Effects of teachers’ use of analogies on the achievement of senior school biology students in Oro, Kwara state, Nigeria

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Introduction

The central position of science in our contemporary world needs no emphasis. Without science broadly construed to include all forms of technical innovation, humans would still be struggling in their crude ways of doing things.

Science has been defined by many scholars depending on the angle from which they see it. Hence Abimbola (¹) defined science “as a body of knowledge, a way of investigating and thinking in the pursuit of an understanding of nature (p. 31). According to Ogunniyi (²) science is defined as an activity in search of meanings or concepts and generalizations about the world capable of observation and experimental testing (p.?).

Despite the contributions of science, notably biology, to the development of humankind in areas like medicine, agriculture, genetic engineering, etc., researches carried out Ahmed (⁵), Akuogbu (⁶) and Asenuga (⁷) show that the performances of students in the Senior School Certificate Examinations of the West African Examinations Council (WAEC) is generally poor and not encouraging.

Data obtained from the West African Examinations Council from years 2005-2009 (See Table 1) demonstrated further the low level of students’ performance in biology. Among the factors that are responsible for poor performances of students in biology include, approaches used in teaching biology by biology teachers Igwe (⁸), and the abstract nature of the science topics Ekpenyong (⁹), Gabebel (¹⁰) (2003) observed that these methods are not the best for high school students of high mathematics anxiety and low proportional ability. Hence, she suggested the use of analogies and schematic drawings on problems involving critical thinking.

Table 1:

<table>
<thead>
<tr>
<th>Year</th>
<th>Total entry</th>
<th>Total Credit Passes 1-6</th>
<th>Percentage Credit Passes 1-6</th>
<th>Total Below Credit Passes P7-F9</th>
<th>Percentage Below Credit Passes</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>1,081,557</td>
<td>377,885</td>
<td>35.74%</td>
<td>663,707</td>
<td>63.26%</td>
</tr>
<tr>
<td>2006</td>
<td>1,082,556</td>
<td>385,469</td>
<td>35.61%</td>
<td>697,087</td>
<td>63.39%</td>
</tr>
<tr>
<td>2007</td>
<td>1,238,168</td>
<td>413,211</td>
<td>33.53%</td>
<td>824,321</td>
<td>66.63%</td>
</tr>
<tr>
<td>2008</td>
<td>1,259,965</td>
<td>427,644</td>
<td>33.94%</td>
<td>832,321</td>
<td>66.06%</td>
</tr>
<tr>
<td>2009</td>
<td>1,292,107</td>
<td>461,583</td>
<td>35.72%</td>
<td>830,524</td>
<td>64.28%</td>
</tr>
</tbody>
</table>

Source: Report of WAEC State Committee Meeting. 2009

Frolov (¹¹) saw analogy as the establishment of similarities in certain aspects, properties and relations between dissimilar objects. Abimbola (¹) Defined analogy as a method of describing things that are not known in terms of things that are known. Also, Calik and Ayas (¹⁰) were of the opinion that analogical reasoning involves transfer of schema from a familiar situation into an unfamiliar situation such that analogies can make individuals to acquire useful insight into unfamiliar domains. It is on the basis of this that this study intended to find out effects of analogies on the achievement of senior school biology students in Oro, Kwara State, Nigeria.

Purpose of the Study

The main purpose of this study was to determine the effects of teachers’ use of analogies on students’ achievement in biology in senior secondary schools in Oro, Kwara State, Nigeria. The study sought to determine the:
(i) effects of the use of analogies on senior school students’ achievement in biology;
(ii) differences in senior school students’ achievement in biology, based on gender, when analogies are used; and
(iii) differences in senior school students’ achievement in biology, based on scoring levels, when analogies are used for instruction.

Research Questions
In this study, answers were sought for the following research questions:
1. What are the effects of teachers’ use of analogies on the achievement of senior school students in biology?
2. Do male and female senior school biology students achieve differently when taught with analogies and when not taught with analogies?
3. Do senior school students with different scoring levels achieve differently when taught using analogies?

Research Hypotheses
The following hypotheses were tested in this study:
1. There is no statistically significant difference between the achievement of senior school students taught using analogies and those taught with conventional method.
2. There is no statistically significant difference between the achievement of male and female senior school students when they are taught using analogies.
3. There is no statistically significant difference in the achievement of low, medium and high scoring senior school students when taught using analogies.

Research Design
This study employed a 2 x 3 x 2 factorial, quasi-experimental design, which involved a pretest, posttest, non-randomized control and non equivalent intact groups. The instructional strategies occurred at two levels; analogy and conventional teaching strategies, students’ scoring ability at three levels (low, medium and high) and students’ gender in two classes (male and female). The independent variable was analogy-based instructional strategy and it was the treatment for the experimental group while the conventional instructional strategy was used for the control group. The dependent variable was the students’ achievement in the pre-test and post-test while students’ gender and scoring levels served as moderating variables. The research design layout is shown in Table 2.

Population and Sample
The population of the study comprised all senior school two (SS 2) biology students in all secondary schools in Oro, Kwara State, Nigeria. However, the sample consisted of one hundred and ninety nine (199) students from four purposively sampled secondary schools in Oro. This sample was made up of ninety-seven (97) students for the analogy-based group and one hundred and two (102) students for the conventional group.

Table 2: Research Design Layout

<table>
<thead>
<tr>
<th>Group</th>
<th>Pre-test</th>
<th>Treatment</th>
<th>Post-test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>O₁</td>
<td>X</td>
<td>O₂</td>
</tr>
<tr>
<td>Control</td>
<td>O₃</td>
<td></td>
<td>O₄</td>
</tr>
</tbody>
</table>

O₁ and O₃ = Pre-test for both experimental and control groups
O₂ and O₄ = Post-test for both experimental and control groups
X = Treatment for the experimental group

Research Instrument
The research instrument was a researcher-designed one, containing a fifty-item multiple-choice test, with four options each derived from past questions in the National Examinations Council (NECO) and West African Examinations Council (WAEC) relevant to the topic of instruction (Animal cell) in the study. Analogy-based instructional lesson note was designed by the researchers and given to experts in biology education to determine its face and content validities, and suitability for the study. The experts certified it suitable for use for the study after making minor corrections in it.

Validity and Reliability
The contents of the Analogy-Based Instructional Strategy (ABIS) and Biology Achievement Test (BAT) were assessed and corrected by experts in biology education. The treatment and the achievement test were then certified to be adequate. The fifty multiple-choice questions were subjected to reliability by administering the test instrument to forty students (20 in the experimental group and 20 in the control group) of another school not participating in the study. A reliability coefficient of 0.73 was obtained, using Pearson Product Moment Correlation Coefficient at 0.05 alpha level.

Procedure for Data Collection
Subject teachers in the sampled schools taught the concepts in animal cell for four weeks, after the administration of pre-test, by using the lesson note prepared by the researchers on analogy-based instructional strategies. The teachers had been trained by the researchers. The response of students during the treatment exercise was impressive and they were also exposed to a post-test after the treatment. In the case of control group, they were equally pre-tested and taught the same topic for the same period without exposing them to analogy technique after which they were equally exposed to post-test.

Results
The pre-test and post-test scores of the students were subjected to descriptive statistics, t-test and Analysis of Covariance (ANCOVA).

Hypothesis 1: There is no statistically significant difference in the achievement of senior school students when taught using analogies and those taught with the conventional method.

Table 3 shows the achievement of the senior school students in analogy and conventional groups in Biology Achievement Test (BAT). Though the mean score of the analogy group (17.08) was higher than the mean score of conventional group (15.32), there is no significant difference in their achievement, as significance level is 0.074, which is greater than 0.05 level of significance. Therefore, from the mean scores of the two groups, it was revealed that students in the two groups had preknowledge of the topic as topics in the biology curriculum were sequentially arranged to be treated in greater details as students move from one lower class to a higher one. This just showed that the two groups were experimentally equivalent.

Table 4 shows the analysis of the result of post-test of the senior school students in analogy and conventional groups after the treatment. The mean score of the analogy group (18.73) was higher than the mean score of the conventional group (15.32).

Furthermore, the significance level, which is 0.000, is less than 0.05 level of significance. Therefore, there is indeed a significant difference in the achievement of students in animal
cell when they were taught using analogies and when they were taught using conventional method. Therefore, hypothesis 1 is rejected and the alternative hypothesis is cautiously upheld. In other words, analogy group performed significantly better than their conventional counterpart.

Hypothesis 2: There is no statistically significant difference in the achievement of male and female students when they are taught using analogies.

Table 5 shows the t-test analysis of male and female in analogy groups before the treatment. Although there seems to be a difference in their mean scores, 19.00 and 17.33, respectively, but the significance level 0.284 is greater than 0.05. This indicates that there is no significant difference between the achievement of male and female senior school students before the treatment exercise. This shows that there was pre-experimental equivalence between the two groups.

Hypothesis 3: There is no statistically significant difference in the achievement of low, medium and high scoring students when taught using analogies.

From Table 8, it is clearly shown that high-scoring senior school students had the highest mean score of 76.55 in the post-test strictly followed by the medium-scoring students’ 60.80; while low-scoring students had the least mean score of 53.60. Furthermore, the mean gain score of low-scoring students (16.98) is higher than the mean gain scores of medium-scoring (4.92) students and that of high scoring students (2.64). The implication of this is that low scoring students achieved better than the medium and high scoring students when analogies were used.

Table 10 shows that there is no significant difference in the post-test means scores of high, medium and low scoring senior school students taught using analogies. This was because at F (2, 192) = 1.180, P > 0.05, therefore, hypothesis 3 is rejected.

Summary of Findings

From the data analyses and interpretations of results, the following is a summary of the major findings from the study:
1. There is a statistically significant difference between the achievement of senior school students taught with analogy-based strategy and those taught with conventional strategy.
2. There is no statistically significant difference in the achievement of male and female senior school biology students taught using analogies.
3. There is no statistically significant difference in the achievement of low, medium and high scoring senior school biology students taught using analogies. However, low scoring students showed remarkable improvement in their mean gain score of 16.98 when compared to the medium (4.92) and high (2.64) scoring students.
Discussion

It was found that senior school students exposed to animal cell using analogies achieved significantly better than their counterparts exposed to the conventional teaching strategy. This shows that analogy is like a link that spans the gap between what a teacher wants students to learn and what they already know. Furthermore, it builds on the framework of the learners’ existing knowledge. Based on the data analysed in this study, analogy-based instructional strategy showed a great difference in students’ achievement in animal cell, and biology generally. This finding is similar to Adedeji (13), Harrison (15), and Ratcliff (16) who found that analogy-based instructional strategy enhanced students’ achievement, when compared with the conventional instructional strategy. In accordance with Novak (14), analogy was defined as a meta-cognitive strategy that enabled and empowered learners to take charge of their learning.

In the case of gender, students’ gender did not have effect on their achievement when exposed to analogies, as their significance level is greater than 0.05. This finding agrees with Iroegbu (12), Aiyedun (17), and Aderogba (11), who reported that gender did not have any effect on students’ performance.

In this study, it was observed that low-scoring senior school students performed best with the highest mean gain score, while medium-scoring students performed better than high scoring senior school students as revealed in their mean gain scores after the treatment exercise. This is an indication that highly structured instructional strategies, such as analogy, seem to be most successful with students of lower ability. Also, low-scoring students participated with keen interest and made meaningful contributions during the treatment exercise, which eventually led to their higher achievement. This finding is in support of Inyang and Ekpenyong (18), where they reported that significant difference existed between the mean post-test and pre-test scores among students of different scoring levels.

Conclusion

The results of this research work showed that teaching of animal cell and biology, in general, with analogy-based instructional strategy would facilitate, enhance and promote senior school students’ learning and achievement in the subject. In addition, it was observed during the treatment exercise that the senior school students’ achievement, notably, the low-scoring group, was enhanced and sustained when analogy was used effectively.

Furthermore, the gender of the senior school biology students, which is still a debate in the academic arena, had no significant effect on their achievement in animal cell when analogy was used.

Recommendations

Based on the findings of this study, the following recommendations are considered appropriate:

(i) It has been established in this study that analogy-based instructional strategy improved the achievement of senior school students in biology. Biology teachers should expose students to the use of analogies instead of using the conventional instructional strategy alone, taking into consideration the nature of instruction and learners.

(ii) Relevant stakeholders at all levels should organize seminars, workshops, conferences as well as in-service training for biology teachers to maximize the benefits of the use of analogies in the teaching and learning processes.

(iii) Authors of biology textbooks should deliberately incorporate analogies in their books to facilitate students’ comprehension and assimilation of textbook contents.

(iv) Curriculum planners should recommend innovative instructional strategies, such as analogies, when reviewing the existing biology curriculum to improve students’ understanding and assimilation of biological concepts and principles.

(v) It is hereby recommended that teachers should not discriminate against students on the basis of their gender in using analogies in instruction because its use did not favour any particular gender.

(vi) It is hereby recommended that teachers should embrace innovative instructional strategies, such as the use of analogies, which would allow all ability groups of students to do well in biology.

References


