Full Length Research Paper

Effects of guided-inquiry and expository teaching methods on senior secondary school students’ performances in Biology in Imo State

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Accepted 3 April, 2013

This study investigated the effects of guided-inquiry and expository teaching methods on students’ performances and interest in Biology. Students’ performances in the sciences (Biology) have been below expectation. The performances of the students in the Researcher-Made Biology Test (RMBT) using the expository method and guided-inquiry were compared. Furthermore, the interests of the two groups of students in Biology were compared. A purposive sample of 84 senior secondary school two (SSS II) students was drawn from two intact classes in a co-educational secondary school in Imo State. Two instruments were used for the study namely Biology Achievement Test (BAT) and Biology Interest Scale (BIS). The reliability of BAT was established at 0.78 through the use of Kuder-Richardson (K-R 20) statistic. The reliability of Biology Interest Scale (BIS) was calculated through the use of Cronbach Alpha statistic and the coefficient of 0.91 obtained. The research questions were answered using Means and Standard deviations while the hypotheses were tested using Analysis of Co-variance (ANCOVA). Major findings of the study include: Teaching methods have statistically significant effect on students’ performances in Biology. Students taught with guided-inquiry teaching method out-performed students taught with expository teaching method in Biology. The female students out-performed the males in the RMBT. The female students have higher interest levels in the RMBT than the males. The researcher recommended among other things that Biology teachers and Science teachers in general take into consideration these teaching methods when presenting Biology and science materials to the students in the classroom.

Key words: Biology, student, performance, interest, teachers.

INTRODUCTION

Science is an essential tool for any nations’ progress and development (Akinbobola, 2009; Agboghorma, 2009, Chukwuneke, 2006). Students should actually be given opportunity to discover, invent and get caught up in the rapid expansion in science and technology. This is because, biology has made great impact in the development of nations and its importance warrants the need to expose biology students to innovative methods like guided-inquiry method in the secondary schools. If biology students are exposed to guided inquiry method of teaching in the secondary schools, students will be able to apply knowledge, communicate effectively, and be analytical, critical thinkers, inquisitive and imaginative. A student must be self confident, motivated learner, creative and curious (NBTE2006). Once an individual acquires the right skills and attitude through appropriate teaching methods she/he can survive even in the desert. Studies like those of Okereke,(2006), Odili,(2006), Betiku,(2002), and Obodo (2001) indicate that many teachers prefer the traditional expository/lecture method of teaching and shy away from innovative methods like inquiry, discovery and laboratory approach to learning. Researchers such as Ibe (2007), Nnaka (2006) and Akubilo (2004) have pointed out that despite the thirty years existence of learning style theories (detailing how people learn), most teachers still dispense information using traditional lecture methods without regard to students’ learning abilities. These traditional teaching methods are theoretical, extremely didactic and teacher-centered, instead of being activity-based and learner-
centered. A study of teaching behaviour and students' achievement in science by Akubuilo (2004) shows that student activities are better than teacher activities in promoting authentic learning, at least in senior secondary school Biology classrooms.

Many Nigerians are concerned about the poor performance of students in science subjects especially at the Secondary School level of Education. One of such subjects in which the situation calls for adequate attention is Biology. In the past 20 years, for instance, not more than 41.25% of the candidates who participated in the senior school certificate Examination obtain credit and above in Biology says WAEC 2007, Aloya, 2004). The researcher as a biology teacher is of the view that biology students in secondary schools in Imo State perform badly over the year – According to this researcher, this could be attributed probably to the teaching methods adopted by the teachers. Could the use of an innovative teaching method such as the guided-inquiry method improve the performances and interest of the students in a Researcher Made Biology Test (RMBT).

Guided Inquiry means careful planning, close supervision, ongoing assessment and targeted intervention by an instructional team of teachers through the inquiry process that gradually leads students toward independent learning (Crede, 2008). Its ultimate goal is to develop independent learners who know how to expand their knowledge and expertise through skilled use of a variety of information sources employed both inside and outside of the school (Kuncel, 2008). Guided-inquiry requires students to find out things for themselves. This cannot be done where the teaching method is lecture-centered and study habit inactive. The use of guided-inquiry method for teaching biology in combination with an active study habit will motivate and interest students in a lesson. It focuses students' attention and initiates problem solving. If guided-inquiry and active study habit for teaching biology are utilized, the students will be self-reliant after graduation.

Expository teaching merely emphasizes presenting ideas and information meaningfully and effectively so that the learner can derive other meanings from what she/he is presented with. Factual information is most easily learned if it is organized and sequenced logically. Hence, the contents of material must be presented in a logical order, moving from generic to specific concepts, so that learners can form cognitive structures and encode new information. The expository approach is a teacher-centred, student-peripheral teaching approach in which the teacher delivers a pre-planned lesson to the students with or without the use of instructional materials. Iheonu (2005) indicated that in using this approach, the teacher talks about science while the students read about science.

The studies by Akinbobola and Afolabi (2009) and that of Agboghoroma (2009) investigated instructional methods such as constructivist practices and three instructional modes and students achievements. The aforementioned studies, however, differs from the present study as this study investigates the effects of two teaching methods, Guided- Inquiry (activity method) and Expository Lecture Method on students' performance and interest in Biology. Akinbobola and Afolabi (2009) in their study investigated constructivist practices through guided discovery approach and the effect on students' cognitive achievement in Nigerian senior secondary school Physics. The study adopted pre-test- post-test control group design. A criterion sampling technique was used to select six schools out of nine schools that met the criteria. A total of 278 students took part in the study; this was made up of 141 male students and 137 female students in their respective intact classes. Physics Achievement Test (PAT) with the internal consistency of 0.77 using Kuder Richardson formula 21 was the instrument used in collecting data. The data were analysed using Analysis of Covariance (ANCOVA) and t-test. The results showed that guided discovery approaches was the most effective in facilitating students' achievement in physics after being taught using a pictorial organizer. This was followed by demonstration while expository was found to be the least effective. Also, there exists no significant difference in the achievement of male and female physics students taught with guided discovery, demonstration and expository teaching approaches and corresponding exposure to a pictorial organizer. The study of Akinbobola and Afolabi (2009) did not indicate the population of the study from where the sample of 278 subjects was drawn. The researchers used intact classes and did not specify the class size for each of the classes: whether equivalent or non-equivalent, whether classes made up of all males or all females.

The following objectives guided the study:

i. Find the performances in a Researcher –Made Biology Test (RMBT) of students taught using Expository method (A) or the others using Guided Inquiry (B) respectively;
ii. Find the performances in a RMBT of the male and female students taught using the expository method or guided inquiry;
iii. Ascertain the interest levels in the RMBT of the students taught using Expository method (A) or Guided Inquiry (B) respectively.

The objectives were transcribed into the following research questions:

i. What are the respective mean scores in a Researcher –Made Biology Test (RMBT) of students taught using the expository method (A) or the guided inquiry (B) respectively?
ii. What are the respective mean scores in a RMBT of male and female students taught using the expository method (A) or the guided inquiry (B) respectively?
iii. What are the respective mean scores on an interest
scale of students taught using the expository method (A)
or the guided inquiry (B) respectively?

The present study finds its educational roots in
constructivism which focuses on the fact that knowledge
is actively built-up by the learner (Heikkila and Lonka,
2006). The role of the lecturer is changed into that of a
manager of knowledge, a facilitator who provides
guidance, a helper and an assistant (Gibbs, 2005). The
constructive perspective of learning states that
knowledge is built by the learner, not supplied by the
teachers. In other words learners play active role in
constructing learning in the learning process rather than
accepting that of the teacher. Innovative method like the
guided-inquiry method may have to be introduced to
prepare students to become independent learners.
Through the use of such method, teachers can provide
opportunity for students to learn, think critically, and
discuss among their peers. This theoretical framework
holds that learning always builds upon knowledge that a
student already knows; this prior knowledge is called a
schema. Because all learning is filtered through pre-
existing schemata, constructivists suggest that learning is
more effective when a student is actively engaged in
the learning process rather than attempting to receive
knowledge passively.

METHODS

The study adopted a two-factor pre-test/post-test non-
randomised quasi-experimental design. The subjects for
the study were Eighty-four (84) senior secondary school
II Biology students from one co-educational school. The
84 students were now divided into two equal parts of 42
each. The guided-inquiry are made up of 42 subjects.
Twenty-four (24) of the subjects are females while
eighteen (18) are males. The expository method on the
other hand consisted also of Forty-two subjects
(42). Twenty-five (25) of the subjects are females while
fifteen (15) of the subjects are males.

The Kuder-Richardson 20 formular was adopted in
determining the reliability co-efficient of this instrument
(BAT). Thirty senior secondary school II Biology students
selected from one co-educational schools not used for
the study gave answers to the items for the reliability of
the instrument. The value of 0.78 was obtained. The
internal consistency of the instrument Biology Interest
Scale (BIS) was established using thirty SS II biology
students. Since the responses to the items of the
instrument were not dichotomously scored, Cronbach's
Alpha reliability method was used to arrive at the value of
0.91

Experimental procedure

After obtaining permission from the principal of the
selected school, the regular biology teacher in this school
who served as the experimental teacher in the study was
trained/inducted for one week by the researcher. The
teacher was then given the validated lesson plans to
enable her get used to the lesson plan. Before treatment
commenced, the two instruments (BAT and BIS) were
administered to the students. The BAT and BIS were
administered here as pre-test and their scores were
noted. The researcher constructed a pre-test test based
on the topic of intervention. The test items were then
marked scored and the scores kept as pre-test scores.
The pre-test was used to assess what the subjects do in
fact already know.

The treatment for the study was teaching methods
(using guided-inquiry and the expository method) and this
lasted for four weeks. The choice of these two methods
was based on the focus of the study. The first group
(group B) was taught skeleton and supporting systems in
organisms by the teacher using guided-inquiry method.
This involved grouping the students into groups of five or
six with each group provided with the relevant
instructional materials (Real materials, charts, models,
etc) needed for each lesson. The teaching featured
introduction of the topic, drawing attention to the
instructional materials, use of probing questions to guide
the students in finding solutions to the problem at hand,
allowing student to ask questions and draw their
conclusions, and direct the student against inconsistencies. Each activity was followed by class
discussion which consisted of contribution and further
question. In other words, the students were allowed to
observe, manipulate, report and draw conclusion under
the guidance of the teacher. Since the class was student-
centred, a lot of questions were raised. Furthermore,
readymade answers were not provided. Both student and
teacher discussed and sought for solution to the
question.

The second group (group A), on the other hand were
taught the same topic using expository method. A lot of
verbal expositions were used by the teacher. That is,
using this method the teacher delivered the pre-planned
lesson to the subjects with the use of instructional materials.
The teacher proceeded directly to the task of solving the
given problems without giving the students (subjects)
the opportunity to discover methods of finding solutions or
principles behind the solutions. Hence, interactions
between the teacher and the students were minimal and
the student listened and tried to assimilate the principles
and procedures to the correct solution to the given
problems without questioning.

Three periods of 40 minutes (one single lesson of 40
minutes and 80 minutes double lesson) each for four
weeks were spent for the treatment. These periods were
in line with the school time-table. There was no alteration
on the time allocated to biology in the selected school. A
day after completing the treatment, the BAT and BIS
were administered as post-tests and the scores of
students collated. The post-test items were constructed
Table 1. Means and standard deviations of the students’ scores in post-test BAT (Teaching Methods).

<table>
<thead>
<tr>
<th>Experimental conditions</th>
<th>Teaching methods</th>
<th>Study habits</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>Active</td>
<td>Inactive</td>
</tr>
<tr>
<td>Guided-inquiry</td>
<td>14</td>
<td>28</td>
<td>42</td>
</tr>
<tr>
<td></td>
<td>X 35.29</td>
<td>46.69</td>
<td>42.89</td>
</tr>
<tr>
<td></td>
<td>SD 4.08</td>
<td>3.84</td>
<td>7.78</td>
</tr>
<tr>
<td>Experimental Groups (A &amp; B)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Expository</td>
<td>23</td>
<td>19</td>
<td>42</td>
</tr>
<tr>
<td></td>
<td>X 46.09</td>
<td>33.63</td>
<td>40.45</td>
</tr>
<tr>
<td></td>
<td>SD 2.92</td>
<td>5.61</td>
<td>7.62</td>
</tr>
<tr>
<td>Overall</td>
<td>37</td>
<td>47</td>
<td>84</td>
</tr>
<tr>
<td></td>
<td>X 45.74</td>
<td>46.34</td>
<td>46.07</td>
</tr>
<tr>
<td></td>
<td>SD 3.34</td>
<td>5.09</td>
<td>4.31</td>
</tr>
</tbody>
</table>

from the unit of the topic that were taught the students during the treatment using the expository and guided inquiry methods. The post-test were given to subjects after completion of the instructional programme. The post-test scores were used to ascertain the performances of the subjects as regards the treatment given. If there is any improvement in the performance of the subject when compared to the pre-test scores, then it will be adduced that the differences arose due to the treatment given.

RESULTS

Data in Table 1 shows that the mean performance score of students with taught using the expository method is (46.09 with SD score of 2.92) while the guided-inquiry method is (35.29 with SD score of 4.08). On the other hand, the mean performance score of students with inactive study habits taught using the expository method is (33.63 with SD score of 5.61) while the guided-inquiry method is (46.69 with SD score of 3.84). In other words, students’ mean performance scores in biology appear to varied across both teaching methods and study habits.

The extent of this variation of students’ mean performance scores in biology with teaching methods was further inferred from the following hypothesis:

**Ho1:** The mean scores in a RMBT of students taught through the expository method or guided-inquiry method do not differ significantly.

Table 2 shows that teaching method as a main effect on students’ performance in biology is significant. This is because the probability value of 0.037 at which this main effect is shown to be significant is lower than the level of 0.05 at which it is being tested. This implies that teaching methods have statistically significant effect on students’ mean performance score in biology. In other words, the null hypothesis of no statistically significant effect is rejected at 0.05 level of confidence. Thus, the earlier observed difference between the overall mean performance scores of the method groups as in table 6 is a real difference which could not be attributed to chance associated with the study.

Data in Table 3 show that the mean scores for the females in the expository method is 11.53 and in the guided inquiry method 17.42. The mean scores for the males in the expository method is 10.26 and in the guided inquiry 16.42. The mean scores of the females on the whole (14.23) were higher than those of the male (13.20).

Data in Table 4 show that the overall mean interest score for the guided-inquiry method group is 72.38 while that of the expository method group is 63.55.

DISCUSSION

**Effect of teaching methods on students’ performances in Biology**

Findings from the study reveal that a difference exists among the performance of Biology students taught with guided inquiry and expository teaching methods. Students performed better in the Researcher Made Biology Test (RMBT) using the guided inquiry than the expository method. The finding implies that the use of learner participatory instructional strategies has positive effects on students’ academic performance. Since the guided-inquiry teaching method has been found to enhance student’s performance in Biology more than the expository method, it becomes clear that the balance should be made between the two methods of teaching when planning learning experiences in the school. This could be attributed to the fact that the guided-inquiry method is child-centred than the expository method. This
Table 2. Analysis of Covariance (ANCOVA) of students’ overall performance scores by teaching methods and study habits.

<table>
<thead>
<tr>
<th>Sources of variation</th>
<th>Sum of Squares</th>
<th>Df</th>
<th>Mean Squares</th>
<th>F_{cal}</th>
<th>Significance of F</th>
<th>Decision at P&lt;0.05</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-test (covariates)</td>
<td>0.002</td>
<td>1</td>
<td>0.002</td>
<td>0.000</td>
<td>0.988</td>
<td>NS</td>
</tr>
<tr>
<td>Main Effects</td>
<td>3.207</td>
<td>2</td>
<td>1.603</td>
<td>0.249</td>
<td>0.688</td>
<td>S</td>
</tr>
<tr>
<td>Teaching Methods</td>
<td>2.716</td>
<td>1</td>
<td>2.716</td>
<td>0.421</td>
<td>0.037</td>
<td>S</td>
</tr>
<tr>
<td>Study Habits</td>
<td>0.255</td>
<td>1</td>
<td>0.255</td>
<td>0.025</td>
<td>0.025</td>
<td>S</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2-Way Interaction</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Teaching method X Study habits</td>
<td>15.020</td>
<td>1</td>
<td>15.020</td>
<td>2.217</td>
<td>0.012</td>
<td>S</td>
</tr>
<tr>
<td>Explained</td>
<td>18.276</td>
<td>4</td>
<td>4.766</td>
<td>0.692</td>
<td>0.89</td>
<td>NS</td>
</tr>
<tr>
<td>Residual</td>
<td>674.677</td>
<td>80</td>
<td>8.43</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>692.953</td>
<td>84</td>
<td>9.44</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 3. Means and standard deviations of the male and female students in the post test BAT.

<table>
<thead>
<tr>
<th>Experimental conditions</th>
<th>BAT</th>
<th>Gender</th>
<th>Mean</th>
<th>SD</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental Group A (Expository method)</td>
<td>Post Test</td>
<td>Female</td>
<td>11.53</td>
<td>1.92</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Male</td>
<td>10.26</td>
<td>2.43</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total</td>
<td>10.71</td>
<td>7.28</td>
<td>42</td>
</tr>
<tr>
<td>Experimental Group B (Guided-inquiry)</td>
<td>Post Test</td>
<td>Female</td>
<td>17.42</td>
<td>2.79</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Male</td>
<td>16.65</td>
<td>2.65</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total</td>
<td>16.99</td>
<td>2.71</td>
<td>42</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Female</td>
<td>14.23</td>
<td>3.85</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Male</td>
<td>13.20</td>
<td>4.08</td>
<td>34</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total</td>
<td>13.86</td>
<td>4.04</td>
<td>84</td>
</tr>
</tbody>
</table>

The finding corroborates with the findings of Agboghorma (2009), Okereke (2006) and Chukwuneke (2006) who reported that, the use of learner participatory instructional strategies (such as guided-inquiry teaching method) significantly enhanced the performance of students' in secondary schools.

The mean interest scores of the Biology students appear to vary with teaching methods. The guided-inquiry method group recorded a higher overall mean of 70.33 as against an overall mean score of 66.94 recorded by the expository method group. This is indicative that the guided-inquiry method fosters student's interest in Biology than the expository method. In other words, teaching method as a main effect is a significant factor in students’ interest in Biology. The observed probability value of 0.042 in Table 2 which is significant at 0.05 level of confidence testifies to this result.

This finding is in agreement with the findings of Ifeakor (2007) that teaching science through activity-based methods has a significant effect in fostering students' interest in science subjects than the conventional expository methods. Thus, students’ interest in Biology has been boosted on account of the guided-inquiry method than the expository method used in the study. These authors asserted there is a connection between interest and effort. The more a person is interested in a subject, the more effort he/she will put into it. These researchers further described an interested person as being engaged, engrossed or entirely taken up an activity because of its recognized worth.

Conclusion

Based on the findings and discussion of this study, the following conclusions were made:

i. This study established the effects of teaching methods on students' performances and interest in Biology.
ii. Teaching methods have effect on students' performances in Biology.
iii. Teaching methods have statistically significant effect
Table 4. Means and standard deviations of the students’ scores in post-test bis (teaching methods x study habits).

<table>
<thead>
<tr>
<th>Experimental conditions</th>
<th>Teaching methods</th>
<th>Study habits</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Active</td>
<td>Inactive</td>
</tr>
<tr>
<td></td>
<td>Guided-inquiry</td>
<td>N</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td></td>
<td>X</td>
<td>77.78</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SD</td>
<td>3.90</td>
</tr>
<tr>
<td></td>
<td>Expository</td>
<td>N</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td></td>
<td>X</td>
<td>68.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SD</td>
<td>3.13</td>
</tr>
<tr>
<td></td>
<td>Overall</td>
<td>N</td>
<td>37</td>
</tr>
<tr>
<td></td>
<td></td>
<td>X</td>
<td>74.07</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SD</td>
<td>3.60</td>
</tr>
</tbody>
</table>

on student’s interest in Biology.

iv. The study revealed that instructional strategy that is learner participatory has a significant influence on students’ performances in Biology.

RECOMMENDATIONS

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

i. Biology teachers and science teachers in general should take into consideration teaching methods when presenting Biology and science materials in the classroom.

ii. Biology teachers as well as science teachers are advised to use the guided-inquiry teaching method as students’ interest; positive attitude formation and performances of the sciences would be enhanced.

iii. Guided-inquiry teaching method should be used in teaching various concepts in Biology starting from the secondary school.

iv. Teacher training programmes should update their courses so that science teachers are able to impart the skill of studying in the learners.

v. Teachers should endeavour to use guided-inquiry teaching methods as it relates to certain topics in Biology. This could be achieved through workshops and seminars on how to use guided-inquiry teaching method.

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