EFFECT OF LEARNING MAP INSTRUCTION APPROACH ON STUDENTS' RETENTION IN BIOLOGY

UKPAI PATRICIA OGONNAYA
triciaukpai@gmail.com
(09043513251)
AND
EZE UCHECHUKWU SIMEON
Ezeusa2002@gmail.com
(08039473994)
DEPARTMENT OF BIOLOGY,
SCHOOL OF SCIENCES,
EBONYI STATE COLLEGE OF EDUCATION, IKWO

TETfund SPONSORED

Abstract

This study was designed to investigate the effects of learning instruction approach on students' retention in biology. The study was carried out in two secondary schools in Ezza south L.G.A. of Ebonyi State. One school was assigned to treatment group while the other school was assigned to control group. The treatment group was taught biology using learning map instructional approach while the control group was taught biology using the conventional approach. Two intact classes were used, one in each of the two schools. Pretest and posttest were administered to the two classes before and after the commencement of the experiment respectively. Biology Retention Test (BRT) was the instrument used for data collection and the teaching lasted for four weeks. The findings revealed that the learning map instructional approach is more effective than the conventional approach in fostering students' retention. It was also discovered that with the learning map instructional approach, males showed higher achievement in biology than females. However, the difference in the mean achievement of males and females taught biology using the approach wasn't statistically significant. This means that there was no interaction between gender and instructional approach on students'

retention in biology. The study therefore recommended that teachers should use learning map in teaching both male and female biology students.
Keywords: ***Effects, learning, map, instruction, approach, retention, Biology.***

Introduction

Biological science education is very important in nation building as it helps students to develop problem solving and critical thinking skills. The world is changing rapidly and science is central to the curing of diseases and solving world problems such as global warming, economic meltdown, insecurity, hunger etc. (Morgan 2009, Ukpai 2022). Students need to learn scientific skills to become scientists or to think critically in everyday situation. Biology is one of the core subjects that students learn in schools. From junior secondary school (JSS) level, it is studied under basic science where it is used to lay the foundation for its take off in the Senior Secondary classes. Science, (especially biology) in its general view, is the tool with which man learns about his environment, its resources and problems and how to control and utilize them both

productively and sustainably (Ukpai 2022). Unfortunately, there are overwhelming evidences of poor performance of students in biology/science at all levels of our educational system. At the secondary school level, both WAEC and NECO Chief Examiners' reports have continued to lament over students' poor performance in biology. Annual report of WAEC (2019-2022) revealed the alarming poor status in secondary school student's achievement in biology. This has a direct bearing on the fact that students have poor knowledge of science subjects right from JSS level. It therefore implies that students enter SSS level with poor pre-requisite knowledge and background of science concepts. According to Aminu (2007) this makes it extremely difficult for the students to recover at higher level of education. This contributes to their poor achievement in Senior Secondary Certificate Examination (SSCE).

That is why concerned Nigerians have gone into serious studies to find out the possible causes of these students' poor achievement in science subjects especially biology. Studies show that different factors contributed to students' poor achievement and retention in science. According to findings, Abonyi (2002), Nwagbo (2001), Ibiene (2009), Olatoye and Atuwape (2004) Ukpai, Okafors, Abonyi, Ugama (2016) and Ukpai and Nwotolo (2022), the prominent among the factors is the poor methods of teaching used by majority of the teachers in teaching biology. Efforts are targeted towards classroom teaching methods that guarantee a shift from teacher-centered to learner –centered methods which are activity-based. One of such methods that are capable of improving students' participation in the class to enhance their performance is the learning map approach of teaching.

Learning map approach is a useful tool in leading students towards meaningful learning. It is activity-based as it involves students' active participation in teaching and learning process. Nzewi (2008) and Onwioduokit and Akinyemi(2005) noted that activities make teaching more

real than verbal presentation of facts, principles and concepts of subject matter. Hence, learning map is seen as a useful tool for helping students learn about the structure of knowledge and the process of knowledge production. Meaningful learning is explained in terms of retention. Retention is the term used to denote the demonstration that learning has been maintained over time. It may be displayed through recognition, retrieval or recall of knowledge or information already learnt (Akuma 2015). Manjula (2010) in his study on the effects of learning map on the achievement, concept attainment, retention and the process skills in the selected few units of science for VI of standard students, found out that there is difference within and between the students of different intelligence in their concept attainment ability, there was no difference observed between girls and boys in their achievement, retention, process skills, concept attainment and in their attitude towards learning map. Based on the findings of this study, it is concluded that there is need to include learning map as one of the constructivists' approaches to teach science in schools and provide strategies to help students "learn how to learn".

Although learning map has been recommended for teaching sciences and other disciplines based on tremendous successes recorded in its application in the fields of medicine and engineering, its efficiency on students' retention in biology has not been empirically determined. This study therefore is an attempt to empirically assess the effects of learning map on students' retention in biology.

Statement of the Problem

The concern about students' performance in biology has raised a number of issues which bothered on pedagogy. Although it has been generally accepted that the current approaches for teaching biology/science are weak in facilitating students' achievement and retention. Hence, researchers in biology/science education are yet to arrive at a universally accepted methods for

teaching biology/science. Learning map, an approach that helps to build students' knowledge may boost the achievement and retention of students in biology/science. Although learning map seems to lead students through simple stages of conception and mastery learning, its exact gains in enhancing students' retention are yet to be confirmed empirically. Consequently, there is the likelihood that the method may yield different results for males and females. Biology/science educators are therefore challenged with the responsibility of verifying the efficacy of learning map on students' retention in biology. This study is therefore a response to this challenge and is faced with the problem of ascertaining empirically the effect of learning map on students' retention in biology.

Purpose of the Study

The purpose of the study is to investigate the effect of learning map approach on students' retention in biology. Specifically, the study is designed to achieve the following purposes, to investigate:

- Students' retention in biology.
- Retention of male and female students in biology.
- 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 learning map approach on students mean retention in biology?
2. What is the effect of learning map on the mean retention of male and female students in biology?
3. What is the interaction effect of gender and instructional approach on students' retention in biology?

Hypotheses

The following null hypotheses were tested at 0.05 level of significance.

Ho_1. There is no significant difference in the mean retention scores of students taught biology using learning map approach and those taught biology using conventional approach.

Ho_2 There is no significant difference in the mean retention scores of male and female students taught biology using learning map.

Ho_3. There is no significant interaction between gender and instructional approach on students' mean retention in biology

Research Method

a. **Design:** The study adopted a quasi – experimental design, specifically a pretest post-test non-equivalent control group design. This involved intact classes which allowed the initial equivalence for the subjects in the two groups to be achieved. However, selection of students was not randomized but assignment of groups to treatment and control groups was randomized. The two groups (treatment and control groups) were each given a pretest before treatment and a post-test after treatment.

b. **Population and sample:** The population of the study comprised of all SS1 students in all the secondary schools in Ezza South Local Government Area of Ebonyi State. In all, 70 students were used for treatment group and 50 students were used for control group making a total sample of 120 students drawn from two randomly sampled secondary schools. Because most of the schools in the area are co-educational, the researchers used co-educational schools. One school was assigned to the treatment group while the other school was assigned to control group through a simple toss of coin.

c. **Instrument:** The instrument used for data collection was Biology Retention Test (BRT). The instrument was a 30 multiple choice item test developed by the researchers from the content was covered in the study. The items were drawn using a table of specification. The instrument covered the topics in the lesson note/ plan: organization of life. The instrument was subjected to both face and content validation. The Kuder Richardson coefficient of internal consistency for the instrument was 0.82.

Experimental Procedure

In order to control for possible pre-existing differences in the overall ability between the treatment and control groups, a pretest was given to both groups before the commencement of the experiment in the respective schools. The treatment group was taught using learning map while the control group was taught using conventional approach with the same content outline for four weeks. Post-test was given to both groups at the end of the experiment.

Method of Data Analysis

Research questions were answered using mean and standard deviation while hypotheses were tested at 0.5% confidence level using analysis Co-variance (ANCOVA).

Results

Research questions 1

What is the effect of learning map on students' mean retention in biology?

Both pretest and post-test data obtained with BRT for the treatment and control groups were used to answer the research questions. Mean for pre and post test were adjusted statistically in the analysis to take care of the initial equivalence of the research subject. Summary of results is shown in table 1 below:

Table 1*: Mean Biology Retention scores of students taught Biology using the learning map and those taught using the conventional method:*

Groups	N	Mean	SD.

Treatment group (Taught with learning map)	70	48.00	12.23
Control Group (Taught With conventional method)	50	38.09	10.22

From table 1, it can be observed that the adjusted mean retention score for the experimental group is 48.00 and the adjusted mean retention score for control group is 38.09. 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 suggested further that learning map approach has positive effects on the students' academic retention in biology.

Research Question Two

What is the effect of learning map on the mean retention of male and female students in biology?

For this research question, both pre and post test data obtained with biology 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 scores of male and female students taught biology using learning map approach.*

Gender Categories	N	Mean	SD
Male Students	40	49.00	11.04
Female Students	30	46.02	13.63

From table 2 above, it is seen that the adjusted mean retention score of male students (49.00) is greater than that of female students (46.02). This shows that learning map had a slight effect on the retention of male and female students in biology in favour of the 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 learning map approach and those subjected to the conventional approach were used to assess the interaction. Summary of result is presented in table 3 below.

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

Gender Groups	Treatment Group	Conventional Method
Males	49.00	38.87
Female	46.2	36.70

In table 3 above, it is shown that the adjusted mean scores of males and females in the treatment group are 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. This employs that there is no interaction between gender and method on retention in biology.

Hypotheses

Ho$_{1:}$ *There is no significant difference in the mean retention scores of students taught biology with learning map approach and those taught biology with conventional method*

Ho$_{3:}$ *There is no significant interaction between gender and instructional approach on student' mean retention biology.*

The two hypotheses 1 and 3, were tested using analysis of Co-Variance. Summary of the analysis for the 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.*

Source of variation	Sum of squares	Df	Mean squares	F	Fcv
Covariates	3901.612	1	3901.612	45.165	
Main effects	2754.710	2	1437.871	16.471	
Teaching Methods	2245.122	1	2245.122	26.141	3.84
Gender	246.402	1	246.402	2.893	
2-Way Interaction Teaching Methods & Gender	29.049	1	29.049	.372	3.84
Explained	6616.576	4	1717.234	19.103	
Residual	11045.345	117	86.915		
Total	17664	121	146.668		

For hypothesis 1, result in table 4 shows that the calculated F-ratio (F-cal) is 26.141 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 is therefore rejected. The researchers therefore conclude that there is significant difference in the mean retention scores of students taught biology using learning map approach and those taught using conventional approach.

For hypothesis 3, the ANCOVA table (table 4) reveals that for the two-way interaction, the F-calculated is .372 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 teaching method on students' retention in biology.

Ho$_{2:}$ *There is no significant difference in the mean retention scores of male and female biology students taught using learning map.*

Scores of male and female students in the treatment group only were used to test this hypothesis. Summary of result is shown in table 5.

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

Source of variation	Sum of squares	Df	Mean squares	F	Fcv

Covariates	2388.456	1	2388.456	24.454	
Main effects	89.213	1	89.213	.928	3.89
Gender	89.213	1	89.213	.928	3.89
Explained	2467.134	2	1293.442	13.022	
Residual	6725.418	67	99.718		
Total	9103.611	69	140.574		

For hypothesis 2, table 6 shows that F- calculated is .928 while the critical value is 3.89 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 upheld. The researchers therefore conclude that there is no significant difference in the mean retention scores of male and female students taught biology using the learning map approach.

Summary of Results

The results of data presented in the tables above reveal that:

(1). the learning map 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 learning map approach.

(3). There is no interaction between methods and gender on retention in biology.

Discussion of Results

The results of this study revealed that the students taught biology using learning map performed significantly better than the students taught using conventional method. That is to say that, the difference between the adjusted mean retention of the treatment group was significant in favour of the treatment group. This implies that learning map method has a positive effect on the students' retention in biology. This finding is in line with the works of Abonyi (2002) and Ibiene (2009), which revealed that instructional method helps in imparting skills, knowledge, attitudes and abilities expertly to enhance students' achievement and retention. The results are also in agreement with the work of Ukpai, Okafor,Ugama & Abonyi (2016), who concluded in their work that the process of drawing a concept map by students makes the task of revision more effective and simple and at the same time makes learning more meaningful and consequently enhances students' achievement and 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 male and female students in biology is not significant. This means that the difference between the retention of male and female students in biology is not significant. This also shows that learning map produced the same effect on the mean retention of male and female students. The findings of this study is supported by the findings of Ibiene (2009), Abonyi & Ibe (2014), Ukpai (2022) 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 gender and methods on students' retention in biology. The result is supported by the works of Akuma (2015), Ukpai, Okafor, Ugama and Abonyi (2016), which yielded similar results.

Moreso, the result is in agreement with the work of Ibiene (2009) who asserted that there is no significant difference when interaction effect of gender and teaching method are explored, showing that the males and females were affected positively by the method. This implies that the

teaching method (learning map) seemed to have provided an environment free from stress and bored in which the male and female students have made the same level of achievement in biology. Hence, learning map should therefore be used to teach both male and female students in biology.

Conclusion

The major results obtained from this study based on data analysis revealed that learning map approach of teaching is more effective than the conventional approach in fostering retention of students in biology. The difference between the mean retention of students in learning map group and conventional group is statistically significant and in favour of the learning map group. The study further revealed that learning map has no differential effect on the retention of male and female students in biology. At the time also, there is no significant interaction between gender and instructional method on students' retention in biology.

References

Abonyi S.O. (2002). Effects of Ethno Science Based Instructional Package on students interests in science. *Journal of Science Teachers of Nigeria (JSTAN). 37, (1 and 2) 70-76.*

Achimugu L. (2000), Poor Achievement of Students. *The agonies of Nigerian Teachers: NUT, Friend or foe?* Baron Press Limited Port Harcourt. 62-68.

Akuma P.O. (2015), Effects of Concept Mapping on Students' Achievement and Retention in Basic Science. *Unpublished Students' M.Ed. Theses of Ebonyi State University.*

Bruner, J. (1961). *The Act of Discovery. Harvard Educational Review* 31 (I):21.

Amina D.K. (2007). Solving Quadratic Inequalities Using Number line. *Journal of Issues on Mathematics 10(1), 67-75.*

Chiov C.C. (2008), The Effects of Concept Mapping on Students' Learning Achievements and Interest. Innovations in Education and Teaching International. 45(4),375-387.

Dye G.A, (2000), Graphic Organizer to Rescue, Helping Students Think and Remember Information. *Teaching Exceptional Children* 32(3), 72-76

GoDaddy L.L.S.(1999),*Graphic Organizer: A Review of Scientifically Based Research.* The Institute for the Advancement of Research in Education at AEL.

Ibiene, T.L. (2009). Effects of Game Method of teaching on Students' Achievement in Chemistry. *Journal of Science Teachers Association of Nigeria (JSTAN) Vol. 44* (1 & 2) 45-51.

Morgan Chylinski (2009), Science Education: Effective Methods of Teaching Elementary School Science. *Unpublished masters student's project, State University College at Cortland.*

Igwe I. O. (2003). Strategies for Teaching Science, *Principles of Science and Science Teaching in Nigeria (an Introduction).*Jones Communication publishers Enugu, Nigeria.

Krasnic T, (2011), How to Study with Mind Maps : *The Course Learning Method.* Concise Book Publishing.

Manjula, P.R. (2006). Effects of concept-mapping in science and science Achievement, cognitive skills and attitude of students. *European Journal of cognitive psychology 11 (3), 307 – 328.*

Novak J.D. (1990). *Concept Mapping: A useful tool for science education Novak.* Cambridge University Press.

Nwagbo, C. (2001). The relative efficacy of guided inquiry and expository methods on the achievement in biology of students of different levels of scientific literacy. *Journal of the Science Teachers Association of Nigeria (JSTAN),* 36 (1 & 2), 43 – 51.

Nzewi M.U. (2008), Practical Approach to Effective Teaching of Ecological Concepts for sustainable Development. *STAN Biology Workshop series* – Enugu. 12-17

O'Dannell A.M.(1994), Learning from Knowledge Maps: The effects of Maps Orientation. *Contemporary Education Psychology:* 33-44

Olatoye, R.A. and Atuwape, M.O. (2004). Students Integrated Science Achievement as a predictor of Later Achievement in Biology, Chemistry and Physics. *JSTAN,* 39 (1 & 2) 31-39.

Okebukola P.A.O. (1996), "National Development: the Teachers make the Difference" *A key, note address presented at 1996 world Teachers' Day lagos.* 5th October

Onwioduokit F.A. and Akinyemi O.A. (2005). Effects of Pictoral and written organizers on students' Achievement in SSS Physics. *STAN Journal* 40 (2) 41-47..

Ukpai P.O., Gabriel O., Abonyi O.S. and Ugama O. (2016) Effects of Concept Mapping Instruction Approach on Students Achievement in Basic Science. *Journal of Education and Practice* 7,(8), 79.

Ukpai P.O. and Nwotolo L.P. (2022). Effect of Graphic Organizer on Students' Retention in Biology.

West African Examination Council (WAEC) (2019-2022) Chief Examiners Report, Yaba Lagos