International Journal of Research and Review
www.ijrrjournal.com E-ISSN: 2349-9788; P-ISSN: 2454-2237

Original Research Article

Effect of Concept Mapping Strategy on Students' Retention in Basic Science in Benue State, Nigeria

Dr. S. A. Adeniran, Dr (Mrs) A.N.O. Ochu, S. F. Atoo

Department of Science Education, Federal University of Agriculture, Makurdi, Benue State, Nigeria

Corresponding Author: Dr. S. A. Adeniran

ABSTRACT

The study examined the effect of concept mapping strategy on students' retention in Basic science. Two research questions and two hypotheses guided the study. The study was a quasi-experimental of non-equivalent, pretest, post-test control group design. The population of the study comprised 1,384 while the sample size was 310 junior secondary two students from four government secondary schools in Benue State, Nigeria. Intact classes of students were randomly selected and assigned to experimental and control groups. Basic Science Retention Test (BSRT) developed by the researcher was used for data collection. The items of this instrument were subjected to face and content validations. The reliability of the instrument was established using Kudar-Richars on formula 20. The reliability coefficient obtained was 0.87. The research questions were answered using mean and standard deviation, while the hypotheses were tested at 0.05 alpha level of significance using Analysis of Covariance (ANCOVA). The results from the study showed that students taught Basic Science using concept mapping strategy improved significantly with a mean retention score of 52.72 against 33.21 for those taught using conventional method. The mean difference between the retention gain scores of males and females was -1.58. This implies that the females gained slightly higher in retention scores compared to the males. Based on the finding from the results, it is recommended that concept mapping strategy should be adopted for teaching science and Basic Science in particular in secondary schools as it involves the students actively, which enhance students' retention.

Key Words: Concept mapping, Students' retention, Basic Science, Conventional method

INTRODUCTION

Science education is essential for any nation that wants to maintain its independence, authority, self-reliance, growth and be recognized among civilized nations. This is because science education plays a significant role in the lives of individuals and the development of a country scientifically and technologically (Alebiosu & Michael, 2008). It is largely acknowledged that, the survival of a nation's scientifically and technologically is scientific literacy, which can only be achieve through science education.

In order to promote citizen's interest in science education, a policy was set up by the Nigerian government that 40 percent of the students should be considered for arts and social science courses, while 60 percent of the students seeking admission into the nation's Universities, Polytechnics and Colleges of education should be admitted for science-oriented courses (Ajibola, 2008). This yielded no satisfactory result given the dwindling nature of students seeking admission into science-oriented courses in the Nigerian tertiary institutions; more students are seeking admission into art and social science courses on yearly basis.

Oludipe (2011) observes that the declining enrollment of students into science-oriented courses in the nation's tertiary institutions could be from the first form of sciences the students come across at the Upper Basic Education level, this is Basic Science.

Basic Science is the first form of science a student comes across at the secondary school level in Nigeria and it prepares students at this Upper Basic Education level for the study of core science subjects at the senior secondary school level (Oludipe, 2014). The implication is that, students had to be well grounded in Basic Science at the Upper Basic level of Education for them to be able to study single science subject at the senior secondary school level successfully. In view of this Adejoh and Idachaba (2010) reveals that Basic Science forms the basis on which further scientific and technological studies rest.

Inspite of the relevance of Basic Science as the basis on which scientific and technological studies rest, the achievement of students in the subject has been reported to be poor (Ochu & Haruna, 2015).The researchers further states that the mayhem in the subject denies many students opportunity from gaining admission into the institutions of higher learning to study prestigious science-based courses. According to Eriba in Ochu and Haruna, (2014), insufficient pre-requisite in science subjects causes students to switch to arts and social sciences, leading to low enrolment and turnover in science, and creating a gap in national development.

In an attempt to improve retention in Basic Science, many research studies have been carried out. Documented research works found out among others, that lack of qualified basic science teachers (Agbidye, 2015), lack of teachers' motivation (Danmole, 2011), lack of classroom, laboratories and other modern structure (Wushishi & Kubo, 2011), and teaching strategies employed by teachers (Duru, 2007) are the logic behind students woeful retention in the subject.

Research report also reveals that students' low retention in Basic Science is a function of several factors among which instructional strategy employed by the teachers is paramount. Eze and Bot (2014) observes that learning outcome is influenced by the instructional strategy employed by teacher; it is the only factor that can easily be maneuver by teacher to achieve learning objectives. Etukudo (2005) in his study states that instructional strategies adopted by teachers evoke students' retention in Mathematics and Sciences in general.

The Basic Science curriculum emphasizes the switch of teaching and learning paradigm from the behaviourism to constructivism to enhance conceptual learning in science and to promote attitude of students towards learning of science (Govt. of Pakistan, 2006). The curriculum demands teaching-learning strategies that place teacher as a facilitator and sees students as centre of learning activity, which involves students in the construction of their own knowledge. Concept mapping is one of the constructivist teaching-learning strategies having its origin in David Ausubel's (1968) assimilation theory of cognitive learning. It aims at promoting meaningful learning in students. Concept mapping as a strategy provides a suitable environment, where students learn individually and in groups to collaborate and support each other (Oakley, 2004). Concept mapping is a technique of visually organization of structure of information, concepts, and their relationship. Previous studies reveal that concept maps are used as a tool for meaningful learning (Nesbit and Adesope, 2006), to document conceptual change (Hay, 2007), develop critical thinking skills (Able and Freeze, 2006), emphasize hierarchical relationships (Laight, 2004), move away from rote memorization (Kinchin, 2001), as a compensation for different learning styles (Brinkerhoff and Booth, 2013) and improve students achievement (Hay, 2007).

Arokoyu and Obunwo (2014) investigated the effect of concept mapping

strategy for retention of Organic Chemistry concepts. They found out that students exposed to concept mapping retained Organic Chemistry concepts more than those taught using conventional method. Their results show a mean score of 60.67 for the experimental group and a mean score of 54.00 for the control group. In a related study, Fatokun and Eniayeju (2014) examined the effects of concept mapping-guided discovery integrated teaching approach on the achievement and retention of chemistry students. The sample comprised 162 Senior Secondary two (SS2) students drawn from two science schools in Nasarawa State, Nigeria with equivalent mean scores of 9.68 and 9.49 in their pre-test. Results of the Scheffe's test for multiple comparison revealed that male in the experimental group performed better than female in the experimental group. The results of the t-test analysis of the retention test showed that the mean scores of the experimental group was significantly better than that of the control group ($P<0.05$).

Learning through concept mapping improves students' meta-knowledge and meta-learning. In other words, concept mapping is known to augment assimilation, retention and retrieval of learned knowledge as the learning situation demands. This is because knowledge acquired through meaningful learning is integrated into the existing cognitive structure and is retained longer (Novak, 2010). It is against this background that this study is carried out to ascertain if concept mapping still enhance assimilation, retention and retrieval of knowledge. Will the situation be same with samples in this study?

Statement of the Problem

Basic science is the first form of science a child comes across at the secondary school; hence Basic Science concepts prepare students at the Junior Secondary School level for the study of core science subjects at the Senior Secondary School level. This implies that for a student to be able to study single science subject at the senior secondary school level successfully, such students had to be well grounded in Basic Science at the Junior Secondary level.

Unfortunately, there is poor retention leading to low achievement in Basic Science in Basic Education Certificate Examination (BECE). Many research studies have been carried out on retention of students in Basic Science. Many of those studies found, that lack of qualified basic science teachers, teaching strategy, lack of instructional materials, and lack of practical works are logic behind students' mayhem in the subject. Despite the number of factors outlined as being responsible for the poor retention in Basic Science, accusing fingers have been pointing at teacher's inappropriate teaching strategy as the major problem.

However, basic science teachers have applied various strategies like jigsaw, inquiry teaching strategy, collaborative learning strategy, cooperative learning strategy, problem-solving strategy among others for teaching Basic Science, yet there has been poor retention, leading to poor achievement in the subject in BECE. This has deprived many Nigerian students' the chances of being admitted in the admired science based courses into the institution of higher learning. There is therefore an out-cry from parents, teachers, curriculum planner and other stakeholders in the educational industry about the poor retention, which leads to decline in achievement in both internal and external examination in the subject. It is on this background that the researcher seeks to determine the effect of concept mapping on students' retention in Basic Science.

Purpose of the Study

The purpose of this study is to determine the effect of Concept mapping strategy on Junior Secondary School student retention in Basic Science. Specifically, the study finds;

1. the mean retention scores of Basic Science students taught using Concept

mapping strategy and those taught using conventional method.
2. the effect of concept mapping strategy on male and female students' retention in Basic Science

Research Questions

The following research questions were raised to guide the study

1. What is the difference in the mean retention scores of students taught Basic Science using concept mapping strategy and those taught using conventional method?
2. What is the effect of concept mapping strategy on male and female students' retention in Basic Science?

Hypotheses

The following research hypotheses were formulated to guide the study.

$H0_1$: There is no significant difference in the mean retention scores of students taught Basic Science using concept mapping strategy and those taught using conventional method.

$H0_2$: There is no significant difference in the mean retention scores of male and female students taught Basic Science using concept mapping strategy.

METHODOLOGY

The study adopted a quasi-experimental design of non-randomized, pre-test, post-test control group design. The population for the study was 1,384 consisting of 665 males and 719 females Upper Basic two students offering Basic Science in public schools in education Zone B of Benue State (Benue Teaching Service Board, 2016). The sample for the study consists of 310 Upper Basic two students randomly selected and assigned to control and experimental groups. The instrument for data collection was Basic Science Retention Test (BSRT). The researchers developed the BSRT which consist of 30-items with four options drawn from living things (Habitat) and chemicals. The instrument was validated by three experts, one from Test, Measurement and Evaluation and two from Science Education.

The reliability coefficient of the instrument was found to be 0.86, using Kuder-Richardson formula 20. Research assistants were employed in order to eliminate bias. A pre-test was administered to both groups to establish equivalence in terms of academic ability.

The experimental group was taught using concept mapping while the control group was taught using the conventional method. A post-test is an equivalent form of the pre-test was administered. Mean and standard deviations were computed for each of the groups in order to answer the research questions. The null hypotheses were tested at 0.05 level of significance using ANCOVA of the Statistical Package for Social Sciences, (SPSS).

PRESENTATION OF RESULTS

The results were analyzed and presented in tables.

Research Question 1

What is the difference in mean retention scores of students taught Basic Science using concept mapping strategy and those taught using conventional method?

Table 1: Mean Retention Scores and Standard Deviation of Students in Experimental and Control Groups

Groups	N	Posttest		Retention Test		Mean Gain
		Mean	SD	Mean	SD	
Experimental	147	52.72	7.45	56.36	5.73	3.64
Control	163	33.21	9.28	35.23	8.24	2.02
Mean Difference		19.51		21.13		1.62
Total	**310**					

Table 1 shows that in posttest, the experimental group had a mean achievement score of 52.72 with a standard deviation of 7.45, while in posttest the

control group had a mean achievement score of 33.21 with a Standard deviation of 9.28. Table 1 also shows that in the retention test, experimental group had a mean retention score of 56.36 with a standard deviation of 5.73, while the control group had a mean retention score of 35.23 with a standard deviation of 8.24. From the posttest and retention scores, the mean gain for the experimental group was found to be 3.64while the mean gain for the control group was 2.02. The mean difference between the retention gain scores of the experimental and control group was 1.62. This shows that the experimental group gained more in retention than their counterpart in the control group.

Research Question 2

What is the effect of concept mapping strategy on male and female students' retention in Basic Science?

Table 2: Mean Retention Scores and Standard Deviation of Male and Female Students in Experimental Groups

Gender	N	Posttest		Retention test		Mean Gain
		Mean	SD	Mean	SD	
Male	82	51.89	9.16	54.83	7.28	2.94
Female	65	53.77	4.30	58.29	1.10	4.52
Mean Difference		-1.88		-3.46		-1.58
Total	**147**					

Table 2 shows that in posttest, the males had a mean achievement score of 51.89 with a standard deviation of 9.16, while the females had a mean achievement score of 53.77 with a standard deviation of 4.30.Table 2 also shows that in the retention test, the males had a mean retention score of 54.83 with a standard deviation of 7.28 while the females had a mean retention score of 58.29 with a standard deviation of 1.10. From the posttest and retention scores, the mean gain for the males was found to be 2.94 while the mean gain for the female students was 4.52. The mean difference between the retention gain scores of males and females students was -1.58. This shows that the females gained slightly higher in retention scores compared to the males.

Hypothesis 1

There is no significant difference in mean retention scores of students taught Basic Science using concept mapping and those taught using conventional method.

Table 3: Summary of Analysis of Covariance (ANCOVA) of Experimental and Control Groups' Retention Scores in Basic Science

Source of Variance	Sum of Squares	Df	Mean Square	F	Sig
Corrected Model	34555.088[a]	2	17277.544	337.090	.000
Intercept	95767.692	1	95767.692	1868.456	.000
Posttest	53.747	1	53.747	1.049	.307
Group	34521.662	1	34521.662	673.528	.000
Error	15735.286	307	51.255		
Total	685080.000	310			
Corrected Total	**50290.374**	**309**			

Table 3 shows the ANCOVA analysis of the data collected from the retention scores of students taught Basic Science using concept mapping strategy and those taught using conventional method. From the analysis, $F(1, 307) = 673.528$, $p < 0.05$ therefore, the null hypothesis of no significant difference in mean retention scores of students taught Basic Science using concept mapping strategy and those taught using conventional method was not accepted. This implies that there is statistically significant difference in retention mean scores in favour of students taught Basic Science using concept mapping strategy. This further indicates that there was higher improvement in the retention mean scores of students in the experimental group than those in the control group.

Hypothesis 2

There is no significant difference in mean retention scores of male and female students taught Basic Science using concept-mapping strategy.

Table 4: Summary of Analysis of Covariance (ANCOVA) of the Retention Scores of Male and Female Students in Experimental Group in Basic Science

Source of Variance	Sum of Squares	Df	Mean Square	F	Sig
Corrected Model	120.844[a]	2	60.422	2.644	.074
Intercept	56961.351	1	56961.351	2493.008	.000
Pretest	101.758	1	101.758	4.454	.037
Gender	31.318	1	31.318	1.371	.244
Error	3290.176	144	22.848		
Total	449407.000	147			
Corrected Total	**3411.020**	**146**			

Table 4 shows the ANCOVA analysis of the data collected from the retention scores of male and female students taught Basic Science using concept mapping strategy. From the analysis, F(1, 144) = 1.371, p >0.05 therefore, the null hypothesis of no significant difference in mean retention scores of male and female students taught Basic Science using concept-mapping strategy was not rejected. This means that there is no statistically significant difference in mean retention scores of male and female students taught Basic Science using concept-mapping strategy. This implies that male and female students had almost equal improvement in their retention scores when taught Basic Science using concept-mapping strategy

DISCUSSION OF RESULTS

The findings of the study revealed that the use of concept mapping strategy improves students' retention in Basic Science. This can be seen from the data analysis in Table 1 which showed that students in the experimental group had mean retention score of 56.36 with a corresponding standard deviation of 5.73 whereas the control group had a mean retention score of 35.23 with corresponding standard deviations of 8.24. The difference in mean scores of the experimental and control groups in the posttest and retention test were 19.51 and 21.13 respectively, while the students in the experimental group gained 3.64, the students in the control group had a mean gain of 2.02. This therefore indicates that students in the experimental group improved more in their retention when compared to their counterparts in the control group.

Furthermore, confirmatory test analysis in Table 3 indicates that the retention of students in the experimental group was significant with F(1, 307) = 673.528, p <0.05 hence the null hypothesis, which stated that there is no significant difference in the mean retention scores of students taught Basic Science using concept mapping strategy and those taught using conventional method was not accepted. This implies that the students taught basic science using concept mapping strategy outweigh their counterpart in their retention who were taught using conventional method.

The result of this study is in line with that of Fatokun and Eniayeju (2014) who in their study found out that students taught with concept mapping strategy retained better than those using conventional method. This is because through concept mapping strategy, concepts and their relationship are organize in a hierarchical manner from more inclusive to more specific and less inclusive concepts. Hence, concepts mapping help students integrate new concept with the previous learning leading to a better retention and should be adopted for teaching science.

The result in Table 2 showed that the mean retention scores of male and female students were 54.83 and 58.29 respectively with corresponding standard deviations of 7.28 and 1.10. The difference in mean scores of the male and female students in

the posttest and retention test are -1.88 and -3.46 respectively while the mean gains of both genders are 2.94 for males and 4.52 for females indicating that the retention scores of male and female students differed only slightly after being taught Basic Science using concept mapping strategy. This was further examined by the test of analysis in Table 4, which shows a probability value of 0.244, which is greater than the set probability value of 0.05. The null hypothesis of no significant difference in the mean retention scores of male and female students taught Basic Science using concept mapping strategy was not rejected. This confirmed that the difference in the mean retention scores of male and female students taught Basic Science using concept mapping strategy was not statistically significant.

The result presented here is in agreement with Orora, Wachanga and Keraro (2007) who found that the retention capacity of male students improved after being taught using concept mapping as compared to the retention capacity of females. According to the researchers, this was because males tend to remember drawings better than the females and concept maps had to do with drawing maps to connect concepts. However, Ukpai, Okafor, Abonyi and Ugama (2016) found no significant difference in the retention capacities of male and female students after being taught using concept mapping instructional strategy in sciences.

Recommendations

Based on the finding of the study, the following recommendations were made.

1. As the use of concept mapping strategy has been found effective in promoting achievement and retention in Basic science and since the strategy is not commonly used in teaching, it should be included in Basic science curriculum to popularize its use among the teachers and hence bring about effective learning of Basic science in our secondary schools.
2. Seminars, workshops and conferences should be organized by government and relevant professional bodies likeScience Teachers Association of Nigeria (STAN) to educate and sensitize the teachers on the use of the concept mapping for teaching Basic science.
3. Government agencies and professional associations whose responsibility it is to design and revise the curriculum for secondary schools should incorporate and emphasize the use of concept mapping strategy in the teaching of Basic science
4. Government agencies and professional bodies such as NERDC and STAN should sponsor further researches on the efficacy of the concept mapping strategy in promoting performance in basic science
5. Government, through the State and Federal ministries of education should encourage the Basic Science textbook writers to write and publish textbooks based on concept mapping strategy.

REFERENCES

- Able, W. M., & Freeze, M. (2006). Evaluation of concept mapping in an associate degree nursing program. *Journal of nursing education, 45*(9), 356-364
- Agbidye, A. (2015). Challenges and prospects in the teaching of Basic Science at the Upper Basic Level in Nigeria. *Journal of qualitative education,11*(1), 331-479.
- Ajibola, M. A. (2008). Innovations and curriculum development for basic education in Nigeria: policy priorities and challenges of practices and implementation. *Research journal of international Studies, 8*(2), 51-58.
- Alebiosu, K. & Michael, E. (2011). Concept Mapping Teaching Strategy and Secondary Students Attitude to Physics in Ibadan, *Nigeria Journal of the African Education Research. 2*(1) 55-62.
- Arokoyu, A. A., &Obunwo, J. (2014). Concept-mapping: An instructional strategy for retention of organic Chemistry concepts. *International journal of scientific research and innovative technology, 1*(3), 50-57.
- Ausubel, D. P. (1968). *Educational psychology. A cognitive view.* New York: Holt Rinehart and Winston.
- Brinkerhoff, J. L., & Booth, G. M. (2013). The effect of concept mapping on students' achievement in an introductory non-major Biology class. *European journal of science and technology,2*(8), 43-72

- Danmole, B. T. (2011). Emerging issues on the Universal Basic education curriculum in Nigeria. Implication for the science and technology. *Medwell journals, 8*(1), 62-68.
- Duru, V. N. (2007). Enhancing integrate science teaching through the use of concept mapping. *Alvana journal of science,3*(1), 65-75.
- Etukudo, U. E. (2002). The effect of computer-assisted instruction on gender and performance of junior secondary school students in Mathematics. *Abucus Journal of Mathematics Association of Nigeria,27*(1), 1-8.
- Eze, J. E., & Bot, T. D. (2014). Effect of concept mapping on secondary school students' achievement in Mathematics in Bichi Education Zone , Kano State. *African Journal of Arts, Science and Educational Issues.2*(2), 45-56
- Fatokun, K. V. F., &Eniayeju, P. A. (2014). The effect of concept mapping-guided discovery integrated teaching approach on Chemistry students' achievement and retention. *Academic journal. 9(22)*, 1218-1223.
- Govt. of Pakistan. (2006). *National curriculum for General Science, grade IV-VIII*. Islamabad; Ministry of Education.
- Hay, D. B. (2007). *Using concept maps to measure deep, surface and non-learning outcome.* Studies in higher education, *32*(1), 39-57.
- Kinchin, I. M. (2001). If concept mapping is so helpful to learning Biology, why aren't we all doing it? *International journal of science education, 23*(12), 1257-1269.
- Laight, D. W. (2004). Attitudes of concept maps as a teaching/learning activity in understanding health professional education: Influence or preferred learning style. *Medical teacher*, *26*(3), 229-233.
- Nesbit, J. C. & Adesope, O. O. (2006). Learning with concept and knowledge maps: A metaanalysis. *Review of Educational Research, 76(3),* 413-448.
- Oakley, L. (2004). *Cognitive Development.* London: Routledge, East Sussex.
- Ochu, A. N. O., & Haruna, P. F. (2015). Challenges and prospects of creativity in a Basic Science classroom: The perception of the Basic Science teachers. *British journal of education, society and behavioural science, 5*(2), 237-243.
- Oludipe, D. I. (2014). Gender and science anxiety as predictors of Basic Science. *Scholars Journal of Arts, Humanities and social Science, 2*(2A), 197-203.
- Oludipe, D. T. (2011). Developing Nigerian Integrated Science Curriculum. *Journal of Science and Environmental Management, 2*(8), 134-145.
- Orora, W., Wachanga, S. W. & Keraro, F.N. (2007). Effects of cooperative concept mapping teaching approach on secondary school students' achievement in Biology in Gucha District, Kenya. *Zimbabwe Journal of Education Research,3*, 1-18.
- Ukpai, P. O., Okafor, G., Abonyi, O., & Ugama, J. O. (2016). Effects of concept mapping Instruction approach on students' achievement in Basic Science. *Journal of Education and Practice, 7*(8), 79-84
- Wushishi, D. I., & Kubo, B. G. (2011). Science. Technology, Engineering and Mathematics Education: Nigeria in the emerging world order and militating issues for development. In O. S. Abonyi (Ed.), *STAN 52nd Annual Conference 23-29.*

How to cite this article: Adeniran SA, Ochu ANO, Atoo SF. Effect of concept mapping strategy on students' retention in basic science in Benue state, Nigeria. International Journal of Research and Review. 2018; 5(5):193-200.

******