Influence of the Use of Analogy on Biology Students' Achievement in Orumba South Local Government Area of Anambra State

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Abstract
The purpose of this research is to access the influence of the use of analogy on the achievement of Biology students in Orumba South Local Government Area of Anambra State. Two research questions guided the study. Quasi - research design was adopted for the study. The population of the study was 520 students. The sample of the study consisted of 64 students. Instrument for data collection was Biology Achievement Test (BAT). Data collected were analyzed using mean while t-statistics was used in testing the hypotheses. The results of the study shows that students taught Biology concepts with analogy performed better than those taught without analogy. It was recommended, amongst others, that Biology teachers should be exposed to the use and application of analogies in the teaching and learning of Biology through seminars, workshops and conferences.

Keywords: Analogy, Biology Students, Orumba South, Anambra State

Introduction

The ineffective skills used in teaching and learning of Biology have been affecting the academic performance of Biology students for the past years. For example it has been revealed that 60% of Biology students fail Biology in West African School Certificate Examination yearly (Juthe, 2005). Many skills have been applied by Biology teachers in teaching and learning of Biology in order to achieve the educational outcomes. Some of the skilled techniques include verbal and non - verbal communication, stimulus variations, planned repetition, use of instructional materials, questioning etc.It has also been observed by Nwona and Akogun (2015) that there is imbalance in the performance of males and females in science, technology and mathematics which are perceived as masculine subjects. Research has demonstrated that different teaching methods produce different results. One teaching skill which perhaps is seldom used is the use of analogy.

Analogy is anything which likens something already known and understood to something less completely understood (Lamond, 2006). It is

a comparison of something unfamiliar with something familiar in order to explain a shared principle. The more familiar concept is called the analog and the less familiar one the target. Both the analog and the target have features (also called attributes). If the analog and the target share similar features, an analogy can be drawn between them. A systematic comparison, verbally or visually, between the features of the analog and target is called a mapping. Analogy plays a significant role in academic performance of students in schools. Well-designed analogies are pedagogical tools that can support students' science learning. They can help students understand many kinds of science concepts, including those with hard-to-visualize systems of interacting parts. This is especially important in inquiry learning where connections are built between familiar and non-intuitive science contexts.

Analogies are used in science to develop insights into hypotheses and questions about, and explanations of phenomena that are usually unobservable. In science, two systems are analogous if they agree in the relations between their respective parts. Well-designed science analogies can help students build conceptual bridges between what they already know and what they are setting out to learn. It has often been asserted that they are fundamental to the development of new ideas. Hofstader (2001) argues that analogy is "the lifeblood of human thinking." An analogy can also foster students' transition to a new conceptualization of a previously taught concept (Glynn, 2014).

Analogies are often used in science, but students may not appreciate their significance, and so the analogies can be misunderstood or discounted. Great care is required in developing an analogy to ensure that it is understood as intended and that misconceptions are minimized. Given the important place of analogies in the discourse of science, it is necessary that students are explicitly shown how they work (Brown and Salter. 2010). Students must understand the elements of an analogy so as to appreciate their significance and avoid misunderstanding them. Several strategies can help to overcome the problem and they include the following steps:

1. Teach the students about analogy: Students must be taught how analogies work to avoid misunderstanding them (Mason, 1994 in Brow and Salter, 2010). Clarification of an analogy involves clearly comparing the base and target but, more importantly, demonstrating

the relations that they share and those that are not shared (Hunter, 2004).

2. Take care to develop good analogies: Good analogies are simple, easy to remember, and based on familiar analog concepts (Orgill and Bodner, 2004; 2007). The (water, pipe) ¡ (blood, blood vessel) example satisfies these requirements, but even such good analogies have limitations. Effective analogy use fosters understanding and avoids misconceptions (Duit, Roth, Komorek and Wilbers, 2001).
3. Explicitly explain the structure of the analogy and its limitations: To be most effective, the elements of an analogy must be made clear and its limitations need to be explained to the students. (Orgill and Bodner, 2004; 2007).
4. Where appropriate, use more than one analogy (Harrison and De Jong, 2005). The Teaching-With-Analogies Model includes six steps. When applied to the analogy between 'The structure of DNA and the ladder, for example, these steps are:

- Introduce the target concept (e.g. the DNA molecule).
- Remind students of what they know of the analog concept (e.g. a long, twisted 'ladder').
- Identify relevant features of targets and analog (e.g. the two side handles of the ladder contain sugar and phosphate units; the "rungs' are made of pairs of chemicals called bases).
- Map similarities (e.g. the two side handles of the ladder and DNA backbone; 'rungs' and bases)
- Indicate where analogy breaks down (e.g. a ladder is rigid; a DNA molecule can open up and be replicated).

Draw conclusions (e.g. about the structure and functions of DNA or about mutations occurring at the bases). (Adapted from Glynn, 2007).

Statement of Problem

Many students fail Biology in external examinations due to reasons which include poor teaching methods and abstractness of certain biological concepts. This informs the need for improvement on the Biology teachers' methods of teaching Biology. It is mandatory, therefore, for the teachers to evolve teaching methods that enhance students' participation in the teaching and learning of Biology. Excellent and effective teaching demands

a lot of devices, techniques and strategies not only to achieve critical outcomes, but because variety itself is a necessity. One teaching skill which perhaps is seldom used is the use of analogy which encourages development and make learning activities become easy. Researchers have shown that using analogy in teaching and learning of Biology increases students learning and interest and also help the students in understanding biological concepts clearly. Button (1993) explained that the use of analogy in Secondary schools helps for the effective understanding of the concepts i.e. makes concepts clear to the students and promotes the interest of the students.From the foregoing, the use of analogy is a great instructional strategy which can enhance effective teaching and learning of Biology. Research has demonstrated that different teaching methods produce different results in the academic achievement of students. This study thus seeks to investigate the influence of the use of analogy in teaching and learning of Biology in secondary schools in Orumba South Local Government Area of Anambra State.

Significance of the Study

- The following people will benefit immensely from this study, the students, teachers, parents, school administrators, Government and researchers.
- For the students the outcome of this study will motivate them, improve their interest/attitude and achievement in Biology and thus helping a greater percentage of them to succeed in their choice of profession which not been the case because of lack of biological knowledge.
- For teachers/school administrators: if this strategy turns to be effective, it will promote an empirical basis for teachers for choosing a suitable method of teaching Biology. The findings of the study will guide school administrator as well as enhance transfer of the acquired knowledge of the use of analogies in Biology to other subjects and to real-life problems.
- If the effectiveness of the use of analogies as an instructional strategy is obvious, the government can make the curriculum planners to include the use of the strategy in the classroom teaching by the teachers in the curriculum.
- The findings of this study will also serve a resource material to researchers who may be interested in the area. Additionally, it will provide the framework for researchers to build on.

Purpose of the Study

The purpose of the study is to investigate the influence of use of analogy

as an instructional strategy on academic performance of senior secondary school Biology students. Specifically the study will:

1. Determine if there is any difference in the achievement scores of Biology students taught with analogies and those taught with conventional methods?
2. Determine how the mean achievement scores of male and female students taught with analogy differ from those of students taught the same Biology concepts using conventional methods.

Scope of the Study

The study was restricted to Senior Secondary Schools in Orumba South Local Government Area of Anambra State.

Research Questions

The following research questions were formulated to guide the study:

1. How do the mean achievement scores of students taught with analogy differ from those of students taught using the conventional methods in Biology achievement test?
2. How do the mean achievement scores of male and female students taught with analogy differ from those of students taught the same Biology concept using conventional methods?

Research Hypotheses

For this study the following null hypotheses were formulated and tested at 0.05 level of significance.

1. There is no significant difference in the mean achievement scores of students taught with the use of analogies and students taught with the conventional methods.
2. There is no significant difference in the mean achievement scores of male and female students taught Biology with the use of analogies.

Research Design

The quasi-experimental design was used for this study. Specifically, the study has non-randomized control group pretest-post-test design. This design is considered appropriate because the researcher cannot randomly sample and assign his subjects, as this might alter and disturb the schools schedule of lessons. The study made use of two groups, the experimental group and the control group. The design is presented in table I below:

Table 1: Representation of the Research Design.

Sample Grouping	Presenting	Research condition	Post testing
Experiment group	O	Treatment (x)	O
Control group	O	Control (-)	O

Key: o - Biology Achievement Test (BAT)
x - Use of analogies
—— - Conventional method of teaching

Area of the study

This study was carried out in the public secondary schools in Orumba South Local Government Area of Anambra State. Orumba South Local Government Area has thirteen (13) public secondary schools.

Population of the Study

The population of the study was all the senior secondary school Biology students from the thirteen (13) secondary schools in Orumba South Local government Area of Anambra State totaling five hundred and twenty (520).

Sample and Sampling Techniques

Two schools that were co-educational drawn by purposive random sampling out of the thirteen (13) existing government owned secondary schools on the study area were used for the study because gender was considered in the study. Then, each of the two schools was placed into either the experimental or the control group for the study by simple balloting by a flip of coin. This was necessary in order to give the two schools equal chances of being either the experimental or control group. In each school selected, simple random sampling technique was used to select an arm from SSI classes. Each arm selected formed the intact group to be used for the study and has thirty – two (32) students. The sample size was,

therefore, thirty-two (32) in control group and thirty-two (32) in experimental group.

Instrument for Data Collection

The instrument used for the study was a Biology Achievement Test (BAT). The BAT was an objective test items consistingof twenty (20) questions covering all the structures of DNA (content) that will be taught during theexperiment. The Continuous Assessment (CA) of students from the two schools chosen as samples was used to select the students for the study from the two schools. Each of the two chosen schools was placed into either the experimental or the control group for the study by simple balloting by a flip of coin..

Validation of the Instrument

The Biology Achievement Test (BAT) and the lesson plan were subjected to face and content validation by three specialists: two from Biology Education Department and one from Measurement and Evaluation Unit of Federal College of Education (Technical), Umunze. Their corrections were effected accordingly before the final draft of the instrument used for the study emerged.

Method of Data Collection

The Biology Achievement Test (BAT) was administered to the students of both control and experimental schools as the test to obtain relevant information for analysis. Research assistants were used in the study. They were the Biology teachers in the schools used for the study and who were exposed to the aim of the study and who were taught how to teach using analogy. Students of the experimental group were taught 'The structure of the DNA' using 'twisted ladder' as an analog of the DNA structure while those in the control group were taught 'The structure of the DNA' using conventional methods and without analogy. At the end of two weeks experimental teaching periods, the same BAT was administered to the students in the experimental and controlgroups on the same day with the help of some research assistants/teachers. This is to avoid interference between the groups.

Method of Data Analysis

Data was analyzed with the use of simple mean and t-statistics.

Presentation and Interpretation of the Result

Research Question 1

How do the mean achievement scores in BAT of students taught using analogy differ from those of the students taught using the conventional methods?

Table I: The means and standard deviations of students' scores in BAT

Group	No of student	Mean	Standard deviation
Control Post-test	32	15.78	3.59
Experimental Post-test	32	18.90	4.90

The above table shows that there is a remarkable increase in the mean of the post test of the experimental group compared to the mean of the post-test of the control group.

The post-test of the experimental group has a mean achievement score of 18.90 and standard deviations of 4.90while the post-test of the control group has a mean achievement score of 15.78 and standard deviation of 3.59, There is an increase of 3.12 (18.90-15.78) in the mean achievement score of both groups of students. This is an indication that the experimental group achieved higher than the control group in Biology Achievement Test (BAT) using analogy as an instructionalstrategy.

Research Question 2

How do the mean achievement scores of male studentsdiffer from those of the female students taught using analogy?

Table II: The mean and standard deviation of male and femalestudents in the BAT

Sex	Test	Mean	No of student	Standard deviation

Male	Post-test	17.82	17	3.96
Female	Post-test	18.73	15	4.68

Table II shows that there is an increase in the mean achievement scores of the female students taught using analogy. The mean of their post-test is 18.73 while the mean of the post-test of the males is 17.82 which indicate an increase of 0.91. The female students' shows a higher increase compared with the male students. This is an indication that the female students achieved higher than the male students in BAT using analogy as instructional strategy.

Research Hypothesis I

Hoi: There is no significance difference in the mean achievement scores of students taught with the use of analogies and those of the students taught with the conventional method.

The data (scores) collected through the post-test of the BAT were subjected to computer analysis using t-test statistics. The result is presented in the table below.

Table III: Summary of t-test statistics on the effects of the treatment and Control on BAT.

Some of variations	N	Mean	SD	DF	t-cal	t-tab	Remarks
Experimental	32	18.90	2.23	62	724	2.07	S
Control	32	15.78	2.13				

S = Significant

Table III shows that the value for t-calculated is greater than t-table. The null hypothesis was therefore rejected at 0.05 level of significance. This means that there is a significant difference between the mean achievement

scores of students taught with the use of analogies and those of the students taught with the conventional methods.
This implies that those students exposed to the use of analogies performed better than those of the students taught with the conventional methods.

Research Hypothesis 2

$H0_2$: There is no significant difference in the mean achievement scores of male and female students taught Biology with the use of analogy.

Table IV: Summary of t-test statistics on the effect of sex on BAT.

Some of variations	N	Mean	SD	DF	t-cal	t-tab	Remarks
Male	17	17.82	3.96	30	0.590	2.04	NS
Female	15	18.73	4.68				

NS = Not Significant

Table IV shows that t-cal was less than t-tab. Thus the null hypothesis was accepted at 0.05 level of significance. Hence, there was no significant difference in the mean achievement scores of male and female students taught Biology using analogies. This means that the male students taught using analogies did not perform better than those female students taught using the same analogies. This finding is line with the findings of Okeke (2007). He discovered in his study that there was no significance of gender difference in the post-test performance of the experimental group (EG) taught with the help of computer assisted instructions package, notwithstanding the difference that existed in the pre-test result in favour of the females.

Research Findings

The findings of the study from the research questions and hypotheses are summarized as follows;

1. There is a significant difference in the mean achievement scores of students taught with the use of analogy and those taught with the conventional method.
2. Despite the fact that the mean indicated that the female students achieved higher than the male students in the BAT with the use of analogies as instructional strategy, the t-test statistic revealed that the difference is not significant. Therefore gender did not influence performance in Biology achievement score with the use of analogies.

Discussion of the Findings

The discussion below is the result of findings made by the researchers during the study and it was based on the research questions that were analyzed.

It was found that the mean achievement scores of students taught Biology with analogies differ from those taught without analogy. From table I, it was found that the experimental group (those taught Biology with analogies) performed better than the control group (those taught without analogies). This agrees with the observation of Azubuike (2009) that knowledge of analogies elucidates theoretical work so as to understand Biology as a course and also helps teachers to consolidate theoretical work in Biology.

Recommendations

1. Seminars, workshops and conferences should be organized to re-orient the Biology teachers and instill the awareness to the public on the use and application of analogies in the teaching and learning of Biology.
2. The Parents' Teachers Association (P.T.A) or Voluntary organizations should assist schools both in cash and kind to raise the standard of Biology teachers in Nigeria in general and in Orumba South Local Government Area of Anambra State in particular.
3. Employment of qualified Biology teachers in secondary Schools should be recommended for male efficient performance.
4. Teachers should use varieties of teaching methods so as to enhance effective teaching and learning of Biology.
5. Government should endeavor to supply adequate facilities to schools for teaching and learning of Biology to help reduce the abstractedness of some concept in Biology.

With the implementation of the recommendations above, it is hoped that there will be improvement in the process of teaching and learning of Biology.

Conclusion

Based on the findings of this study, the students taughtBiology with analogies performed better than those studentstaught with just the conventional methods. However, therewas no significant difference in the mean achievement scoresof male and female students' taught with use of analogies.

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