



## Effect of Use of Analogy Strategy on Senior Secondary School Students' Achievement in Biology in Imo State

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### Abstract

The study investigated the effect of use of analogy strategy on senior secondary school students' achievement in Biology in Imo State. There were two research questions that guided the study and two hypotheses which were tested at 0.05 level of significance. The design adopted for this study was quasi-experimental research design. The population for the study was 3,589 with 1,818 female and 1,771 male students. A sample size of 88 SS1 Biology students (41 male and 47 female) was used. Sampling was done in multi stages using purposive and simple random sampling techniques. The instrument used for data collection was Biology Achievement Test (BAT). The instrument was validated, its reliability was established using Kuder Richardson 20 (KR20) statistic, and a coefficient of 0.81 was obtained. Mean and standard deviation were used to answer the research questions, while Analysis of Covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance. The results of the study show that there was a significant difference in the mean achievement scores of Biology students exposed to analogy and conventional teaching method with those taught under analogy having a higher mean gain. There was no significant difference in the mean achievement scores of male and female Biology students when exposed to analogy strategy. It was recommended that analogy strategy should be used more in teaching Biology than conventional teaching method without preference to any gender.

**Key Words:** Achievement, Analogy, Biology, Gender, Lecture

### Introduction

Biology as a branch of science deals with the study of the structure, function and behaviour of organism. It is the study of plants and animals and their interactions with their physical environment (Ozoemzinem, 2015). Biology can be seen as the study of living things and their relationship with the environment. It is also a natural science that studies life and living organism including their physical structure, chemical process, molecular interactions, psychological mechanisms, development and evolution. Freeman et al. (2019), stated that Biology has numerous branches which include genetics, biochemistry, molecular biology, cell biology, histology, physiology, anatomy, microbiology and ecology. Biology serves as prerequisite to the study of medicine, agriculture, pharmacy among others.

Despite the importance of Biology to the individual and the nation, academic achievement of Biology students has been a major concern among stakeholders. Academic achievement can be seen as the extent to which a student, teacher, or institution has achieved their short or long- term educational goals (kapur, 2018). Reports have shown persistent

poor students performance in Secondary School Certificate Examination (SSCE) conducted by WAEC (Chief Examiners Report, 2015–2018). West African Examination Council (WAEC) chief examiner's report (2015,2016,2017 and 2018) have consistently listed some of the challenges of the candidates to be poor interpretation of questions, poor definition, wrong spelling of scientific concepts, inability to adhere to instruction, poor answers to questions bordering on descriptions and many others.

Students' poor achievement in sciences is a concern among educators. It is caused by poor teaching methods which fail to inspire students' learning (Adegun and Adegun, 2013). The authors add that the lack of understanding of science concepts results in students finding such concepts difficult to learn. Such difficult concepts are capable of causing students' poor achievement in examinations. Cimer (2011) identified some biology content areas perceived to be difficult to learn by students as: ecology, genetics, physiology, cellular respiration, growth, and chromosomes. This indicates that the

implementation of the curriculum needs to be reviewed.

Furthermore, curriculum of any subject is so important that proper attention should be given to. Many researchers agree that there is a demand for a shift in the rethinking of curriculum content and ways in which students are taught (Kolawole, 2007; Okeke, 2007; Adeyemi, 2008). It can be deduced from the authors' submissions that the uninspiring teaching strategies adopted by science teachers have led to under-achievement of students in science subjects, including biology. These studies show that teachers shy away from activity-oriented teaching methods and rely heavily on methods that are easy but usually inadequate and inappropriate for teaching many science concepts at secondary school level.

In most schools in Nigeria, biology is taught using the conventional method. It has been noted that biology as a school discipline in the Nigerian educational system relies solely on the use of lecture/expository method of teaching. This conventional method is teacher-centred and students are mostly passive learners. It is a one-way flow of information; teachers often continuously talk for an hour without knowing students' response and feedback. Scrivener in Edidiong and Saheed (2018), imagined conventional teaching as "jug" and "mug". The knowledge is being poured from one receptacle into an empty one. It must be noted that students' achievement and productivity in any course is a function of instruction, therefore, approaches to instructions are considered a serious issue in biology as a science, especially with the current emphasis on competency and sustainable science education. Edidiong and Saheed (2018) suggested the use of activity-oriented and learner-centred strategies that will enable students to comprehend effectively and also recall concepts learned in order to improve students' achievement in science. Kolawole (2007) argues that while the conventional traditional methods may be adequate for the teaching of humanities, it is quite inappropriate for the teaching of science and calls for a shift to methods that will enable the learners develop and acquire skills essential for scientific and technological development. This, Kolawole suggests, is likely to improve the students' understanding of science concepts which could lead to improving their achievements in external examinations.

This change reflects a move away from the conventional mode of information transmission to that of knowledge construction. This model in which the learner builds his own understanding is known as constructivism (Epstein, 2013). Constructivism is a strategy of instruction that focuses on the learners'

ability to construct his own understanding from experiences and in so doing make meaning of what they learn (Tauritz, 2012). This new trend which is child-centered according to Tauritz, has led to the development of various instructional strategies, amongst which are; discovery learning, analogy, hands-on, minds-on, inquiry, cooperative or collaborative learning, conceptual change, concept mapping, and mnemonics amongst others.

Analogy is a comparison of something unfamiliar with something familiar in order to explain a shared principle, like a bridge that spans the gap between what a teacher wants a student to learn and what the student already know (Nworgu & Otum, 2013). Nworgu (2013) noted that analogy can be regarded as comparison between something that is familiar to students (base) and unfamiliar things in science which the teacher wants the students to acquire. Analogy builds on the framework of the learner's existing knowledge so that students are not starting from the scratch. The goal of analogy is to transfer ideas from a familiar concept (the analogue) to an unfamiliar one (the target). It plays a significant role in problem solving, decision making, creativity, explanation and communication. When students study two concepts, meaningful learning proceeds when they find and visualize connections between a newly taught context and what they already know. If the analogies are appropriate, they promote concept learning because they encourage students to build links between past familiar knowledge and experience and new contexts and problems. Most analogies are teacher generated but, in conducive circumstances, students can generate effective analogies. Analogies and analogical models are popular in science and help scientists and educators understand and communicate the intricacies, beauty and strangeness of the natural world.

Various studies have been carried out on analogy as a strategy. Edidiong and saheed (2018) examined the effect of analogy and guided inquiry instructional strategies on students' achievement in basic science. The result obtained showed that analogy instructional strategy contributed most to students' achievement in basic science. Ayande et al (2012) examined the effects of teachers' use of analogies on the achievement of Senior School Biology Students in Oro, Kwara State, Nigeria. Findings from the study showed that there was a significant difference in the achievement of the experimental group exposed to analogies and the control group exposed to the conventional method in favour of the experimental group. Fathi-Azar et al. (2013) investigated the effect of instructional analogies in interaction with logical thinking ability

on achievement and attitude towards chemistry. The results showed that teaching with analogy model had no significant effect on the students' chemistry achievement irrespective of gender. Some studies such as Edidong and saheed (2018), and Ayande et al (2012) showed that teaching with analogy has significant effect on students' achievement, while others like Fathi-Azar et al. (2013) shows that teaching with analogy has no significant effect on students' achievement irrespective of gender. The differences in the findings of previous researchers, coupled with the fact that most of the previous studies were done outside Imo State, necessitate the present study in the state.

Studies in biology education indicate that gender, among other factors may be responsible for students' perception of concepts as being difficult. This explains why gender issues have remained a subject of discussion among researchers in education. Gender is an ascribed attribute that socially differentiates feminine from masculine. It connotes male and female or boys and girls in a given group of students. Gender is the range of physical, biological, mental, and behavioural characteristics pertaining to and differentiating between the feminine and masculine (male and female) population (Adigun et al, 2015).

Teaching activities are presumed to affect male and female students differently in a typical African society where there are prescribed roles for boys and girls in the society. This could give a particular sex an advantage over another. Iloputaife (2001) investigated the effects of analogy and conceptual-change instruction models on physics achievement of boys and girls taught simple electric circuit in Enugu state senior secondary schools. It was found out that there was no significant difference in the achievement of boys and girls exposed to analogy and conceptual change instruction. Gongdon (2016) observed the comparative effects of analogies and concept mapping strategies on male and female students' problem solving ability in tasks involving mole, electrolysis and stoichiometry. Results showed that there was a significant difference between the post test mean scores of the male and female students taught using analogies in favour of the male students. On the other hand, Olowe (2010) found out that females achieved better than males in the science subjects. From the reviewed studies, Gongdon (2016) shows that there is a significant difference in the achievement of male and female students in favour of male students, while Olowe (2010) favour female students. On the contrary, Iloputaife (2001) found out that there is no significant difference in the achievement of male and female students when taught with analogy. These differences in the findings of

previous researchers also made this study necessary to find out the effect of analogy strategy on secondary school male and female students' achievement in Biology.

### Research Questions

The following research questions guided this study:

1. What are the mean achievement scores of Biology students exposed to analogy and conventional teaching method?
2. What are the mean achievement scores of male and female Biology students exposed to analogy strategy?

### Hypotheses

The following hypotheses were formulated and tested at 0.05 level of significance.

- H<sub>01</sub>: There is no significant difference in the mean achievement scores of Biology students exposed to analogy and conventional teaching method.
- H<sub>02</sub>: There is no significant difference in the mean achievement scores of male and female Biology students exposed to analogy strategy

### Research Method

The design adopted for this study was pretest and post test non randomized quasi-experimental research design. The design was considered appropriate for the study because the subjects were not randomized. The population for the study was 3,589 senior secondary one students (SS1) in the Public Secondary Schools in Orlu Education Zone, Imo State for 2023/2024 academic session. This population was made up of 1,818 female students and 1,771 male students. A sample size of 88 SS1 Biology students from two intact classes in two public co-educational schools in Orlu education zone served as sample of this study. Sampling was done in multi stages using purposive and simple random sampling techniques. Two secondary schools were drawn out from population of the schools in Orlu education zone using purposive sampling technique. Purposive sampling technique was used to deliberately choose schools with a reasonable population of Biology students and also schools that had enough biology laboratory and Biology teachers so that they could act as research assistants to aid the research work.

Furthermore, by simple random sampling technique one secondary school was assigned to experimental groups (Analogy) while the other secondary school was used as the control group (conventional lecture method). Finally, there was random assignment of intact classes from each school to experimental and control groups. The experimental



group (Analogy) consisted of a total number of 44 students (20 males and 24 females) and control group (conventional teaching method ) 44 students (21males and 23 females) SS 1 Biology students based on intact classes.

The instrument used for data collection was Biology Achievement Test (BAT). The BAT consists of multiple choice questions adapted from WAEC Biology past questions from years 2000-2022. The BAT comprises of items based on two topics in the SS1 Biology curriculum namely; skeletons and supporting systems in animals and tissues and supporting systems in plants. These topics were chosen because they are part of the difficult areas in Biology where the students usually find difficulty during their SSCE. This claim is supported by WAEC chief examiner’s report on Biology (WAEC 2018). The Biology Achievement Test was a 50 item

multiple choice question test, the items were administered to the groups in 1 hour under the same examination condition. Every correct answer had one (1) point, while an incorrect answer was awarded zone (0) point. Two experts in education measurement and Evaluation and one in Biology Education validated the instrument to ensure its face and content validity. The instrument was trial tested on 20 SS1 Biology students. Its reliability was established using Kuder Richardson 20 (KR20) statistic, and a coefficient of 0.81 was obtained. Mean and standard deviation were used to answer the research questions, while Analysis of Covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance. Hypotheses were rejected when the calculated p value was less than 0.05 level of significance, and was retained when the calculated p value was greater than 0.05.

**Results**

The results of the study are presented in the tables below:

**Table 1: Mean and Standard Deviation of Achievement Scores of Biology Students Exposed to Analogy and Conventional Teaching Method**

Variable Learning Strategies	Pre-test			Post-test		Mean Achievement Gain
	N	$\bar{X}$	SD	$\bar{X}$	SD	
Analogy	44	39.18	9.00	67.00	13.04	27.82
Conventional	44	32.72	8.17	55.81	11.16	23.09

Where N= Number of respondents,  $\bar{X}$ = mean, SD= Standard deviation

Table 1 showed that Biology students exposed to analogy strategy had pre-test mean achievement score of 39.18 with standard deviation of 9.00 and post-test mean achievement score of 67.00 with standard deviation of 13.04 and mean achievement gain of 27.82. Students taught with conventional method had pre-test mean achievement score of 32.72 with standard deviation of 8.17 and post-test mean achievement score of 55.81 with standard deviation of 11.16 and mean achievement

gain of 23.09. However, for each of the groups, the post achievement mean was greater than the pre-test mean achievement with the students taught Biology using analogy strategy having higher mean achievement gain. This result shows that analogy strategy leads to students’ higher achievement in Biology more than conventional method. This is an indication that learning strategy has some effects on students’ achievement in Biology.

**Table 2: Analysis of Covariance of Students’ Achievement Means Scores in Biology Exposed to Analogy and Conventional Teaching Method**

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	7632.259 <sup>a</sup>	2	2544.086	24.814	.000
Intercept	8688.744	1	8688.744	84.745	.000
PRE-TEST Strategies*	4839.909	1	4839.909	47.206	.000
Error	1011.630	2	505.815	14.933	.000
TOTAL	12918.541	126	102.528		
Corrected Total	517052.000	130			

a. R Squared = .371 (Adjusted R Squared = .356)



The result in Table 2 shows that with respect to the achievement mean scores of Biology students exposed to analogy and conventional teaching method, an F-ratio of 14.933 was obtained with associated exact probability value of .000. Since the associated probability (.000) was less than 0.05 set as level of significance, the null hypothesis ( $H_{01}$ ) which stated that there is no significant difference in the mean achievement scores of Biology students

exposed to analogy and conventional teaching method is rejected. Thus, inference drawn is that there was a significant difference in the mean achievement scores of Biology students exposed to analogy and conventional teaching method with those taught under analogy having a higher mean gain. This seems to indicate that analogy strategy was superior to conventional method.

**Table 3: Mean and Standard Deviation of Achievement Scores of Male and Female Biology Students Exposed to Analogy Strategy**

Learning Strategy	Gender	Pre-test		Post-test		Mean Achievement Gain	
		N	$\bar{X}$	SD	$\bar{X}$		SD
Analogy strategy	Male	20	38.80	9.28	65.40	12.42	26.6
	Female	24	40.33	8.80	67.50	13.78	27.17

Where N= Number of respondents,  $\bar{X}$ = mean, SD= Standard deviation

Table 3 shows that male Biology students exposed to analogy strategy had pre-test mean score of 38.80 with standard deviation of 9.28 and post test mean score of 65.40 with standard deviation of 12.42 and mean achievement gain of 26.6. Female Biology students exposed to analogy strategy had pre-test and post-test mean scores of 40.33 and 67.50 respectively with standard deviations of 8.80 and 13.78

respectively and mean achievement gain of 27.17. The result showed that, the female Biology students' exposed to analogy strategy had slight achievement mean higher than the male Biology students with slight higher mean achievement gain than the male. The observed slight difference was subjected to test of hypothesis to test if the difference is significant.

**Table 4: Analysis of Covariance of Mean Achievement Scores of Male and Female Biology Students Exposed to Analogy Strategy**

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	2084.256 <sup>a</sup>	2	1042.128	8.167	.001
Intercept	2847.964	1	2847.964	22.319	.000
PRE-TEST	2071.056	1	2071.056	16.230	.000
GENDER	8.115	1	8.115	.064	.802
Error	5231.744	41	127.604		
TOTAL	204832.000	44			
Corrected Total	7316.000	43			

a. R Squared = .285 (Adjusted R Squared = .250)

Table 4 shows that with respect to the achievement mean scores of male and female Biology students exposed to analogy strategy, an F-ratio of .064 was obtained with associated exact probability value of .802. Since the associated probability (.802) was greater than 0.05 set as level of significance, the null hypothesis ( $H_{05}$ ) which stated that there is no significant difference in the mean achievement scores of male and female Biology students when exposed to analogy strategy is accepted. Thus, inference drawn is that there was no significant difference in the mean achievement scores of male and female Biology

students when exposed to analogy strategy, any difference observed was as a result of chance. This indicated that gender is not a significant factor affecting students' achievement toward Biology when exposed to analogy strategy.

### Discussion of Findings

Result on achievement of students exposed to Biology using analogy strategy had higher achievement mean gain than conventional method. This result shows that analogy strategy enhances students' achievement more than conventional

method. This also means that learning strategy may have some effects on students' achievement in Biology when taught using analogy. The corresponding hypothesis affirmed that there was a significant difference in the mean achievement scores of Biology students exposed to analogy strategy and conventional teaching method with those exposed to analogy strategy having a higher achievement mean gain than the conventional method. This could be because teaching with analogy is activity – oriented and learner centred strategy that enables students to have interest and comprehend what is learnt effectively. This finding is in disagreement with the findings of Fathi-Azar et al. (2013) who investigated the effect of instructional analogies in interaction with logical thinking ability on achievement and attitude towards chemistry and reported that the analogy model had no significant effect on the students' chemistry achievement. On contrary, the finding of Edidong and saheed (2018) on main effect of analogy and guided inquiry instructional strategies on students' interest and achievement in basic science and reported that students taught basic science using analogy have high mean gain than those taught using conventional method. In the same vein, Ayande et al (2012) examined the effects of teachers' use of analogies on the achievement of Senior School Biology Students in Oro, Kwara State, Nigeria. Findings from the study showed that there was a significant difference in the achievement of the experimental group exposed to analogies and the control group exposed to the conventional method in favour of the experimental group. In this study Biology students taught using analogy achieved better than those exposed to conventional method in Biology. This could be as a result of the learners centered nature of analogy strategy of learning.

The finding further showed that there was no significant difference in the mean achievement scores of male and female Biology students exposed to analogy strategy, any difference observed was as a result of chance. This indicated that gender is not a significant factor affecting students' achievement toward Biology when taught with analogy strategy. This could be as a result of all the students exposed to the same strategy, by the same teacher in the same classroom irrespective of gender. This finding has shown that analogy strategy is not gender bias when used in teaching Biology. This finding is in conformity with the report of Iloputaife (2001) who investigated the effects of analogy and conceptual-change instruction models on physics achievement of boys and girls taught simple electric circuit in Enugu state senior secondary schools, no significant difference was found between the boys and girls when

taught physics using analogy and conceptual-change model in teaching. In the same vein, Gongdon (2016) observed the comparative effects of analogies and concept mapping strategies on male and female students' problem solving ability in tasks involving mole, electrolysis and stoichiometry. The finding revealed that male and female did not differ in their problem solving ability when exposed to analogy strategy. This could be because both male and female students have almost similar learning abilities.

### Conclusion

Based on the findings of the study, there was a significant difference in the mean achievement scores of Biology students exposed to analogy and conventional teaching method with those taught under analogy having a higher mean gain. There was no significant difference in the mean achievement scores of male and female Biology students when exposed to analogy strategy, any difference observed was as a result of chance. This implies that teaching Biology with analogy affects students' achievement. On the other hand, analogy teaching strategy is not gender bias.

### Recommendations

Based on the findings of this study, the following recommendations were made.

- i. Teachers should incorporate analogy strategy into the teaching of Biology without preference to any gender in secondary schools in Imo State.
- ii. Biology teachers should be trained on how to implement analogy strategy through workshops, conferences and seminars.

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