The Effects of Instructional Model on Student's Performance in Organic Chemistry in Obio/Akpor Local Government Area, Rivers State

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Abstract
The effects of Instructional model on students' performance in chemistry in Obio/Akpor Local Government Area, Rivers State. The study was carried out to determine the effect of teaching students organic chemistry using physical model as instructional aid against teaching students organic chemistry using diagrams as instructional aid. Two research questions and two hypotheses guided the study. A pre-test posttest non-randomized control quasi-experimental design was adopted in the study. A cluster sampling technique was used to obtain a sample of two intact classes which consisted of 50 students in the control group and 50 students in the experimental group. Students in the control group comprised 28 male and 22 female while the experimental group comprised of 30 male and 20 female students. Two instruments were developed and used for data collection. To obtain reliability coefficient Using test-retest, Pearson Product Moment Correlation was used to calculate the reliability coefficient. A reliability coefficient of 0.98 was obtained for the Chemistry Achievement. Treatment for both control and experimental groups lasted for a period of 2 weeks. The research questions were answered using mean while the hypotheses were tested at 0.05 alpha level of significance using analysis of covariance. The results of the study showed that there was a significant statistical difference in the mean achievement of students taught organic chemistry using physical model as instructional aid and students taught organic chemistry using diagram as instructional aid with the students taught using physical model performing better. It was also found that students exposed to instruction using physical model as instructional aid agreed that the exposure enhanced their interest in chemistry. Based on the findings of the study, it was therefore recommended that physical model should be made available in schools by government and teachers should also utilize this models in teaching the students because it enhancing their performance.

Introduction

The role of science and technology in the development of a nation is never in dispute. The current upsurge effort in development of science and technology has greatly affected human beings and, to be ignorant of this development is to live in an empty, meaningless and probably unreal life. The technological development of any nation lies on its emphasis on sciences especially chemistry. This is evidenced in the admission ratio of 60:40 of the science and science related courses to the Arts and Humanities into Nigerian Federal and State universities. In an effort to achieve national developmental needs, the Federal Government of Nigeria made special provisions and incentives through the provision of instructional materials, laboratory equipment's, training and retraining of teachers, provision of research grants and adoption of information and communication technology (ICT), (Federal Ministry of Education, 2008).

Besides, the Federal Government of Nigeria through the Education Tax Fund (ETF) intervention project supplied science equipment's and instructional materials about six hundred and thirty-three secondary schools all over the country in 2008 (Federal Ministry of Education, 2008). The aim was to reduce or eradicate the problems encountered by the teachers as a result of the lack of laboratory equipment and instructional materials in schools. However, in spite of these efforts by the Federal Government, students' performance is still very poor in the sciences particularly chemistry. Chemistry as a branch of science which deals with how substances are made up, how atoms of elements combine or breakup and how atoms and compounds react under different conditions. Students have often gone through the secondary school either blindly or without proper guidance as to the importance of chemistry. It is only when students wish to enter the university that they realize they should have taken chemistry more seriously. The chemist is found in all facets of the community and so job opportunities are quite high Usman (2008). A chemist is employed in chemical industries such as breweries, cement factories, drug companies, food industries, oil companies and in government establishments like institutions of learning, ministries of defense, environment, education, agriculture, technology and internal affairs.

The fundamental principles of chemistry covered in this curriculum include: particulate nature of matter; periodicity, chemical combination, quantitative aspects of chemical reaction; rates of reaction; equilibrium, carbon chemistry and industrial application of chemistry Usman (2008). The above recommendation became necessary because a review of students' achievement in Senior Secondary School Certificate Examination (SSCE) in chemistry showed a pathetic trend of performance compared to other sciences. Many factors such as mathematical aspects of chemistry, poor instructional models, lack of instructional materials, and lack of interest were associated with students' poor performance in chemistry (Amadi, 2016).It was further reported that candidates concentrated mainly on familiar questions that demanded recall of facts and were unable to apply their knowledge of scientific principles to answer other questions as well as poor mathematical skills, inability to write chemical formula - correctly, poor spelling and poor understanding of the structures and properties of compounds (West African Examination Council (WAEC, 2008).

Furthermore, candidates answered chemistry questions poorly and also failed to draw correct structures and give correct structures. Hence, it is considered that the candidates could perform better if instructional materials are used in teaching them. The instructional materials are those ones whose production and usage are activity oriented, pupil centered, interesting, intellectually stimulating and innovative, and capable of creating interest and ultimately affecting learning behaviour of students. These materials include models, mock-ups, and simulations Souse (2006).

Purpose of the Study

The purpose of the study is to determine the effect of instructional model on student performance in organic chemistry in Obio/Akpor Local Government Area, Rivers State. Specifically, the study intends:

1. Determine the difference in the mean performance of male students taught with diagram as an instructional aid and male student taught with physical model in organic chemistry test in secondary schools in Obio/Akpor Local Government Area, Rivers State.
2. Determine the difference in the mean performance of female students taught with diagram as an instructional aid and female student taught with physical model in

organic chemistry test in secondary schools in Obio/Akpor Local Government Area, Rivers State.

Research Questions

This following research questions have been posed to guide the study:

1. What is the difference in the mean performance of male students taught with diagram as an instructional aid and male student taught with physical model in organic chemistry test in secondary schools in Obio/Akpor Local Government Area, Rivers State?
2. What is the difference in the mean performance of female students taught with diagram as an instructional aid and female taught with physical model in organic chemistry test in secondary schools in Obio/Akpor Local Government Area, Rivers State?

Research Hypotheses

The following hypotheses were formulated for the study and tested at 0.05 alpha level

Ho_1: There is no significant difference in the mean performance of male students taught with diagram as an instructional aid and male taught with physical model in organic chemistry test in secondary schools in Obio/Akpor Local Government Area, Rivers State.

Ho_2: There is no significant difference in the mean performance of female students taught with diagram as an instructional aid and female student taught with physical model in organic chemistry test in secondary schools in Obio/Akpor Local Government Area, Rivers State.

Significance of the Study

The significance of this study is discussed on the basis of the use of physical model and the use of diagram as instructional aids. On the diagram, this study is anchored on some psychological theories that account for how learning takes place. The use of physical model is anchored on the cognitive theory of learning. In this study, opportunities are created for students to be exposed to a chart and physical model, also known as instructional aid for the purpose of understanding chemistry.

Research Design

The research design adopted pre-test, post-test control non randomized group quasi experimental design. Intact classes and two levels of treatments are involved.

Area of the Study

This study was carried out in Senior Secondary Schools in Obio-Akpor Local Government Area of Rivers State, Nigeria.

Population of the Study

The population for the study comprised of 850 senior secondary SS II Chemistry students, and 2 selected government secondary schools out of 10 co- educational public schools in ObioAkpor Local Government Area was selected.

Sample and Sampling Technique

The sample comprised one hundred (100) SS (II) chemistry students in 2 senior secondary schools in Obio-Akpor Local Government Area. A purposive sampling technique was used to select two co-educational schools that have up to 50 chemistry students in a class. 50 Students

from one school was assigned to control and other 50 students in the other school was assigned to experimental, intact classes was used.

Instrument for Data Collection

Two instruments was used for data collection in this study. They are:

1. Organic Chemistry Achievement Test (OCAT).
2. Organic Chemistry interest Inventory (OCII).

These instruments are developed by the researcher and are based on the contents taught while the OCII is as well on the felling of student about the method used.

Reliability of the Instruments

The reliability of the instrument of Organic Chemistry Achievement Test (OCAT) was determined using test-retest method (measure of stability). 20 item sample was used to draw a sample of 20 students. This set of students did not participate in the main study. Copies of the instrument was administered to the sample of the student selected for the study. They were requested to attempt all the 20 items of OCAT. After an interval of 2 weeks, the instrument was re-administered to the same sample of students to respond to the second time. The initial and retest scores of the students was correlated using Pearson Product Moment Correlation (PPMC) which is 0.98.

Method of Data Analysis

The mean and standard deviation was used to answer the research questions. Analysis of Covariance (ANCOVA) was used for testing the hypotheses. This statistical technique (ANCOVA) enables the researcher to adjust the initial, group differences (Non-equivalence) since intact classes used and hence establish the equivalence statistically. The ANCOVA is also a means of controlling the extraneous variables from the dependent variables and thereby increasing the precision of the experiment and thus reducing error variance (Ferguson. 1981). The hypotheses was tested at the significance level of 0.05.

Analysis of Data

Research Question 1

What is the difference in the mean performance of male students taught with diagram as an instructional aid and male taught with physical model in organic chemistry test in secondary schools in Obio/Akpor Local Government Area, Rivers State?

Table 4.1: Mean scores of male students taught organic chemistry

Groups	N	Pre-test Mean (M_1)	Post-Test Mean (M_2)	Mean Difference (Within)
Control	28	26.75	47.79	**21.04**
Experimental	30	40.13	58.67	**18.53**
Mean Difference (Between)		**13.38**	**10.88**	**-2.50**

Source: Field study

Table 4.1 shows the mean scores of male students taught organic chemistry using diagram as instructional aids and male students taught organic chemistry using physical model in secondary schools in Obio/Akpor Local Government area of Rivers state. The table shows a pre-test mean score of $M_1 = 40.13$ for the experimental group and a pre-test mean score of $M_1 = 26.75$ for the control group. This shows a difference of 13.38 in favour of the experimental

group. This slight difference in the mean scores of the two groups could be attributed to extraneous variables. The table also reveals a mean difference of 21.04 for the control group and a mean difference of 18.53 for the experimental group between pretest and posttest scores. This indicates that the mean score in chemistry for the both groups improved after being taught using the two instructional aids. It is however observed from the table that the mean post-test score for the experimental group (M_2=58.67) was higher than that of the control group (M_2= 47.79) by a difference of 10.88, meaning that male students taught using physical model as instructional aid performed better than male students taught using diagrams as instructional aids.

Hypothesis 1: There is no significant difference in the mean performance of male students taught with diagram as an instructional aid and male taught with physical model in organic chemistry test in secondary schools in Obio/Akpor Local Government Area, Rivers State.

Table 4.5: ANCOVA for research question 1

Groups	Mean	Std. Deviation	N	df	F_{cal}	F_{crit}	Decision
Control	47.79	7.579	28				
Experimental	58.67	2.657	30	1,55	17.942	4.020	Reject
Total	53.41	7.802	58				

Source: Field study

The results from Table 4.5 show that after controlling for the difference in pre-test scores, the difference in posttest scores between the two groups was statistically significant at 0.05 level of significance. This is evident by $F_{cal}(1,55) = 17.942$ greater than $F_{crit}(1,55) = 4.020$. With these result, the hypothesis was rejected. This implies that there was a significant statistical difference in the mean score of male students taught organic chemistry using physical model as instructional aid and male students taught organic chemistry using diagrams as instructional aid. This result shows that the difference (10.88) in mean scores of the two groups on posttest scores as recorded in Table 4.1 is statistically significant at 0.05 alpha level of significance (See Table 4.8, Appendix for SPSS output).

Research question 2

What is the difference in the mean performance of female students taught with diagram as an instructional aid and female taught with physical model in organic chemistry test in secondary schools in Obio/Akpor Local Government Area, Rivers State?

Table 4.2: Mean scores of female students taught organic chemistry

Groups	**N**	**Pre-test Mean (M_1)**	**Post-Test Mean (M_2)**	**Mean Difference (Within)**
Control	22	25.73	43.91	**18.18**
Experimental	20	39.10	59.80	**20.70**
Mean Difference (Between)		**13.37**	**15.89**	**2.52**

Source: Field study

Table 4.2 shows the mean scores of female students taught organic chemistry using diagram as instructional aids and female students taught organic chemistry using physical model in secondary schools in Obio/Akpor Local Government area of Rivers state. The table shows a pre-test mean score of M_1 = 39.10 for the experimental group and a pre-test mean score of M_1

= 25.73 for the control group. This shows a difference of 13.37 in favour of the experimental group. This slight difference in the mean scores of the two groups could be attributed to extraneous variables. The table also reveals a mean difference of 18.18 for the control group and a mean difference of 20.70 for the experimental group between pretest and posttest scores. This indicates that the mean score in chemistry for the both groups improved after being taught using the two instructional aids. It is however observed from the table that the mean post-test score for the experimental group (M_2=59.80) was higher than that of the control group (M_2= 43.91) by a difference of 15.80, meaning that female students taught using physical model as instructional aid performed better than female students taught using diagrams as instructional aids.

Hypothesis 2: There is no significant difference in the mean performance of female students taught with diagram as an instructional aid and female student taught with physical model in organic chemistry test in secondary schools in Obio/Akpor Local Government Area, Rivers State.

Table 4.6: ANCOVA for research question 2

Groups	Mean	Std. Deviation	N	df	F_{cal}	F_{crit}	Decision
Control	43.91	7.733	22				
Experimental	59.80	6.254	20	1,39	8.756	4.020	Reject
Total	51.48	10.643	42				

Source: Field study

The results from Table 4.6 show that after controlling for the difference in pre-test scores, the difference in posttest scores between the two groups was statistically significant at 0.05 level of significance. This is evident by $F_{cal}(1,39) = 8.756$ greater than $F_{crit}(1,39) = 4.020$. With this result, the hypothesis was rejected. This implies that there was a statistical significant difference in the mean score of female students taught organic chemistry using physical model as instructional aid and female students taught organic chemistry using diagrams as instructional aid. This result shows that the difference (13.04) in mean scores of the two groups on posttest scores as recorded in Table 4.2 is statistically significant at 0.05 alpha level of significance (See Table 4.9, Appendix for SPSS output).

Discussion of Findings

Research question one sought the difference in mean score of male students taught organic chemistry using physical model as instructional aid and male students taught organic chemistry using diagrams as instructional aid in secondary schools in Obio/Akpor Local Government Area, Rivers State. The finding showed that there was a difference in the mean scores of male students exposed to the instruction using physical model as instructional aid performed and their counterparts exposed to the instruction using diagrams as instructional aid with those exposed to instruction using physical model as instructional aid performing better. The result of the test of hypothesis one which corresponds to research question one revealed that the difference in the mean performance in organic chemistry of the two groups was statistically significant at 0.05 level of significance. Such result could have risen from the fact that students exposed to instruction with physical model as instructional aid may have concretized the concepts being taught through their sense of sight and as such gained better understanding. Hence their better performance in the Chemistry Achievement Test. This result is in agreement with the result of Bayram (2004) who conducted a study to investigate the effects of concrete

models on eighth grade students' geometry achievement and attitudes toward geometry in private schools in Ankara-Turkey and found students taught Geometry using concrete model to performed better than students who received instruction in Geometry through traditional method.

Research question two sought the difference in mean score of female students taught organic chemistry using physical model as instructional aid and female students taught organic chemistry using diagrams as instructional aid in secondary schools in Obio/Akpor Local Government Area, Rivers State. The finding showed that there was a difference in the mean scores of female students exposed to the instruction using physical model as instructional aid performed better than their counterparts exposed to the instruction using diagrams as instructional aid with those exposed to instruction using physical model as instructional aid performing better. The result of the test of hypothesis two which corresponds to research question two revealed that the difference in the mean performance in organic chemistry of the two groups was statistically significant at 0.05 level of significance. Such result could have risen from the fact that students exposed to instruction with physical model as instructional aid may have concretized the concepts being taught through their sense of sight and as such gained better understanding. Hence their better performance in the Chemistry Achievement Test. This result corroborates the result of Adipo (2015) who conducted a study to determine the impact of instructional (concrete) materials on academic achievement in Public Primary Schools in Siaya County, Kenya, when compared to only abstract mathematics symbols. The study found that students taught algebra using concrete materials performed better than students who received instruction in Algebra through symbols.

Conclusion

The study investigated the effect of the use of instructional aid on student's performance in organic chemistry. Therefore, the research showed that the use of physical model as an instructional aid increases student's performance because what you see appeal to all senses, and is easily retained and remembered and it gives room for creativity of new ideas. Meanwhile, the use of physical, model as an instructional aid is recommended in teaching and learning of organic chemistry.

Recommendation

The following recommendation were made

1. The Government should fund the schools; especially chemistry laboratory should be equipped with all kinds of models relating to the topics in organic chemistry for effective performance of students in organic chemistry.
2. Science teachers especially chemistry teacher should have extra wages that will encourage them to put in their best, thereby improving student's performance.
3. Chemistry teachers should make chemistry especially organic chemistry real and interesting by using visual aids like physical model that will increase student performance.

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