



Effect of 5 Step Constructivist-Based Instructional Model on Student's Achievement in Biology

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ABSTRACT

The study was carried out to investigate the effect of 5 step constructivist-based instructional model on student's achievement in biology in Anambra State. Three hundred and eighty-five students were sampled using multi stage sampling technique. The study adopted a quasi-experimental research design. The control group was taught using conventional method while the experimental group was taught using constructivist-based model. Data was collected using biology achievement test (BAT). Mean and standard deviation were used to answer the research questions while analysis of covariance (ANCOVA) was used to test the null hypothesis at .05 level of significance. Data obtain revealed that there is a significant difference in the achievement of constructivist method, also male students taught with CBM perform better than female students. Based on the findings, recommendations were made among which is that teachers should engage students in constructivist classes, since it improved students with different intelligent levels, encouraged the ability to analyze facts and helped in divergent thinking towards biology in particular and science in general.

INTRODUCTION

Science is a systematic enterprise that builds and organizes knowledge by virtue of testable explanations and predictions about the universe. The role of science, particularly biology in the development of a nation cannot be over-emphasized. Science is highly valued in every part of the world and has been the bedrock of modern technological breakthrough. Biology is one of the core subject in Nigeria secondary school curriculum, mostly preferred by many students because it has less mathematical calculations and deals with non-abstract things. It is the key to

economic, intellectual, sociological, human resources development and wellbeing of any society (Ezuike & Ayo Vaughan, 2020). Biology has a very high enrolment of students in Senior Secondary School Certificate Examination (SSCE) than physics and chemistry.

A sound knowledge of biology is a prerequisite factor for entrance into such profession like medicine, pharmacy, nursing, agriculture, forestry, biotechnology, nanotechnology and so on (Maduabum, 2014). Despite the importance of biology as one of the key subjects in realizing any nations scientific and technological aspirations, evidence of low achievement

in the subjects by Nigeria students abound (Ige, 2010; Opara, 2011; Akinfe, Olofunmiyi & Fashiku, 2012; Anyaegbunam, Nwodo & Enibe 2015; Arokoy & Chukwu, 2017). Considering the importance and roles played by the knowledge of biology, the teaching of biology should be planned in a way that it would be taught to help the students to achieve greatness in science and technology in this 21st century.

Students achievement is influenced by the teacher's teaching method as observed by (Nwagbo, 2015; Akpan, 2013; Jajapraba, 2013; Akanwa & Ovute, 2014; Aydishel & Gharibi, 2015; Semerci & Batdi, 2015) when they opined that teacher's teaching methods increased students achievement in subject area. According to Umar (2011), the method used in teaching contributes significantly to the academic achievement of the students. Problem solving and decision-making skills also make them to underachieve in science. There is need to use an innovative teaching method which is more activity-based using questioning, explanation, demonstration and collaborative technique such as constructivism.

Constructivism is activity based, student's centered and interactive learning strategy which upholds the view that knowledge should be constructed by the learners through active mental developmental processes (Ekon & Nwosu, 2016). Nworgu (2016) developed an instructional model based on constructivism adopted from Stofflet and Stoddart (1994), which is a five-step instructional model comprising prior knowledge, exploration, discussion, dissatisfaction and application (PEDDA). It upholds that knowledge should be constructed by the learners through active mental developmental processes (Ekon, 2018). It is problem solving oriented allowing students to explore and work in groups. Constructivist-based model is all inclusive for teacher and students. It is against this background that this research was carried out in order to establish the effect of 5 step constructivist-based instructional model on student's achievement in biology.

Statement of the Problem

Poor academic achievement of science students especially in biology at senior secondary school certificate examination by Nigeria students had been a cause of concern for biology teachers and other stake-holders in education. This has been blamed on many factors especially the way biology is being taught in schools. A lot of teaching methods have been tried but more has been able to make sufficient impact on student's achievement in biology. Literature revealed that the predominant method used by teachers does not allow active participation of students. It is against this backdrop that this study sought to find out the effect of five step constructivist-based instructional model on secondary school student's achievement in biology.

Objective of the Study

The objectives of the study are as follows;

- i. To determine mean achievement scores of students taught biology using a 5 step constructivist-based instructional model and those taught using conventional teaching model (CTM).
- ii. To find out mean achievement scores of male and female students taught biology using CBM.

Research Questions

The following research questions were answered;

- i. What are the mean achievement scores of students taught biology using constructivist-based instructional model (CBM) and those taught using conventional teaching model (CTM)
- ii. What are the mean achievement scores of male and female students taught biology using CBM.

Hypothesis

- H01: There is no significant different in the mean achievement scores of students taught biology using CBM and those taught using CTM.
- H02: There is no significant difference in the mean achievement scores of male and female students taught biology using CBM.
- H03: There is no significant difference in the interaction effect of treatment and gender on the mean achievement scores of students taught biology using CBM.

Research Design

The research design used in this study is the quasi-experimental research design. This is because randomization tended to disrupt the school activities.

Population

The population of the study comprises 138,910 SS1 biology students (18,272 males and 120,637 females) in all the 150 co-educational secondary schools in six education zones of Anambra State.

Sample Size and Sample Technique

The sample of the study was made up of a total of 385 senior secondary 1 biology students and was drawn from the study, sampling was done in stages firstly purpose random sampling technique was use to select two co-educational schools from the six education zones. Then the next stage was simple random sampling technique to select six schools for experimental and six again for control groups respectively, while the third stage was the use of simple random sampling again to select intact classes from each of the schools. All the students in each of the intact classes were used for the study. The experimental group was taught the selected biology concept using the 5 step constructivist-based instructional approach while the control group was taught the same concepts using the conventional lecture method.

Instrument for Data Collection

The study was carried out using one instrument, Biology Achievement Test (BAT). The face validity and reliability of the instrument was equally obtained. Kuder Richardson K-20 formular was used and 0.77 reliability co-efficient was obtained.

Again, difficulty index was carried out and 93.8% was obtained meaning that most items fell within acceptable range and fit for any predictive purpose. Also 63.1 discrimination index was obtained which signifies that most item are within excellent range.

Table 1: Mean Achievement and Standard Deviation scores of Students Taught Biology using Constructivist-based Instructional Model.

Teaching Approach	Pre-test			Post-test			Mean Gain Score
	N	Mean	SD	N	Mean	SD	
CBM	176	17.92	6.49	176	51.45	5.98	33.53
CTM	209	15.11	5.19	209	42.76	6.43	27.65

The data in table 1: shows that the pretest and post-test mean achievement scores of students taught biology using constructivist-based instructional model was 17.92 and 51.45 with standard deviation 6.49 and 5.98 respectively. On the other hand, their counterpart taught using conventional model had 15.11 with standard deviation 5.19 as their pretest and 42.76 and standard deviation 6.43 as post-test. The result

Data Analysis

Descriptive statistic using mean and standard deviation were used to answer research questions while Analysis of Covariance (ANCOVA) was used to test the hypothesis at .05 level of significance using SPSS version 20.0.

Research Question 1: What is the mean achievement scores of students taught biology using constructivist-based instructional model and those taught using conventional teaching method?

signifies that CBM is efficacious in improving student's achievement in biology.

Research Question 2: What is the mean achievement scores of male and female students taught biology using CBM?

Table 2: Mean Achievement and Standard Deviation Scores of Male and Female Students taught Biology using Constructivist-based Instructional model

Teaching Approach	Gender	Pre-test			Post-test			Mean Gain Score
		N	Mean	SD	N	Mean	SD	
CBM	Male	73	19.22	6.72	73	53.59	6.20	34.37
CTM	Female	103	17.00	6.19	103	49.94	5.36	32.94

In table 2 above, the pre-test and post-test mean achievement scores of male and female taught biology with constructivist-based model are 19.22, 53.59 and standard deviation 6.72 and 6.20 for male and 17.00, 49.94 with standard deviation 6.19 and 5.36 respectively. The result showed a remarkable difference in mean gain score of male and female

students taught biology using CBM with male students having higher mean gain score.

Hypothesis 1: There is no significant difference in the mean achievement scores of students taught biology using CBM and those taught using CTM.

Table 3: Analysis of Covariance of Students' Mean Achievement Scores in Biology

Source	SS	Df	Ms	F	P
Pre-test	146.35	1	146.35	3.79	.052
Group	6365.83	1	6365.83	165.07	.000
Error	14731.31	382	38.56		
Total	863003.00	385			

Table 3: Showed that there is a statistically significant difference in mean achievement scores of students taught biology using constructivist-based instructional model and those taught with conventional instructional model, $F = 165.07$. The obtained P-value (.000) is less than the stipulated level of significance (.05). The

null hypothesis of no significant difference between the two groups was there rejected.

Hypothesis 2: There is no significant difference in the mean achievement score of male and female students taught biology using CBM.

Table 4: Analysis of Covariance of Male and Female Students' Mean Achievement Scores in Biology

Source	SS	Df	Ms	F	P
Pre-test	666.51	1	666.51	12.80	.000
Group	1217.60	1	1217.60	23.39	.000
Error	19879.52	382	52.04		
Total	863003.00	385			

Table 4 shows that there is a statistically significant difference in mean achievement scores of male and female secondary school students taught biology using constructivist-based instructional model and those taught with conventional instructional model $F = 23.39$. The obtained P-value (.000) is less than the stipulated level of significance (.05). The null

hypothesis of no significant difference between the two groups was rejected.

Hypothesis 3: There is no significant interaction effect of treatment and gender on the mean achievement scores of students taught biology using CBM.

Table 5: Analysis of Covariance of Interaction Effect of Gender and Treatment on Students Achievement in Biology

Source	SS	Df	Ms	F	P
Pre-test	42.64	1	42.64	1.2	.273
Group	6103.38	1	1610	0172.34	.000
Gender	1250.24	1	1250.4	35.30	.000
Group* Gender	4.33	1	4.33	.12	.725
Error	13457.34	380	35.41		
Total	863003.00	385			

Table 5 shows there is no statistically significant interaction between the mean achievement scores of male and female students taught biology using constructivist-based instructional model, $F = .12$, the obtained P-value (.727) is greater than the stipulated .05 level of significance. The null hypothesis was therefore not rejected.

- Teachers should engage students in constructivist classes, since it improved students with different intelligent level, encouraged the ability of analysis, divergent thinking towards biology in particular and science in general.

DISCUSSION OF FINDINGS

From the results, it was found out that there existed a significant difference between the academic achievement of students taught biology with constructivist-based instructional model and those taught using conventional teaching model. The result showed that the experimental group had a higher mean than the control group. Thus, the use of constructivist-based model facilitates the learning of biology concepts. The constructivist steps provide an opportunity for students to take active role in building their own knowledge. The results are consistent with the findings of Bimbola & Daniel (2010), Bagar, Kalender & Serika (2012), Ekoh & Nwosu (2016), Muligo & Owin (2016) that showed significant difference in achievement between the experimental and control groups when exposed to constructivist model. Again, Abdul-Raheem (2012) pointed out that male students performed better than their female counterparts after treatment.

RECOMMENDATIONS

From the study, the following recommendations were made;

- Biology teachers are encouraged to use constructivist model because it has been found

REFERENCES

- Abdul-Raheem, B. O. (2012). The influence of gender on secondary school students' academic performance in South West, Nigeria *Journal of Science* 31(1), 93-98.
- Akinfe, E. Olofinniyi, O. E. & Fashiku, C. O. (2012). "Teachers quality as correlates of student's academic performance in biology in senior secondary school in Ondo State, Nigeria". *Journal of Education research* 1(16), 108-114.
- Akanwa, U. N. & Ovute, A. O. (2014). The effect of constructivist teaching model on SSS physics students' achievement and interest. *Journal of research and method in education (IOSR-JRME)* 1, 35-38. Available online on www.iosrjournals.org
- Akpan, B. (2013). *Science education: A global perspective information*. Springer international publisher.
- Anyaeibunam, N. J. Nwodo, B. I. & Enibe, D. E. (2015). Effective application of constructivist theatre instruction (CTI) procedure for improving achievement and attitudes of biology students. *Proceeding 56th Annual conference of science teachers association of Nigeria (STAN)* 102-111.
- Arokoyu, A. A. & Chukwu, J. C. (2017). *Biology teacher's methods of teaching and academic*

- performance of secondary school students in Abia State Nigeria. *Journal of emerging trends in educational research and policy studies* 8(4), 228-231.
- Aydisheh, F. & Gharibi, H. (2015). Effectiveness of constructivist teaching method on students' mathematics academic achievement: *Mediterranean Journal of social sciences MCSER Publishing Rome – Italy* 6(6), 572.
- Bimbola, O. & Daniel, O. (2010). Effect of constructivist-based teaching strategy on academic performance of students in integrated science at the junior secondary level. *Edu Res Rev.* 5(7), 347-353. Available online @ <http://www.academicjournals.org/ERLS>
- Ekon, E. E. & Nwosu, A. A. (2016). Utilizing pedda as an effective teaching strategy for better cognitive achievement and interest in biology. *Proceedings 5th annual conference of science teachers association of Nigeria*, 410-418.
- Ekon, E. E. (2018). Effect of five-step conceptual change instructional model on students' perception of their psychosocial learning environment, cognitive achievement and interest in biology, unpublished Ph.D thesis, University of Nigeria, Nsukka.
- Ezuike, C. P. & Ayo-vaughan, A. F. (2020). Influence of teacher-centered and student-centered teaching methods on the academic achievement of post-basic students in biology in Delta State, Nigeria. *Teacher education and curriculum studies* 5(3) 120-124.
- Ige, A. (2010). Strategies for improving biology teachers for optimum performances (online) available @ [http://en.obonlo.com/strategies for improving biology-teacher joropt](http://en.obonlo.com/strategies-for-improving-biology-teacher-joropt).
- Jayapraba, G. (2013). Effect of metacognitive instruction and cooperative learning strategies for promoting insight learning in science. *International journal on new trend in education and their implication (yante)* 4(5), 165-172. Retrieved from www.ijonle.org.
- Maduabum, M. (2014). Student's interest and achievement in biology. Some correlates. *Journal of curriculum and instruction* 3(1 & 2) 10-19.
- Nwagbo, C. R. & Aham, A. (2015). Utilizing the 5E's constructivist instructional approach for effective classroom delivery of genetic concepts. 56th Annual conference STAN proceeding, 166-172.
- Nwanda, G. M., Odundo, P. Midigo, R. & Owino, S. M. (2016). Adoption of the constructivist learning approach in secondary schools in Kenya: Focus on learner achievement in biology by class. *Education review* 6(1), 31-44.
- Nworgu, L. N. (2016). Modern techniques of teaching biology. A paper presented for open university.
- Opera, J. A. (2011). Inquiring method and students' academic achievement in biology: Lessons and policy implications. *American Eurasian Journal of scientific research* 6(1), 28-31.
- Semerici, C. & Batdi, V. (2015). Meta analysis of constructivist learning approach on learner's academic achievement, retention and attitudes. *Journal of educational training studies* 3(2), published by Redframe publishing. Available online URI: <http://jets.realfame.com>.
- Stofflet, R. T. & Stoddart, T. (1994). The ability to understand and use conceptual change pedagogy as a function of prior content learning experience. *Journal of research in science teaching* 31(1), 31-51.
- Umar, A. A. (2011). Effect of biology practical activities on student's process skill acquisition in Mina, Niger State, Nigeria *JOSTMED*, 7(2), 118-126.

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