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

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ABSTRACT

This study examined the effects of teachers' use of analogies on the achievement of Senior School Biology Students in Oro, Kwara State, Nigeria. A total of one hundred and ninety-nine students comprising 110 males and 89 females in senior secondary school two, were purposively sampled from four schools in Oro. The sampled students were assigned into two groups, experimental (97 students) and control (102 students). The reliability of the instrument was determined by administering the test to forty students of another school not participating in the study and the reliability coefficient of 0.73 was obtained using Pearson Product Moment Correlation Coefficient, at 0.05 alpha level of significance. The test scores were analysed using mean scores, *t*-test and Analysis of Covariance on the hypotheses formulated. Findings from the study showed that there is a significant difference in the achievement of the experimental group exposed to analogies and the control group exposed to the conventional method. The mean score of the experimental group was 18.73 compared to conventional group with the mean score of 15.32. It was hereby recommended, among other things, that biology teachers should incorporate innovative instructional strategies, like analogies into their conventional teaching method for their teaching and their students' learning of biology

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[(3)], Akuogbuo[(4)] and Asenuga [(5)] show that the performances of students in the Senior School Certificate Examinations of the West African Examinations Council (WAEC) was 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[(6)], and the abstract nature of the science topics Ekpenyong [(7)], Gabebel [(8)] (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:
Students' Performance in SSCE Biology (WAEC) from 2005–2009

Year	Total entry	Total Credit Passes 1-6	Percentage Credit Passes 1-6	Total Below Credit Passes P7-F9	Percentage Below Credit Passes
2005	1051557	377,8850	35.74%	663,707	63.26%
2006	1,082,556	385,469	35.61%	697,087	63.39%
2007	1,238,168	413,211	33.37%	824,321	66.63%
2008	1,259,965	427,644	33.94%	832,321	66.06%
2009	1,292,107	461,583	35.72%	830,524	64.28%

Source: Report of WAEC State Committee Meeting, 2009

Frolov [(9)] 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:

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(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

Group	Pre-test	Treatment	Post-test
Experimental	O_1	X	O_2
Control	O_3		O_4

O_1 and O_3 = Pre-test for both experimental and control groups
O_2 and O_4 = 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 pre-knowledge 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)

Table 3:
***t*-test Analysis of Pre-test of Analogy and Conventional Groups**

Group	No	x	SD	df	t-cal	Sig.
Analogy-based method	97	17.08	8.131	197	1.797	0.074
Conventional method	102	15.32	5.479			

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.

Table 4
***t*-test Analysis of Post-test of Analogy and Conventional Groups.**

Groups	No	x	SD	df	t-cal	Sig.
Analogy based method	97	18.73	7.119	197	3.796	0.000
Conventional method	102	15.32	5.479			

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.

Table 5
***t*-test Analysis of Pretest Scores of Males and Females in Analogy Group.**

Groups	No	x	SD	df	t-cal	Sig.
Male	54	19.00	8.042	95	1.077	0.284
Female	43	17.33	7.019			

The post-test mean score of the male students is 27.02 while the mean score of female students is 25.77, as indicated in Table 6. The t-value is 0.815 and the significance value is 0.417. Since the significance level is greater than 0.05, hypothesis 2 is not rejected. This indicates that there is no significant difference in the achievement of male and female students in animal cell when they were taught using analogies.

Table 7 shows clearly that both males and females in the analogy group performed better than their counterparts in the conventional group. However, the mean score of the males (19.13) in the conventional group was almost equal to that of their female counterparts in the same group (18.12). This implies that there is no significant difference in the achievement of males and females in the conventional group.

Table 6
t-test analysis of post-test scores of male and female students in analogy group.

Group	No	x	SD	df	t-cal	Sig.
Male	54	27.02	7.899	95	0.815	0.417
Female	43	25.77	6.986			

Table 7:
Comparison of Means of Post-test Scores of Males and Females in Analogy and Conventional Groups.

Gender	Research Group	N	X	SD
Male	**Analogy**	54	27.02	7.899
	Conventional	57	19.13	6.712
Female	**Analogy**	43	25.77	6.986
	Conventional	45	18.12	7.759

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 8
Students' Mean Scores, Standard Deviation and Mean Gain Scores by Scoring Level

Test	Level	N	$\bar{X}$	SD	X Gain Score
Pre-test	**Low**	61	36.62	7.660	
	Medium	25	55.88	4.362	
	High	11	73.91	3.727	
Post-test	**Low**	61	53.60	13.423	16.98
	Medium	25	60.80	6.367	4.92
	High	11	76.55	5.520	2.64

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.

Table 9
Analysis of Co-variance (ANCOVA) of the Effect of Students' Scoring Levels on the Use of Analogies

Between Subject Factors		
Scoring Level	**Score group**	**No**
Low	1	61
Medium	2	25
High	3	11

Table 10
Tests of Between-subjects Effects on Students' Achievement in Biology

Source	Type III sum of squares	df	Mean Square	F	Sig.
Corrected model	31955.449	6	5325.908	46.616	.000
Intercept	1182.162	1	1182.162	10.347	.002
Pretest	4968.595	1	4968.595	43.489	.000
Scoring levels	269.741	2	134.871	1.180	.309
Error	21935.978	192	114.250		
Total	563565.000	199			
Corrected total	53891.427	198			

a. R squared = .593 (Adjusted R squared = .580)

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 when 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 [(11)], Harrison [(12)], and Ratcliff [(13)] 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 [(15)], Aiyedun [(16)], and Aderogba [(17)], 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

1.Abimbola, I.O. (2006). *Philosophy of science for degree students.* Osogbo: Olatunbosun Publishers.

2.Ogunniyi, M.B. (1985). Problems of science education relative to the nature of scientific concepts and generalizations in developing countries. In F.M.A. Ukoli (Ed.), *What Science? The problems of teaching and research in science in Nigeria Universities.* Ibadan: Heinemann Educational books (Nig.) Limited

3.Ahmed, M. A. (2004). *Analysis of biology teachers' ratings of nutrition concepts in secondary schools in Ilorin Metropolis.* Unpublished M. Ed. Research Project, Department of Curriculum Studies and Educational Technology, University of Ilorin, Ilorin, Nigeria.

4.Akuogbuo, C. N. (2002). Problems of poor performance of secondary school biology students. *Nigerian Journal of Curriculum Studies*, 7(1), 53-55.

5.Asenuga, J. O. (1999). Problems of teaching practical biology in Nigerian secondary schools and colleges. *Journal of Science Teachers' Association of Nigeria, 23* (1), 152 – 156.

6.Igwe, O. O. (1990). Science teachers' qualifications and student's performance in secondary schools in Kano State. *Journal of Science Teachers' Association of Nigeria*, *26*(2), 46–50.

7.Ekpenyong, H. E. (2000). Influence of ability and gender groupings on senior secondary school chemistry students' achievement on the concept of red of reactions. *Journal of Science Teachers' Association of Nigeria, 35*(1), 34–40.

8.Gabell, D. I. (2003). Research matters to the science teachers. Publication of the *National Association for Research in Science Teaching.* Retrieved on 29th April, 2003 from http://www.edu.stu.ca/narstite/publications/research/problem.htm

9.Frolov, I. D. (1984) *Dictionary of philosophy*, Mosco: Moscow Publishers.

10.Calik, M., & Ayas (2005). An analogy activity for incorporating students' conceptions of types of solutions. Asia-pacific forum on science teaching and learning 6(2) Retrieved 10th April, 2009 from http://www.ied.uk./aptsh.

11.Adedeji, D.B. (2002). The effectiveness of the use of analogy in teaching secondary school chemistry. *Journal of the Science Teachers' Association of Nigeria,* 27 (1) 84 – 54.

12.Harrison, A. G. (1996). Using an analogical teaching approach to engender conceptual change. *International Journal of Science Education*, *18*, 210–222.

13.Tregido, D., & Radcliffe, M. (2000). The use of modeling for improving pupils'learning about cells. *School Science Review 81*(296), 53–58.
14.Novak, I. D. (1989). *Meta-cognitive strategies to help students learn how to learn*. Publication of the *National Association of Research in Science Teaching.* Syndicate of the University of Cambridge, United Kingdom.
16.Aiyedun, J. O. (2000). Influence of sex difference of students on their achievement in secondary school mathematics *ABACUS: The Journal of the Mathematics Association of Nigeria* 25 (1) 100 – 107.
17.Aderogba, G.A. (2006). Comparative effects of concept-mapping and analogies on secondary school students' performance in chemistry in Ilesha, Nigeria. *Unpublished Ph.D. Thesis*, University of Ilorin, Ilorin, Nigeria.