

Effects of Graphic Organizer on Students 'Retention in Biology

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Abstract

The study investigated the effects of graphic organizer on students' retention in biology. The study was carried out in Ebonyi state of Nigeria. The study used a quasi experimental design specifically, the pretest posttest non-equivalent control group research design. The sample used was 122 students selected from two secondary schools drawn from the population through a simple random sampling. One school was used for treatment group and the other for control group. Graphic organizer method was used to teach the treatment group while conventional method was used to teach the control group. Three research questions and three null hypotheses guided the study. Mean, standard deviation and the Analysis of Co-Variance (ANCOVA) were used for data analysis. Results of the study showed that graphic organizer enhances students' retention in biology than conventional method. The results also showed that graphic organizer boosts the retention of both male and female students in the subject. In addition, the results showed that there is no interaction between gender and teaching methods in students' retention in biology.

Keywords: Graphic, Organizer, Retention, Biology, Conventional, Method.

Introduction

Learning biology in schools helps students to develop problem solving and critical thinking skills. The world is changing and biology is central to the curing of diseases and solving world problems-like global warming etc. (Morgan 2009). Students need to learn scientific skills to become scientists or just think critically in everyday situation. Biology is a popular subject among secondary school students due to its nature. Biology is the study of living things. It is a live science that deals with the study of organisms and the environment (Ukpai & Ibe 2014). Biology education is so important in nation building. It is so wide and touches almost every area of human endeavour. Biology education plays important role in various aspects of the economy, public and personal life including manufacturing/production, teaching, industry, health, agriculture, attitudinal change to mention but a few.

Previous studies tend to show that students'

retention and achievement in science is very poor (Onwioduokit & Akinyemi 2005). Onwioduokit & Akinyemi attributed this to lack of equipment in schools, insufficient manpower, poor attitude of students and poor understanding of science concepts. Others according to Ukpai (2020) are poor method of teaching and nature of the curriculum. Ukpai argued that science instruction in Nigeria is non student centered. In her argument, she said that a child creates a mental picture of nature from his immediate environment and interaction with his culture. This mental picture could be represented as graphic organizer which could be most appropriately integrated in the instructional process to desired outcome in terms of mastery, retention and achievement.

One instructional strategy which probably has the potential to offer opportunities to address the problems of effective teaching and learning of biology is the graphic organizer. Kang (2004) defined graphic organizer as a non-linguistic, visual

tool that enables the learners to:

- Connect new information to their existing knowledge.
- See how concepts relate to each other and fit in.
- Recall information easily.

Graphic organizers are visual devices that depict information in a variety of ways (Alshatti 2011). Most commonly, they employ lines, circles, and boxes, to form images which depict four common ways information is typically organized: hierarchic, cause/effect, compare/contrast, and cyclic or linear sequences. Graphic organizers find their origin in the cognitive theories of learning. Cognitive theories of learning attempt to explain how people learn on basis of thought processes. There is a presumption amongst cognitive theorists that the mental processes operate in an organized, predictable fashion. Kang stressed that incorporating the use of graphic organizers during the learning process will enhance the functionality of these processes and improve memory retention and retrieval. Ukpai, Gabriel, Abonyi and Ugama (2016) believed that learning occurs when new material is related to relevant ideas that are already present in the existing cognitive structure. Graphic organizers can facilitate this process by providing students a framework for relating existing knowledge to the new information learned. Studies have found that many constructivist beliefs are realized when learners use graphic organizers (Alshatti 2011 and Kang 2004), it:

1. Allows learners to work actively to construct their understanding.
2. Facilitates visual thinking as it represents what the learner understands.
3. Makes thought and organization of thoughts visible and lead to deeper understanding.
4. Helps process and restructure thoughts and information.
5. Facilitates elicitation, explanation of a concept.
6. Promotes recall and retention through synthesis and analysis
7. Facilitates conceptual change.
8. Enhances critical thinking. or higher order thinking skills.
9. Improves problem solving skills in students.

Although graphic organizer approach seems to lead students through simple stages of conception and

mastery learning, and its exact potential gains to science instruction has been widely articulated in literature (Igwe 2003; Onwioduokit and Akinyemi 2005), its efficacy in biology is still in doubt and needs an empirical investigation. Sometimes concept categorization and restructuring are influenced by gender and some cultural factors, it may be logical to argue that male and female students may differ in their graphic organizers and as such respond differently to preplanned instructional graphic organizer. This may lead to doubts on the likelihood of interactions between gender and methods on students' retentions in situations where graphic organizers are dominant instruction approach. This study therefore is a thorough instigation of the efficacy of graphic organizer on students' retention in biology.

Purpose of the Study

The purpose of this study is to investigate the effect of graphic organizer approach on students' retention in biology. Specifically, the study investigated the following:

1. Students' retention in biology.
2. Retention of male and female students in biology.
3. Interaction effect of gender and instructional approach on students' retention in biology.

Research Questions

The following research questions guided the study:

1. What is the effect of graphic organizer approach on students' mean retention in biology?
2. What is the effect of graphic organizer on the mean retention of male and female students in biology?
3. What is the interaction effect of gender and instructional approach on students' mean retention in biology?

Hypotheses

The following null hypotheses were tested at an alpha level of 0.05.

HO₁: There is no significant difference in the mean retention scores of students taught biology using graphic organizer approach and those taught biology using conventional

approach.

HO₂: There is no significant difference in the mean retention scores of male and female students taught biology using graphic organizer approach.

HO₃: There is no significant interaction between gender and instructional approach on students' mean retention in biology.

Research Method

The study adopted the quasi experimental design. Specifically, the researchers used a pre-test post-test non-equivalent control group design. The study was carried out in Ebonyi State of Nigeria. A total of one hundred and twenty two (122) senior secondary school students drawn from two intact classes of SSS 1 were involved in the study. Two secondary schools were drawn from the secondary schools in Ebonyi State through a simple random sampling. Since most of the schools in the area are coeducational, the researchers used only coeducational schools. Out of the two secondary schools that were used for the study one was assigned to the treatment group while the other was assigned to the control group through a simple toss of coin. In all, 70 respondents were used for treatment group while 52 respondents were used for control group.

Results

Research Questions

Research Question 1

What is the effect of graphic organizer on students' mean retention in biology?

For this research question both pretest and posttest data obtained with the biology retention test for both the treatment and control groups were used to answer the research question. Mean for pre and post tests were adjusted statistically in the analysis to take care of the initial equivalence of the research subjects. Summary of result is shown in table 1 below:

Table 1: Mean Biology Retention Scores of Students Taught Biology Using Graphic Organizer and Those Taught Biology Using Conventional Method

Teach methods	Groups	N	Mean	SD
Graphic organizer	Experimental group	70	50.61	13./09
Conventional	Control group	52	37.42	10.97

The instrument the researchers used for data collection is the Biology Retention Test (BRT). The instrument is a 30 item multiple choice test developed by the researchers from the content that was covered in the study. The items were drawn using a table of specification. The instrument covered the three main topics in the lesson plan: the living components of the environment, grouping of living things and classification of living things. The instrument was subjected to both face and content validation. The Kuder Richardson coefficient of internal consistency for the instrument is 0.97.

Experimental Procedure

A pretest was administered to both treatment and control groups in the respective schools before the commencement of the experiment in order to control for possible pre-existing differences in the overall ability between the groups. The treatment group was taught biology using graphic organizer approach while the control group was taught biology using conventional approach using the same content for four weeks.

Method of Data Analysis

Research questions were answered using mean and standard deviation while the hypotheses were tested using analysis of Co-variance (ANCOVA).

From table 1, it can be observed that the adjusted mean retention score for the experimental group is 50.61 and the adjusted mean retention score for control group is 37.42. The two mean scores from the table tend to suggest that the students in the experimental group performed better academically than the students in the control group. This further suggested that problem-solving approach has positive effects on the students' academic retention in biology.

Research Question Two

What is the effect of graphic organizer on the mean retention of male and female students in biology?

For this research question both pretest and posttest data obtained with the Biology Retention Test for only the treatment group was used to answer the research question. Summary of result is shown in table 2 below;

Table 2: Mean Biology Retention scores of males and females taught Biology using the graphic organizer Approach.

Gender Category	N	Mean (\bar{X})	SD
Male Students	30	15.13	14.19
female Students	40	50.23	12.37

From table 2, it is observed that the adjusted mean retention score of male students (51.13) is greater than that of the female students (50.23). This shows that graphic organizer had a slight effect on the retention of male and female students in Biology in the favour of male students.

Research Question 3

What is the interaction effect of gender and instructional approach on students mean retention in biology?

The scores of males and females that were subjected to the graphic organizer approach and those subjected to the conventional approach were used to assess the interaction. Summary of result is presented in table 3.

Table 3: Summary of interaction of gender and teaching method on students' mean retention scores in Biology.

Gender	Treatment Group (X)	Conventional Approach (X)
Male	52.25	38.18
Female	51.52	36.17

Table 3 reveals that the mean scores of males and females in the treatment group is higher than those of males and females in the conventional group. This is to say that at all levels of gender; the treatment group is superior to the control group, implying that there is no interaction between method and gender on student retention in biology.

Hypotheses

HO₁: *There is no significant difference in the mean retention scores of students taught Biology with graphic organizer approach and those taught Biology with conventional approach.*

HO₃: *There is no significant interaction between gender and instructional approach on students' mean retention in biology.*

Both hypotheses 1 and 3 were tested using Analysis of Co-Valiance. Summary of the analysis for these two null hypotheses is shown in table 4 below:

Table 4: Analysis of Co-Variance for students overall biology retention scores by teaching methods and by gender with interaction effect.

Sources of variation	Sum of square	Df	Mean square	F	Fcv
Covariates	13983.631	1	13983.631	200.063	
Mean Effects	567.821	1	283.910	4.062	
Teaching Methods	567.626	1	567.626	8.121	3,84
Gender	1.922	1	1.922	.027	
Two-way Interaction	221.696	1	221.696	3.171	3.84
Teaching Methods & Gender Explained	14973.148	4	3743.287	53.555	
Residual	8177.844		117 69.896		
Total	23150.992		121 191.331		

For hypothesis 1, result in table 4 shows that the calculated F-ratio (F-cal) is 8.121 while the critical value (F-critical) at alpha level of 0.05 is 3.84. The decision rule is to reject the null hypothesis if the calculated value is greater than the critical value at a given probability level. The null hypothesis was therefore rejected. The researchers therefore conclude that there is significant difference in the mean retention scores of students' taught biology using graphic organizer approach and those taught with the conventional approach.

For hypothesis 3, the ANCOVA table (4) shows that for the two-way interaction the F-calculation is 3.171 while the critical value is 3.84 at alpha value of 0.05. Based on the decision rule, the researchers upheld the null hypothesis and conclude that there is no significant interaction between gender and method on students' retention biology.

HO₂: *There is no significant difference in the mean retention scores of male and female biology students taught with graphic organizer approach.*

Scores of males and females in the treatment group only were used to test this hypothesis. Summary of result is shown in table 5 below:

Table 5: Analysis of Co-Variance for students overall biology retention scores by teaching method and gender.

Sources of variation	Sum of square	Df	Mean square	F	Fcv
Covariates	6002.421	1	6002.421	71.690	
Mean Effects	206.389	1	206.389	2.465	3.84
Gender	206.389	1	206.389	2.465	3.84
Explained	5208.810	2	3104.405	37.077	
Residual	5609.775	67	83.728		
Total	11818	69	171.284		

For hypothesis 2, table 5 revealed that F-calculated is 2.465 while the critical value is 3.84 at an alpha level of 0.05. Since the calculated value is less than the critical value at a given probability level, the null hypothesis is not rejected (retained). The researchers therefore conclude that there is no significant difference in the mean retention scores of male and female students taught Biology using the graphic organizer approach.

Summary of Results

The results of data analysis reveal that:

- (1) .The graphic organizer approach is superior to the conventional approach in fostering retention in biology.
- (2) .There is no significant difference in the mean retention scores of both male and female students taught biology using graphic organizer approach.
- (3) There is no interaction between method and gender on students' retention in biology.

Discussion of Result

The results of this study revealed that the students taught biology using graphic organizer performed significantly better than the students taught biology using conventional approach. In other words, the difference between the adjusted mean retention of the experimental group was significant in favour of the experimental group. This implies that graphic organizer method has a positive effect on students' retention in biology.

This finding is in line with the works of Abonyi (2002), Onwuodoikit and Akinyemi (2005), Ibieme (2009) and Ukpai, Gabriel, Abonyi and Ugama (2016) which revealed that teaching method helps in imparting knowledge, attitude, abilities and skills

to enhance students' retention. This is also in agreement with the results of Kang (2004) and Alshatti (2011), who individually concluded that the process of graphic organizer makes the task of revision more simple and effective for students and significantly makes learning more meaningful and consequently facilitates students' retention in the subject.

From the results obtained and tested based on research question 2 and hypothesis 2, it is evident that the mean retention of males and females in biology is not significant. This further indicates that graphic organizer produces the same effect on the mean retention of male and female students. This finding is contrary to the work of Olatoye and Afuwape (2004), which revealed that there is gender difference in the achievement and retention of students in science subjects. This study that provides gender disparity is against other studies which showed that graphic organizer is not gender biased. This is because graphic organizer presents concepts/topics bit by bit, from known to unknown and promotes creative thinking in both male and female students. Graphic organizer takes care of individual differences in students and reduces to the barest minimum the bore on the students when taught with conventional method. This finding is in

line with the works of Nsofor (2001) and Yoloye (2004), who observed that both males and females could do well in science if exposed to similar learning conditions.

The result of data analysis also revealed no interaction between method and gender on students' retention in biology. The result is supported by the work of Abonyi (2002), which yielded a similar result. Also, the result is in agreement with the work of Ibieme (2009), who asserted that there was no significant difference when interaction effect of gender and instructional method is explored, showing that the males and females were affected positively by the method. This instructional method (graphic organizer) seemed to have provided an environment free from bored and stress in which male and female students have achieved some level of equilibrium in biology. Graphic organizer

therefore, should be used for teaching both male and female students in biology.

Conclusion

Based on data analysis the major results obtained from this study revealed that graphic organizer instructional approach is more effective than the conventional approach in fostering retention of students in biology. The difference between the mean retention of students in graphic organizer group and conventional group is statistically significant and in favour of the graphic organizer group. Furthermore, the study revealed that graphic organizer has no differential impact on the retention of male and female students in biology. In the same vein also, there is no significant interaction between gender and instructional method on students' retention in biology.

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