

USE OF MODELS AND SECONDARY SCHOOL STUDENTS' PERFORMANCE IN BIOLOGY IN OBIO/AKPOR LOCAL GOVERNMENT AREA

Martha Ijok Adibe Njoku (PhD)
Department of Biology, Ignatius Ajuru University of Education,
Port Harcourt, Rivers State, Nigeria

Email: martha.njoku@iaue.edu.ng

ABSTRACT

This study investigated the use of models by teachers to facilitate effective teaching and learning of Biology in secondary schools in Obio/Akpor local government area. Three research questions and one null hypothesis guided the study. Descriptive survey and Quasi-experimental designs were adopted for the study. Using intact classes, 200 SS II students and 56 Biology teachers formed the sample size. Instruments for data collection were Questionnaire on Teachers' Use of Models (QOTUM) and Biology Performance Test (BPT). Using Cronbach's Alpha and Kuder-Richardson formula 20 (R-20), reliability coefficient of 0.81 and 0.76 were obtained for QOTUM and BPT respectively. Mean and standard deviation were used to answer research questions while student t-test was used to test the only null hypothesis at 0.05 level of significance. Result shows that Biology teachers do not utilize models to facilitate the effective teaching and learning of Biology in secondary schools. The use of models enabled students participate effectively in the teaching/learning process of Biology in secondary schools. Also there was significant difference in the academic performance of students taught with models and those that are taught without models in favour of those taught with models. It was recommended among others that Biology teachers should ensure that models are used whenever necessary in the teaching of Biology.

INTRODUCTION

Teaching and learning processes are very crucial at all levels of educational development. If well planned and directed, they are the keys to success and progress of individual. Therefore, best methods couple with the right instructional materials has to be used in order to enhance effective teaching and learning. A model is a three-dimensional, recognisable imitation of an object. A model may be the same size as the object it represents or it can be smaller or larger. It can be handled and seen from a number of angles (Brainkart, 2024). Models do not only increase the motivation of the teachers and learners; they add clarity to the topic taught and make learning more interesting (Dike, 2018). Permanent learning is the goal of education in that the learners should be able to retain what is taught and make learning more permanent since they appeal to more than one sense. Ode and Omokaro, (2007) cited in Sanni, et al., (2019) revealed that learners retain most of what they hear, see and feel than what they merely hear. This concept bears credence to the old Chinese adage which says "what I hear I forget, what I see I remember and what I do, I understand" (Kroon, 2016). Visual instruction encourages the use of models to make abstract ideas more concrete to the learners. Therefore, the teacher's duty is to make learning live, not just something to remember but part of living experience. This can be done effectively by employing the use of models in teaching and learning of Biology as a mean of imparting knowledge to learners. Educators have come to realize that the most effective teaching and learning take place when an individual has direct experience with the subject under study. Biology is the study of living things,

and as such it is essential for secondary students to learn about the complexities and interconnectedness of life (Njoku et al., 2020). By studying Biology, students can develop a greater understanding of the natural world and the myriad of issues that affects.

In addition, Biology teaching can help students develop critical thinking and analytical skills that are useful in a variety of settings. Ultimately, the study of Biology can provide students with a valuable foundations for making informed decisions about their own health and health of the environment. Biology teaching in secondary Schools gives students knowledge on the use of antibiotics, and the eradication of invasive species. Besides, use of models in Biology teaching and learning enables students to experience the future works of scientists, engineers, and problem-solvers through model building (Bryce et al., 2016) thus making it aligned with the goal and objectives of secondary school Education Program of producing holistically skill-competent learners as enshrined in the National Policy on Education (FRN, 2013).

In modern times the teaching of Biology is aimed at developing different skills in the students by which they can resolve the daily life problems for their further improvement. Teaching Biology in secondary School helps students learn about the origin, structure and function of all living organisms, it is of a great importance in the formation and development of an individual. It provides students with sound knowledge of the basic principles and techniques of Biology. To effectively use this teaching methods in the classroom, the use of instructional materials is highly needed for easy remembrance and also broaden the knowledge of the students (Isma'il, & Lukman, 2022).

Model is a representation of a system (for instance, the human respiratory system, id cardiovascular etc) or a phenomenon (such as the changing seasons, the oxidation of body, Humans maintaining their body temperature etc). These representations can take the form of drawings, diagrams, simulation or even physical replicas. According to Okobia (2015) teachers frequently use models in the classroom; in fact, textbooks are full of these representations and are referred to as visual resources. Visual resources are books, charts, motion pictures, posters, diagrams, and photographs. Models are used as props to show, point out, or provide examples of a system or phenomenon. They are often used by teachers to help explain difficult concepts or demonstrate how different components interact with each other (Aseeva, 2021)

Unfortunately in a developing country like Nigeria, students have invariably had their imaginations stretched too far due to the teacher's excessive use of words to convey meanings. Students need a rich store of concrete sensory experience to aid understanding of their learning experience. The development of modern technology has placed within the reach of the teachers, a vast array of teaching aids, thus providing an escape from verbalism to concretized learning. Teaching aids are materials which make a tremendous enhancement of lesson impact if intelligently used. They are also instructional materials used in teaching and learning which aid the teacher for easy demonstration and stimulate the sensory of the learner's. Instructional materials are the devices developed or acquired to facilitate teaching and also transmitting knowledge and skill to the learners (Jenkinson, 2018). There are varieties of materials which can be used in teaching Biology, they can be models, charts, and preserved specimen of plant and animals. A teacher may use models such as diagrams or animations when teaching about the structure of cells so students can better visualize what they are learning about. Furthermore, models also provide an opportunity for hands-on exploration, which helps engage learners more deeply in their studies (Kolchin et al., 2022).

In spite of the accompanying gains and the clarion call for the provision and utilization of models in secondary schools in Obio/Akpor Local Government Area, there are still serious inhibiting factors

encountered in the attempt to implement these laudable ideas. Although there are many challenges that hinder the process of using models in the classroom, when effectively used, models have a dramatic effect on teachers and learners. But, where models are not used effectively, they do not add value to teaching and learning. The problem of this study therefore is to find out how the provision and utilization of models influence academic performance of students in secondary schools in Obio/Akpor Local Government Area.

The study will be guided by 3 research questions; 1. Do Biology teachers utilize models to facilitate the effective teaching and learning of Biology in secondary school? 2. Does the use of models enable students participate effectively in the teaching process of Biology in secondary schools? and 3. Is there a difference in the academic performance of students taught using models and those that are taught without models? To further test for difference in scores at 0.05 level of significance, one null hypothesis was formulated; **Ho:** There is no significant difference in the academic performance of students taught with models and those that are taught without models

LITERATURE REVIEW

Shabiralyani, et al., (2015) in a study on the impact of visual aids in enhancing learning process, found out that majority of the teachers and students had positive perceptions of the use of visual aids which includes models. The research concluded that using visual aids during teaching stimulates thinking and improves the classroom learning environment. Again, Babalola (2022), carried out a study on the utilization of 3D-model of human digestive system (3-DMHDS) and its influence on students' understanding of human digestive system. Findings show that 3-DMHDS significantly influence the understanding of the human digestive system among students irrespective of their gender and institutional ownership. It was recommended among others that Biology teachers and students should be motivated to use the 3D model for the teaching and learning of the human digestive system among other biology topics. Lucas (2021) developed 3D modeling for molecular Biology teaching at the university level and examined its impact on biology teaching. It was noted that students were able to better understand certain topics when they could see them represented visually through diagrams or physical objects like blocks or balls representing molecules or atoms respectively. Additionally, research showed positive effects on both short-term knowledge acquisition as well as long-term retention rates compared with traditional methods alone such as lectures and readings without any visual support material provided by models used during instruction time periods. Njoku, (2014) in a study on effective use of models for science and technology instruction, found out that students learn more deeply with words and models combined than they could have with either words alone or models alone, and that models are more effective when it is interactive and under the control of the learner.

METHODOLOGY

The design for the study were descriptive survey and quasi-experimental designs. Specifically, the study applied the non-equivalent control group design. Quasi-experimental design was considered appropriate for the study because intact classes was used to avoid disruption of normal class lessons and to control extraneous variables. Survey was adopted to gather information from Biology teachers on use of models in the classroom, this was adopted in other to reach as many teachers as possible. This study was carried out in Obio/ Akpor Local Government Area of Rivers State. Geographically, the area is located within the tropical region between latitude 4° 45'N and 4° 60'N of the equator and longitude 6° 50'E and 6°70'E of the Greenwich Meridian. Its total land mass is

approximately 260km², occupied by 115725 people as projected in 2017 (NPC, 2017). Hence, it has a high population density of 2,134 persons per km². The area is bounded in the north by Ikwerre and Etche Local Government Areas, in the south by Port Harcourt City Council, in the east by Oyigbo and Eleme Local Government Areas and in the west by Emohua Local Government Area respectively. It is one of the twenty three Local Government Areas in Rivers State (Niger Delta). The area is one of the major locations of the oil and gas sector of the economy and the centre of commerce and industry in Nigeria.

The population of this study consisted of all Biology students in senior secondary II (SSII) and Biology teachers in Obio/Akpor Local Government Area. According to information obtained from Statistics Unit, Planning, Research and Statistics Department, Rivers State Senior Secondary Schools Board, there are 28 public schools in the Local Government. The total number of SSII students in public schools was 12,863 and 99 Biology teachers. The sample size of the study comprised 56 Biology teachers randomly selected from several schools and 200 SS II students, from two (2) intact classes of the two randomly selected secondary schools who participated in the study in Obio/Akpor Local Government of Rivers State. Each class consisted of 85 and 115 students and were assigned control and experimental groups respectively.

Two instruments were used to gather data for the study. The instruments were, Questionnaire on Teachers' Use of Models (QOTUM) and Biology Performance Test (BPT). The questionnaire consisted of 10 statements presented in a modified 4 Likert scale of Strongly Agreed (SA), Agreed (A), Disagree (D) and Strongly Disagree (SD). Five statements to gather information on Biology teachers' utilization of models during lessons delivery and the remaining five to gather information on class participation while using models to teach secondary school students. The other instrument; BPT consists of 15 multiple choice items with four options, A, B, C, and D. Each of the items in the BPT carries one mark. The test items were developed using Biology text books based on the content to be taught in the lesson. The instruments were validated by two experts in Biology Education and a senior Biology teacher to ensure that it contained the required questions to achieve the objectives of the study. For the reliability of the research instruments, 20 copies each of QOTUM and BPT were administered to Biology teachers and students respectively, in schools outside the study area, and the data obtained were subjected to analysis. The reliability of the research instruments were determined using Cronbach's Alpha and Kuder-Richardson formula 20 (R-20), to obtain reliability coefficients of 0.81 and 0.76 for QOTUM and BPT respectively. These values were considered suitable for the instruments to be used for data collection.

A pretest was administered to the control and experimental groups respectively, then the test scripts were retrieved, marked and packed away for future use. Then the treatment which is teaching was administered to both groups. Group A (experimental group) was taught using models. Then the group B (control group) was taught using discussion method without models. After the teaching, the post-test was administered to both groups. The test scripts were retrieved and scored. The scores were used to determine which method of teaching was more effective in enhancing academic performance of students in Biology. The data obtained from the pre-test and post-test were analyzed using mean and standard deviation for research questions and t-test analysis for testing the null hypothesis at 0.05% level of significance.

RESULTS

Research Question 1: What extent does Biology teachers utilize models to facilitate the effective teaching and learning of Biology in secondary schools?

Table 1: mean and standard deviation showing the extent Biology teachers utilize models to facilitate the effective teaching and learning of Biology in secondary schools

S/N	ITEMS	Mean	Std. Deviation	Decision
1	Models are used in teaching all topics in Biology	1.42	0.50	Not Accepted
2	Models are provided by the government for teaching Biology	1.82	0.77	Not Accepted
3	Teachers are not knowledgeable in the use of models	2.21	1.03	Not Accepted
4	Models are readily available for use in the teaching of Biology	1.85	0.75	Accepted
5	Models are prepared in line with curriculum objectives	2.35	0.78	Not Accepted

Table 1 above present information on the extent Biology teachers utilize models to facilitate the effective teaching and learning of Biology. It can be observed that all the items had a mean score below the criterion mean 2.50 and this indicates Biology teachers do not utilize models in teaching Biology in secondary schools.

Research Question 2: Does the use of models enable students participate effectively in the teaching process of Biology in secondary schools?

Table 2: Mean and standard deviation showing students effective participation with the use of models in the teaching process of Biology in secondary schools

S/N	Items	Mean	Std. Deviation	Decision
6	The use of Models makes the teaching process of Biology interesting	1.73	0.73	Accepted
7	Students get involved when Models are used in the teaching and learning process	3.33	0.66	Accepted
8	Teaching aids presents information in a clear and organized way	3.26	0.73	Accepted
9	Understanding is enhanced in the use of models	2.70	1.02	Accepted
10	The use of models promotes team learning	3.23	0.97	Accepted

Table 2 above reveals information about the students' effective participation in the teaching and learning process of Biology in secondary schools. All the items above presents a mean score above the criterion mean 2.50 which implies that the use of models enable students participate effectively in the teaching process of Biology in secondary schools.

Research Question 3: Is there a difference in the academic performance of students taught with models and those that are taught without models?

Table 3: Mean and standard deviation showing the academic performance of students taught with models and those that are taught without models

Teaching Method		Pretest		Post test		Mean gain	
		N	Mean	Std.dev	Mean		Std.dev
With Models (Experimental)		115	5.91	0.82	26.80	2.57	20.89
Without Models (Control)		85	6.54	1.06	16.40	3.51	9.86

Experimental group has a mean pretest score of 5.91 with a standard deviation of 0.82, and mean posttest score of 26.80 and standard deviation of score of 2.57 respectively. Thus the experimental group has a mean gain score of 20.89 after treatment. On the other hand, the control group has a mean pretest score of 6.54 with a standard deviation of 1.06, and posttest mean score of 16.40 and a standard deviation of 3.51 respectively. Thus the control group had a mean gain score of 9.86. Obviously the Experimental group scored higher mean score than the Control group. It can therefore be concluded that the Experimental group out-scored the Control group, indicating that there is a difference in the academic performance of students taught with models and those that are taught without models.

HO: There is no significant difference in the academic performance of students taught with models and those that are taught without models

Table 4: t-test analysis showing the academic performance of students taught with models and those that are taught without models

Group	N	Mean	Std.dev	Df	t-cal	Sig	Decision
With Models (Experimental)	115	26.80	2.57	198	4.32	0.00	S
Without Models (Control)	85	16.40	3.51				

From Table 4, the result revealed that t-cal was 4.32 and a p-value of 0.00 was recorded at df = 198. Since the p-value of $p=0.00$ is less than 0.05, it implies that there is significant difference in the academic performance of students taught with models and those that are taught without models. Thus, the null hypothesis that says there is no significant effect is rejected.

Summary of findings

1. Result shows that Biology teachers do not utilize models to facilitate the effective teaching and learning of Biology in secondary schools
2. It was found out that the use of models enable students participate effectively in the teaching process of Biology in secondary schools
3. There was significant difference in the academic performance of students taught with models and those that were taught without models

DISCUSSION OF FINDINGS

Findings on table 1 of this study show that Biology teachers do not utilize models in teaching Biology in secondary schools. It can be observed that all the items had a mean score below the criterion mean 2.50 and this indicates that teachers did not utilize models in teaching their

students. This finding disagrees with Okobia (2015) and Aseeva (2021) who said that teachers often or frequently use models to teach difficult concepts. On the other hand, the findings of this study corroborates Babalola (2022) who upheld the assertion that Biology teachers need to improve in their use models in teaching.

Furthermore, findings on table 2 indicated that the use of models enable students to participate effectively in the teaching and learning of Biology in secondary schools. This result agrees with Kolchin et al. (2022) who stated that use of models provide opportunity for hands-on exploration, which enhances students' engagement. Findings also agree with Shabiralyani, et al., (2015) who revealed positive perception of teachers and students about the use of visual aids (models inclusive). Positive perception from both students and teachers will provide a comfortable environment for effective Biology teaching and learning to thrive.

Results on table 3 revealed that Experimental group scored 26.80 while the control group 16.40. Experimental group out- scored the Control group, indicating that there is a difference in the academic performance of students taught with models and those taught without models. The result on table 4 which was a further test for significant difference revealed a clear significant difference in the mean scores of those taught with or without models respectively. This result agrees with Babalola (2022) who revealed significant influence of the use of 3-D models on students' academic performance. Lucas (2021) also discovered that the use of model have positive effect on both short term and long term knowledge acquisition.

CONCLUSION

Based on the findings of this study, the researcher concluded that;

1. Biology teachers do not utilize models as frequent as possible to facilitate the effective teaching and learning of Biology in secondary schools.
2. The use of models enable students participate effectively in the teaching/learning process of Biology in secondary schools.
3. The use of models during the teaching process of Biology improves students' learning outcome and performance in examination.
4. There is a difference in the academic performance of students taught using models and those that are taught without models.

SUMMARY

In this study, focus was on the use of models and secondary school students' performance in Biology using some selected secondary schools in Obio/Akpor Local Government Area of Rivers State. The study is was specifically carried out to; determine the extent Biology teachers utilize models to facilitate the effective teaching and learning of Biology in secondary school; ascertain whether the use of models enable students participate effectively in the teaching process of Biology in secondary schools; find out whether the use of models during the teaching process of Biology improves students learning outcome and performance in examinations; and ascertain whether there is any difference in the academic performance of students taught using models and those that are taught without models.

The study adopted the survey research design and randomly enrolled participants in the study.

RECOMMENDATIONS

Based on the responses obtained, the researcher proffers the following recommendations:

- Biology teachers are encouraged to utilize models to facilitate the effective teaching and learning of Biology in secondary schools, whenever necessary.
- For effective Biology teaching and students' participation in the teaching and learning process, school principals and relevant government agencies should ensure that models of different organs and parts of living organisms are made available in schools.
- Training activities on use of models should be carried out more frequently, and teachers monitored closely by authorities to ensure compliance in the classroom for enhance academic performance.

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