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**Editorial**

Embarking on a project of publishing a journal is a herculean task and painstaking endeavour. Despite the seeming obstacles we remained committed to the project of producing LER as at when due. And since the inception of Lagos Education Review, it has continued to be respected as a source, of well-researched and authoritative articles by a wide spectrum of experienced and leading educational practitioners.

This edition of Vol. 14, N0.1 of January, 2014 comprises of well-articulated articles in different areas of education. The articles submitted, assessed and published had gone through the sharp and rigorous eyes and pencils of our body of reviewers and consulting editors. Let me use the opportunity to thank our numerous reviewers and consulting editors. We will still continue to count on your support.

We sincerely acknowledge and appreciate the contributions of scholars, whose articles appeared in this edition. We welcome constructive criticisms that could assist to improve on the subsequent editions.

Thank you all and God Bless

**Professor Mopelola Omoegun**
*Editor-in-Chief*

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# EFFECTS OF INVESTIGATIVE LABORATORY AND EXPOSITORY METHODS ON ACQUISITION OF SCIENCE PROCESS SKILLS BY CHEMISTRY STUDENTS IN SENIOR SECONDARY SCHOOLS

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**Abstract**
*The study investigated the effects of the investigative laboratory approach and the expository method on science process skills acquisition by chemistry students. The design of the study was a pre-test post-test control group quasi-experimental design. The sample consisted of one hundred and twenty students from senior secondary schools in Ondo State, Nigeria. Two research hypotheses guided the study. Treatment consisted of teaching selected chemistry concepts to the experimental group using investigative laboratory approach while the other group was taught using the expository method. Test of science process skill acquisition (TOSPSA) and chemistry achievement test (CAT) were the instruments used for data collection. Mean and standard deviation and also T-test were used to test the hypotheses at 0.05 level of significance. Results revealed that students taught using the investigative laboratory approach performed significantly better than those taught using the expository method. Base on the findings of this study, the use of investigative laboratory approach to enhance science process skills acquisition in chemistry students was recommended.*

**Keywords:** Investigative laboratory approach, Expository method, Acquisition of science process skills, chemistry.

**Introduction**

The enviable position which science education occupy in most countries of the world including Nigeria is perhaps justifiable. The reason is that science can exert a dominant if not decisive inference on the life of individual as well as on the development effort of a nation (Adesoji, 2008). The universal recognition of the above submission is responsible for the prime position that has been accorded science and in particular, chemistry world-wide. Within the context of science education, chemistry has been identified as a very important school subject and its importance in scientific and technological development of any nation has been widely reported (Nelson, 2000). It was as a result of the recognition given to chemistry in the development of the individual and the nation that has made it a core – subject among the natural sciences and other science related courses in the Nigeria education system (Hornby, 1995).

The importance of chemistry mentioned above justifies the effort of previous researchers in chemistry and chemistry education in making the study of chemistry comprehensive and interesting as possible. The inclusion of chemistry as a core – subject in science in the secondary school calls for the need to teach it effectively. This is because effective science teaching can lead to the attainment of scientific and technological greatness (Abdullahi, 1982). Within the last two decades great deals of researcher efforts in science education have been directed at strategies or techniques that will enhance the teaching and learning science in general and chemistry in particular. Several researcher reports (Olarewaju, 1986; Okoli, 1995; Nwagbo, 2001; Madu, 2004) converge to indicate that students' perform poorly in secondary school science subjects.

The performance of students in chemistry external examinations especially in the practical examination has been reported as a poor one where students exhibit very poor skill acquisition (West Africa Examination Council Report, 2008; 2011) on students' performance. A number of factors have been identified as contributing to non-acquisition of skills by secondary school students. One of such factors is the teacher variable that is, the teacher's method of teaching, several research reports (All, 1984; Okebukola, 1985; Okoli, 1985; Nwosu, 1993; Nwagbo, 1999) indicate that many science teachers prefer the traditional expository method of teaching and shy away from innovative activity-oriented teaching methods, (such as inquiry, discovery, cooperative learning, investigative laboratory approach and expository method on acquisition of science process skills by chemistry students was investigated.

The expository method is a teaching method in which the teacher presents a verbal discourse on a particular subject, theme or concept to the learners. It is an ideal way of communicating coherent sequence of ideals and it is used to elaborate, clarify and discuss factual information or views on issues and problems. The teachers deliver pre-planned lessons to the students with little or no instructional materials. Investigative laboratory approach is a method of teaching in which students are guided to find out the truth of ideas, facts or assumptions for ultimate confirmation or rejection. This method emphasizes knowledge and skills acquisition through hands-on minds-on scientific activities under the guidance of the science teachers. Students are provided opportunity to interact with materials within the environment through observing, classifying, measuring, questioning, hypothesizing, collecting and interpreting data, accurate reporting, predicting, and inferring (Miller, 2010). Investigative laboratory activities are not restricted to the laboratory alone but any environment outside the classroom that provides

practical work to give first hand experiences to the learners could be regarded as an investigative laboratory activity.

Science process skills are cognitive and psychomotor skills which scientists employ in problem identification, objective inquiry, data gathering, transformation, interpretation and communication. Havlen (1984) describes science process skills as abilities which can be developed by experience and which are used in carrying out mental operations and physical actions. Studies by Okebukola and Ogunniyi (1984), Nwosu (1990) and Okoli (1998) assert that when one acquires the science process skills of observing, measuring, questioning, designing experiment, interpreting data etc. such a person become specially equipped with the tools required for science inquiry or problem-solving as well as ability to use these skills in the laboratory for a variety of investigations. Laboratory skills are therefore synonymous in many ways with science process skills. Hence instructional strategies that enhance the acquisition of science process skills also enhance the acquisition of laboratory skills. The present study therefore focused on effects of laboratory approach and expository method on acquisition of science process skill by chemistry students.

**Statement of the Problem**

The persistence poor performance of students in chemistry coupled with poor science process skills acquisition exhibited by chemistry students in practical examinations in chemistry at senior school certificate examination leaves one in doubt about the effectiveness of the teaching method popularly used by chemistry teachers for teaching the subject. The expository method of teaching is very popular and is widely used by chemistry teachers to convey large volumes of scientific information to senior secondary school students in a bid to prepare them for the rigorous senior school certificate examination. Therefore the present study sought to investigate effects of laboratory approach and expository method on acquisition of science process skills.

**Research Hypotheses**

To guide the study two hypotheses were formulated and tested.

1: There is no significant difference in the pre-test mean scores of students exposed to investigative laboratory approach and those exposed to expository method of teaching in chemistry.

2: There is no significant difference in the post-test mean scores of students exposed to investigative laboratory approach and those exposed to expository method of teaching in chemistry.

**Methodology**

The design of the study was a pre-test post-test control quasi-experimental design. Intact classes were used as it was not possible to randomly assign students to experimental and control conditions. The study sample was one hundred and twenty (120) senior secondary year one (SS1) chemistry students randomly selected from two senior secondary schools selected from all the schools in Akure Local Government Area of Ondo State, Nigeria. The two schools were randomly assigned to experimental and control conditions. The experimental school was taught using investigative laboratory approach while control school was taught using expository method of teaching. All the students in each of science classes in the two schools were used for the study. The experimental sample and control sample were made up of forty students respectively.

The level of acquisition of science process skills was measured using Test of Science Process

Skill Acquisition (TOSPSA) developed by the researcher based on some chemistry topics from Senior Secondary School I chemistry curriculum. The instrument was designed to assess students' ability in the use of manipulative skills The TOSPSA is 25-item on acquisition of process skills through practical exercise and each item required students to complete simple laboratory tasks keyed to one or more process skill objectives using simple laboratory instruments. Students were required to demonstrate behaviours such as making careful and accurate observations, classifying, measuring, drawing and labelling correctly, making tables, recording data interpreting observed data, experimenting, predicting on the basis of experimental, data and inferring based on the topics covered during the investigation. Marking guide with the necessary scoring keys for the process skills was also developed by the researchers.

The research instrument was validated by three experts in the field of chemistry and science education. The experts were requested to determine if the language used was clear and unambiguous and whether the items were keyed to the appropriate process skill objectives and within the capability of the students. The experts were in agreement with the scoring key, the match between the items and process skill objectives. Their comments and suggestions were considered in the final draft of the instrument and the revised version of TOSPSA had twenty five (25) items. The reliability of TOSPSA was determined using Test-retest reliability method the reliability coefficient of 0.65 was obtained for the instrument. A sample of the test item and the process skill objective is presented below:

| *Science Process Skills* | *Item Sample-TOSPSA* |
|---|---|
| ***Experimenting***<br>Ability to plan or follow a procedure, collect data, recognising a problem, draws conclusions.<br>***Observing***<br>Ability to look deliberately for known or unusual characteristics or features of things, and relationships among things observed.<br>***Communicating***<br>Ability to ask questions, explains, write a report of an experiment, evaluate a scientific procedure, and understand instruction.<br>***Inferring***<br>Ability to obtain logical judgment from a given premise or observed data. | ***Test Item***<br>You are provided with the following items funnel, a bowl of sand and distilled water.<br>a. Carry out the following instructions carefully<br>i. Add distilled water to the sand in the bowl and stir.<br>ii. Filter the mixture<br>b. Write a short explanation about your observations.<br>c. What inference can you make from your observation? |

The experimental group was handled by a research assistant after being trained on how to

conduct instruction using the investigative laboratory approach. The control group was taught by the regular chemistry teacher in the

selected school using the conventional expository method which was popularly used by chemistry teachers. Each teacher in both groups was given the validated lesson note and copy of TOSPSA which was used for data collection. The pre-test was administered by the two teachers initially briefed on how to teach their groups using TOSPSA instrument without feedback to the students.

The teacher for the experimental group (i.e. investigative laboratory group) taught the students the theoretical concepts of nature of matter, separation techniques, acids, bases and salts, kinetic theory and gas laws. The teacher then allowed the students to perform the experiments relating to the topics taught by following the procedure given by the teacher while the teacher observed, monitored and guided them when necessary.

The teacher in charge of the control group used expository method to teach the topics as in case of experimental group but without performing any experiment or engaging the students in any experiment related to the topics taught. The teaching here involved delivery of pre-planned lesson to the students. The teacher presented factual information on chemistry concepts and in addition, gave a verbal explanation of the experiment procedures, and expected results.

The teaching lasted for four weeks, each teacher in the experimental and control groups administered the TOSPSA again as post-test after teaching the chemistry concepts following the stipulated guidelines. The data collected were subjected to descriptive and t-test analyses

**Results**

The groups' pre-test observations were subjected to T-test and T-value obtained was less than table value at 2 and 118 degree of freedom and at 0.5 level of significance. This means that the result was not significant and that the two groups had the same pre-entry knowledge therefore the two groups' post-test observation were subjected to T-testy to test the hypothesis of the study.

**Hypothesis 1:**

There is no significant difference in the pre-test mean scores of students exposed to investigative laboratory approach and those exposed to expository method of teaching in chemistry.

**Table 1: T-Test Analysis of Pre-Test Score of Students' Science Process Skill Acquisition in Chemistry**

| Group | Type of test | Mean | SD | DF | T-cal | T-table |
|---|---|---|---|---|---|---|
| Investigative Lab. | Pre-test | 11.10 | 6.01 | 118 | 0.16 | 1.96 |
| Expository method | Pre-test | 11.28 | 6.10 | | | |

**At 0.05 level of significance**

From table 1, the groups pre-test scores show that the mean score (11.10) of the Experimental group is closer to that of control group (11.28). This shows that the result was not significance and this implies that students in the two groups have the same initial knowledge of the concepts under study. Table 1 shows that T-cal <T-table therefore, $H_0$1 is accepted meaning there is no

significant difference in the pre-test score of experimental and control groups.

**Hypothesis 2:**
There is no significant difference in the post-test mean scores of students exposed to investigative laboratory approach and those exposed to expository method of teaching in chemistry.

**Table 2: T-Test Analysis of Post-Test Score of Students' Science Process Skill Acquisition in Chemistry**

| Group | Mean | SD | df | T-cal | T-table |
|---|---|---|---|---|---|
| Investigative | 34.80 | 10.31 | 118 | 4.88 | 1.96 |
| Expository | 26.75 | 7.53 | | | |

**At 0.05 level of significance**

Table 2 shows that T-cal >T-table therefore, $H_0 2$ is rejected meaning there is a significant difference in the post-test score of experimental and control groups.

From table 2 it was revealed that the experimental group performed better than the control group. Thus, the hypothesized similarity of no significant difference between the experimental and control groups was rejected. The calculated T-value (4.88) at $P<0.05$ is considerably greater than the T-table (1.96). This indicates that students exposed to investigative laboratory approach (experimental group) perform significantly better and acquired high science process skills than students exposed to expository method.

**Discussion**

The findings of this study as presented in table 1 indicated that the students pre-test mean score was not significant and the two groups had the same pre-entry knowledge. The table 2 indicated that the investigative laboratory approach produced high mean science process skills acquisition score in chemistry. This implies that the experimental (investigative laboratory approach) group was significantly better than the control (expository method) group. The success of the investigative laboratory approach group over expository method group may have been due to the fact that the former were provided with opportunity to employ the process skills of science such as observation, organization, classification, investigation, thinking and critical analysis and interpretation of their findings in order to draw logical conclusion and generalization. This could have enable them apply the knowledge acquired to a new but related situations. The result of this study was found to be consistent with Okoli (2006), who found out that the investigative laboratory approach was significantly better than expository method in improving the overall achievement of students and also, in facilitating application of principles and science concepts.

**Conclusion**

From the findings of this study, it can be posited that teaching students using the investigative laboratory approach enable students to acquire not only scientific knowledge but also science process skills. This implies that chemistry teachers should use the investigative laboratory approach that exposes students to hand-on-minds-on scientific activities, rather than the expository method that encourages only role memorization of scientific knowledge. Such memorized knowledge has little transfer value to new situation outside the school context and

does not promote creativity and science process skill acquisition.

The findings of this study have projected an innovative teaching method (the investigative laboratory approach) to science teachers and students.

Based on the findings of this study, it is recommended that the Government should provide conducive learning environment by providing adequate chemistry classroom as well properly equipped chemistry laboratories to enhance the acquisitions of science process skills by chemistry students. Also, the Government is encouraged to utilize the services of various professional bodies such as Science Teachers Association of Nigeria (STAN), All Nigerian Conference of Principals of Secondary Schools (ANCOPSS); National Union of Teachers (NUT); and Facilities/Institutes of Education in the Universities to organise in-service training programmes, workshops, conferences and seminars for serving chemistry teachers to update their knowledge on the use of innovative teaching methods that can enhance acquisition of science process skill by chemistry students.

Science educators and curriculum planners are encouraged to incorporate innovative and pedagogical strategies (like the investigative laboratory approach) into their various teacher education programmes. Chemistry teachers should make them available in attending in-service training conferences and workshop to update their knowledge and skill in the use of innovative teaching methods. More importantly, chemistry teachers should be creative, resourceful, and enthusiastic in their chosen profession by adopting measures that ensure that their students acquire the right scientific knowledge, skills and attitudes while at the same time inculcating literacy in these students.

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