-value of 0.05, df=118. This result shows that there is no significant difference in the academic performance of students in prior exposure to laboratory apparatus activities and those exposed to lecture method at the beginning or initial stage without any prior exposure.

2.5. Treatment Session

The schools used for the study, Chemistry was allocated four period of forty minutes each per week the treatment in the study lasted six weeks with each group having twenty four teaching session. The selected topics choose for study includes volumetric analysis and qualitative analysis. Lesson note were develop on the topics for both experimental and control groups respectively.

3. Data Collection and Analysis

By the end of the main treatment the instrument earlier on described administered. This is to measure the impact of prior exposure to laboratory apparatus on acquire or of process skills strategy under investigation.

Table la: summary of t-test analysis of process skills acquisition mean academic achievement scores of experimental groups and control groups.

Table lb: indicate the t- value of 0.53 with a p- value of 0.00 and the df of 118.

The p -value is less than the stated level of significance set at p< 0.05, which is an indication that, there is no significant difference in the academic achievement of student prior exposure to laboratory apparatus i.e. experimental group and those exposed to lecture method at the beginning or initial stage with any prior exposure. Thus, the null hypothesis which states that there is no significant difference between the mean academic achievements of secondary school chemistry students prior exposure to laboratory apparatus compared to their counterpart not exposed was accepted.

Research Question: How would the academic achievement of students prior exposed to laboratory apparatus on acquisition of process skills of chemistry differ from those not so exposed?

For the purpose of answering the research question, the data collected was analyzed using descriptive statistics in the form of mean and standard deviation as follows.

Table 2a. Summary of Post Test Mean, Mean Difference and Standard Deviation, Scares of Experimental and Control Groups

Variable	N	X	SD	M
Expgp	60	18.30	7.37	
				5.29
Control gp	60	13.01	5.39	

The post -test in Table 2a shows that the mean performance of experimental group (18.30) is slightly higher than the control group (13.01) with a mean difference of 5. 29 of students who were prior exposure to laboratory apparatus on acquisition of science process skills.

To test whether there was a significant difference in the mean scores of experimental and control group as stated in Ho1 as follows:

Hypothesis one (Ho2) There is no significant difference between the mean academic performance of secondary school chemistry' student prior exposed to laboratory apparatus compared to their counterpart not exposed.

To test this hypothesis data collected was analyzed using t-test statistic at $p < 0.05$.

Table 2b. Summary of T-Test Analysis of Post- Test Mean Scored of Experimental Group and Control Group.

Variable	N	X	SD	SE	Df	t-val	P
Expgp	60	18.30	7.37	0.95			
					118	4.39	0.0
Control gp	60	13.01	5.39	0.69			

From Table 2b, the results showed t- value of 4.39 with t - value of 0.00 which is less than $p = 0.05$ at dif = 118. The result shows that there is a significant difference in the academic achievement of secondary school chemistry students prior exposed to laboratory apparatus compared with those not so exposed. The significant is in favour of experimental group as shown in their mean scores.

Therefore the null hypothesis which says there is no significant difference in the academic achievement of experimental and control group was the rejection. The findings of this study is in line with those of some past studies which were of the view that, for concept to be taught in science properly for Learners to understood, the method used in teaching the concepts plays a vital role such studies include those by [7,8,9] and most especially House [4], who stated that prior exposure to laboratory apparatus on acquisition of science process skills goes beyond mere seeing which appear more than simply holding a piece of apparatus. He says that, the raw sense behind being exposed to laboratory apparatus strategy can be visible almost unconsciously, without having any significance attached to them.

However, when this seeing is registered and interpreted in the light of prior exposure and expectation, it becomes acquisition of science process skills.

4. Implications of the Findings

Findings from the study suggest the following:

1. Prior exposure to laboratory apparatus or acquisition on process skill strategy is far more superior to the understanding of the concept and hence enhance the academic performance in Chemistry.
2. Prior exposure to laboratory apparatus strategy encourages effective observation and manipulation of chemistry apparatus as the acquisition of science process skills in Chemistry students.

5. Recommendations

Based on the findings of this study the following recommendations were made:

1. Curriculum planner should recommend the use to prior exposure to laboratory apparatus on acquisition of science process skills approach inteaching and learning of chemical concepts. This is because, the approach has the method for creating friendly activities that make the learning of topic love volumetric analysis and separation teaching to be more meaningful.
2. Conferences, seminars and workshop should be organized by professional associations such as educational research centre to sensitize the various stakeholders on the need. For the adaptation of the prior exposure to laboratory apparatus on acquisition of science process, skills.
3. Teachers teaching at secondary schools level should be trained and retrained through workshops on the use of prior exposure to laboratory apparatus in the teaching of Chemistry concepts.
4. Science curriculum developers and educators should produce textbooks and teacher guides based on prior exposure to laboratory apparatus activities model of teaching and learning strategy.

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