Laboratory Activity Method: Best Strategy in Teaching and Learning of Chemistry

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Abstract
This study was designed to investigate the influence of laboratory activity as the best strategy for teaching and learning of chemistry in Senior Secondary School. A pretest and post-test experimental control group design was employed. The sample consists of one hundred (100) senior secondary school (SS III) chemistry students who were grouped into two and used in the three year study. The principle of randomization by flipping a coin was applied in selecting the experimental group and control group. Both groups were exposed to the same chemistry topics. Pretest was administered at the beginning to the two groups using Chemistry Achievement Test (CAT). Two hypotheses formulated guided the study. At the end of the treatment both groups were post-tested and the result was analyzed using t-test to determine a significant difference in their mean scores at $P \geq 0.05$ level of significant. The findings among others revealed that students taught using the laboratory activity method (experimental groups) performed significantly better than those taught through lecture method (control group). Some recommendations were given among which includes; laboratory activity method should be given more emphasis in teaching and learning of chemistry at all levels of education rather than using lecture method of instruction. This will spur their interest to learn. Workshop should be organized to train teachers in the uses of and relevance of laboratory activity method in teaching and learning of chemistry.

Keywords: Best Strategy, Laboratory Activity Method, lecture method, experimental group, Teaching, Learning.

Introduction
There are various methods of teaching and learning of chemistry, the modern chemistry teaching method should be organized in such a way to reflect the processes chemistry and science in general. No matter how much effort a teacher put in teaching, his methods of instruction can never be effective unless he is able to capture the interest, and therefore, the attention of the learners. He needs to motivate and inspire his learners, all with the sole objective of reaching the instructional purpose, and one way in which the teacher accomplished these expectations is through the use of appropriate/best teaching method. The attainment of a goals of science education is major concern of education policy makers of the world. One of the important problems that confront the present day teacher is how to raise the efficiency of the learners in their procedures of the study in their various subject.
Several teaching methods exist that chemistry teachers use in presenting scientific information, principles or skills to the students depending on their professional levels, these methods have been grouped into convectional and non-convectional approaches methods of teaching (MDGs project, 2011).

Learners of chemistry need to be engaged actively in the learning processes and their learning must supported and monitored explicitly so that the learning becomes meaningful especially if it is learners centered. This will enhance the learner understanding / mastering of abstract principle, remembering of factual information, techniques, reasoning etc, to enabling them to develop skills and positive attitude toward learning of chemistry. The ultimate importance goal in teaching and learning is what learners are able to learn and not just what teachers are required to teach (NCCE, 2011). In science instructions for instance, if a learner accomplish a task successfully and attains a specific goals for a particular learning experience, he/ she is said to achieve in learning.

Kankia (2008) revealed that learners remember one-fifth (1/5) of what they hears, half (1/2) of what they sees and three-quarters (3/4) of what they do practical with their own hands. Therefore, learning by doing and not by seeing or hearing should be given more emphasis so that proper transfer of information should take place.

The poor chemistry skill acquisition by student is not in keeping with the aims and objectives of education in Nigeria which state that “education should aim at helping the student acquire appropriate skills, competences and abilities, both physical and mental as equipment for the individual to live in and contribute to the development of the society” (FRN 2004). The most important of all, is to develop student in their manipulative and experimental skills necessary to make them competent and confident in their investigation of matter around them, and inculcate in them scientific approach to problem solving.

**Laboratory Activity Method of Instruction**

Science laboratories is an important resource input for teaching and learning of chemistry and an important predictor of academic achievement, but depends upon the degree to which it is essentially used (Dahar and Faize, 2011). Lunetta, Hofstein and Clough (2007) reported that science laboratories are intended to promote scientific reasoning, and improve understanding of scientific concept. Laboratory work is considered essential in promoting students learning of science and scientific inquiry. Hosfstein and Lunetta (2004) reported that inquiry-Type laboratories activity have the potential to develop student ability and skills such as: posing scientific orientated questions, formulating hypothesis, designing scientific investigation, revising scientific explanations, and defending scientific argument.

Practical experiences in science subjects are crucial for the understanding of principles and application of knowledge and in any learning experience, practical involves learners in activities that enable them to use their science process skills such as measuring, observing, experimenting, classifying etc, and also practical work motivate and generates student interest in science (Onu, 2007). The national Policy on Education stated clearly in its aims and objectives that the learner would be given opportunity to acquire basic practical skills for self- reliance and employments (NPE, 2004). Chemistry as a mother science subject the need to teach it through practical activity cannot be over emphasized.
Laboratory activities used hands-on, cooperative, inquiry, experimentation and constructivist learning techniques collectively known as active learning techniques, which has been shown to increase learner’s interest in science. (Colangelo et al., 2009). Through laboratories activities students discover new ideas for themselves. Teacher–student, student–student interactions during laboratory activities contribute to developing learning experiences and promote long-term memory than theory alone.

Researchers in Science Education have suggested that learning science is enhanced and the understanding level is improved when the learners are engaged in science practical and experiments (Hodson, 1993 and Dahar and Faize 2011). Practical work stimulates the learner’s interest in the science subjects they are studying when they are personally made to engage in the useful scientific activities and experimentation.

Teaching and learning of chemistry has been through the traditional method, with little or no attention paid to the ways in which students learn. In view of various methods of various studies in respect to teaching and learning of chemistry and how improvement can be enhanced. This study is designed to investigate the effect of laboratory activity instructional method in relation to convectional lecture method of teaching and learning on student’s academic achievement in senior secondary school chemistry and empirical investigation to determine the relative effectiveness of laboratory activity methods of teaching chemistry when compare with the convectional lecture teaching methods.

**Statement of Problem**

The prevailing teaching method in most Nigeria is the lecture method. This method does not allow active student’s participation in the lessons, but rather student’s memorized the facts and concepts without their basic understanding, and this unfortunately leaves no one in doubt about the effectiveness of the teaching methods popularly used by the chemistry teachers. In the light of these, there is need to find out how effective the teaching and learning of chemistry through laboratory activity method of instruction to the academic achievement of the chemistry students.

**Purpose of Study**

This study was undertaken to determine possible relationship that may exist between students’ performance in chemistry when exposed laboratory experimental method of teaching and when exposed to convectional lecture method. It further aimed to determine if any significantly better achievement in chemistry when student expose to laboratory activity than lecture method.

**Research Questions**

This research is design to provide immediate answer to the following questions:-

1. Are there any differences in academic achievement of chemistry students when expose to new concept using laboratory activity method and lecture method?
2. What influence does laboratory activities method has on the students’ interest in learning of chemistry?
3. Are there any significant differences between mean performance scores of the student taught using laboratory method and those students taught using lecture method of instruction?
Hypothesis
The following null hypothesis was formulated to guide the study:

\( H_{01} \): students exposed to laboratory activity do not exhibit significantly better performance in chemistry than those exposed to lecture method of instruction.

\( H_{02} \): there is no significant difference in the mean score of the chemistry students taught using laboratory method and those students taught using lecture method.

Research Design
The design of the study was experimental and control condition, specifically the pretest and posttest of equivalent control design.

Population and Sample
A total number of one hundred S.S III chemistry students in Lapai Local Government Area of Niger state were involve in the period of three years study. The two schools offering chemistry were purposely selected which formed the samples for the study. They are Government Secondary Schools, Ebbo and Government secondary school, Muye. There were selected using the principles of randomization by flipping a coin. Based on that, Government secondary school, Muye became the experimental group while Government Secondary Schools, Ebbo became the control group. Experimental group consist of forty-two students and Control group consist of fifty-eight student.

Table 1: Distribution of groups
<table>
<thead>
<tr>
<th>Session</th>
<th>Groups</th>
<th>Name of the school</th>
<th>Number of student</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011/2012</td>
<td>Experimental</td>
<td>GSS Muye</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>GSS Ebbo</td>
<td>14</td>
</tr>
<tr>
<td>2012/2013</td>
<td>Experimental</td>
<td>GSS Muye</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>GSS Ebbo</td>
<td>17</td>
</tr>
<tr>
<td>2013/2014</td>
<td>Experimental</td>
<td>GSS Muye</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>GSS Ebbo</td>
<td>23</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>100</td>
</tr>
</tbody>
</table>

Methodology
A pre-test was administered to the students in both experimental and control groups to ensure equivalence. Two different method of teaching was adopted to the different groups under study, the use of laboratory activity method to one group (experimental group) and convectional lecture method to another group (control group) in other to compare their performance at the end of the whole programmed. Experimental group students and control group students were taught separately. The topics in the experimental group were taught in the laboratory using laboratory method of instruction, while the control groups were taught in the classroom using the lecture method of instruction. The different treatment last for 12 weeks to cover all the topics. The post-test was administered at the end of the treatment, the student performance in the assessment were compared by using t-test to determine the difference in the mean scores of the two different groups.
Data Analysis
The t-test statistical method at $p \geq 0.05$ level of significant was used to analyze the data obtained. Data obtained from the results of Chemistry Achievement Test (CAT) that was administered to the students after they have been exposed to experimental method and lecture method of instructions is shown in Table 2 and 3.

Results
The results are presented in form of Tables.

HO$_1$: students exposed to laboratory activity do not exhibit significantly better performance in chemistry than those exposed to lecture method of instruction. T-test statistical techniques was used to compare the mean scores of the both experimental and control groups as shown in Table 2.

Table 2: T-test comparison of mean scores for the Students’ Academic Performance of Experimental (laboratory activity method) and Control (lecture method) Groups for three Academic Sessions.

<table>
<thead>
<tr>
<th>Session</th>
<th>Groups</th>
<th>N</th>
<th>X</th>
<th>SD</th>
<th>SE</th>
<th>t-value</th>
<th>Df</th>
<th>P</th>
<th>Decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011/2012</td>
<td>Experimental</td>
<td>12</td>
<td>58.64</td>
<td>9.86</td>
<td>2.85</td>
<td>2.892</td>
<td>24</td>
<td>0.106</td>
<td>Significant</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>14</td>
<td>42.80</td>
<td>7.94</td>
<td>2.12</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2012/2013</td>
<td>Experimental</td>
<td>15</td>
<td>63.40</td>
<td>13.51</td>
<td>3.49</td>
<td>2.792</td>
<td>30</td>
<td>0.084</td>
<td>Significant</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>17</td>
<td>44.35</td>
<td>11.63</td>
<td>2.82</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2013/2014</td>
<td>Experimental</td>
<td>19</td>
<td>61.52</td>
<td>13.79</td>
<td>3.16</td>
<td>3.227</td>
<td>40</td>
<td>0.097</td>
<td>Significant</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>23</td>
<td>41.76</td>
<td>12.36</td>
<td>2.58</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- All significant at $p \geq 0.05$

The results from Table 2 above showed the t-values calculated for all the three academic session, that is, the t-value calculated for 2011/2012 academic session is 2.892 at df of 24 which is greater than the t-critical value of 2.064, also in 2012/2013 session the t-value calculated is 2.792 at df of 30 which is greater than the t-critical of 2.042 and the t-value calculated for 2013/2014 academic session is 3.227 at df of 40 which is also greater than the t-critical value of 2.021. The results showed that, all the t-values calculated were greater than the t-critical and the p-values were greater than 0.05, thus the HO$_1$ that students exposed to laboratory activity do not exhibit significantly better performance in chemistry than those exposed to lecture method of instruction is rejected.

HO$_2$: there is no significant difference between the pre-test and post-test mean performance scores of the chemistry students taught using lecture method of instruction (Control Group).

Table 3: Comparison of Academic Performances of the lecture method (Control Groups) in the pre-test and post-test mean scores for three Academic sessions.

<table>
<thead>
<tr>
<th>Session</th>
<th>Control Groups</th>
<th>N</th>
<th>X</th>
<th>Sd</th>
<th>t-values</th>
<th>Df</th>
<th>P</th>
<th>Decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011/2012</td>
<td>Pre-test</td>
<td>14</td>
<td>41.14</td>
<td>8.89</td>
<td>1.765</td>
<td>13</td>
<td>0.026</td>
<td>Not significant</td>
</tr>
<tr>
<td></td>
<td>Post-test</td>
<td>14</td>
<td>42.80</td>
<td>7.94</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2012/2013</td>
<td>Pre-test</td>
<td>17</td>
<td>43.68</td>
<td>12.85</td>
<td>1.736</td>
<td>16</td>
<td>0.021</td>
<td>Not significant</td>
</tr>
<tr>
<td></td>
<td>Post-test</td>
<td>17</td>
<td>44.35</td>
<td>11.62</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The results from the Table 3 above revealed that all the calculated t-values were less than the t-critical values at $p \geq 0.05$, the calculated t-value of 2011/2012 session at $df= 13$ is 1.765 which is less than the t-critical value of 2.160, also in 2012/2013 session, the calculated t-value at $df=16$ is 1.736 which is less than the t-critical value of 2.120 and the calculated t-value of 2013/2014 session at $df = 22$ is 1.653 which is less than the t-critical value of 2.074, thus the HO$_2$ that there is no significant difference in the mean performance scores of the student taught using lecture method (control groups) in their pre-test and post-test mean scores is accepted, since the calculated t-values were all less than the t-critical values and $p$ values of 0.026, 0.021 and 0.029 were all less than 0.05. Showing no significant difference in the mean performance scores of the student taught using lecture method (control groups) in their pre-test and post-test mean scores.

Discussion of the Results

The results from Table 2 indicate that the experimental groups student performed significantly better in their mean scores than the student in the control groups for all the three academic session, also the results showed that, all the t-values calculated were greater than the t-critical, thus the HO$_1$ is rejected, indicating that students exposed to laboratory activity method of instruction (experimental groups) do exhibit significantly better performance in chemistry than those taught using lecture method (control groups) of instruction. This tends to shows that the use of laboratory activity based method of teaching such as experimental method is best strategy for effective teaching and learning of chemistry in secondary schools. The null hypothesis in Table 3 is accepted at $p \geq 0.05$, this implies that the lecture method used in teaching the control groups do not enhance their performance significantly beyond their performance in the pre-test. This result goes further to support the effectiveness and superiority of laboratory activity method of instruction over the lecture method. The above evidence therefore suggests that the laboratory activity method is the best strategy for the teaching and learning of chemistry in secondary schools. The finding of the present study is in agrees with (Dahar and Faize, 2011) “Science laboratories is an important resource input for teaching and learning of chemistry and an important predictor of academic achievement”.

Conclusion

The results of this research work showed that the laboratory activity method of instruction is the best practice in teaching and learning of chemistry when compared with lecture method. The use of laboratory activity method such as experimentation enhances the quality of instruction and understanding of basic scientific concept thus, leading to improved academic performance in chemistry.

Recommendations

From the findings of this research work, the following recommendations were made:

- Laboratory activity method of instruction should be emphasized for teaching and learning of chemistry more than lecture method.
- Chemistry teachers should guide and direct the students appropriately so that they will not loss direction of the targeted objectives.
- Government should provide adequately all necessary logistics that are needed by chemistry teacher to guide and direct the learning process.
- Given the general poor facilities in the laboratories, chemistry teachers should be trained in improvisation so as to improvise for the lacking facilities in laboratories.
- Seminars and workshop should be organized and attained by chemistry teachers for training and retraining on effective and best method of teaching and learning in all level of education.

References


