Effect of Concept Mapping on Academic Achievement of Upper Basic Students in Basic Science in Uyo Local Government Area, Akwa Ibom State

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ABSTRACT

This study investigated the effect of concept mapping teaching strategy on academic achievement of upper basic students in basic science. It also examined the interaction effect of the teaching strategy and gender. Two research questions and two hypotheses guided the study. The population of the study was 202 JS3 students of basic science in all the 15 coeducational secondary schools in Uyo Local Government Area in Uyo Local Education Committee (LEC) Akwa Ibom State, while the sample size was a total of ninety (90) students which is the number of students in two contact JS3 classes in two of the fifteen coeducational secondary schools. The two intact classes were used separately as the experimental and control groups. The study used a quasi-experimental design of pretest-posttest non-equivalent control group. Basic Science Achievement Test (BSAT) on the concept of atomic structure which is a 20 item multiple choice questions adopted from Junior WASSCE past questions papers was used for data collection. The instrument was trial tested and the reliability coefficient was determined to be 0 b.74using Pearson Product Moment Correlation. The research questions were answered using mean scores, while the hypotheses were tested at .05 level of significance using Analysis of Covariance (ANCOVA). The result of the study show that the students taught using concept mapping strategy performed better than those taught using the conventional teaching method. The study also recorded higher achievement score for the male students taught using concept mapping strategy compared to the female counterparts. It was recommended among other things that the curriculum planners should incorporate concept mapping in the curriculum of pre-service teachers. Again, adequate training for basic science teachers on the use of concept mapping teaching strategy could be organized at the government levels and science teachers' association of Nigeria national workshops and conferences.

KEYWORDS: Concept, mapping, students, achievement, basic science

Introduction

Science education involves experimentation and activity based. Literature shows the important role of experimentation in increasing student's active and vital participation in the learning process as well helping students to acquire different skills and form positive attitudes towards science learning (ICSU, 2011). Effective teaching is so crucial to learning that the product of teaching such as knowledge, altitudes and skills acquisition are much dependents on the teacher's effective teaching. Teaching is said to be effective when the approach used brings about a desirable change in the life and behavior of the learners. If learning strategies and student's achievements have to improve, then, the students have to be introduced to more effective, efficient, and appropriate teaching approaches. The effectiveness of a teacher and students learning can be enhanced through the use of appropriate teaching strategies in the

classroom. Effectiveness in the teaching of basic science will bring about the desired change in the behavior and academic achievement among students of basic science.

In other to meet the transformation challenges of the 21st century, there is need to improve the scientific knowledge of students, especially in basic science. This is because the subject is core and basic, laying the foundation for the takeoff of the sciences in the senior secondary school levels such as biology, chemistry and physics (NPE, 2013). This could be done through effective teaching of scientific concepts to students using appropriate instructional strategy. One of which is the use of concept mapping strategy which provides a strategy for finding the nature of things (Nakhled, 2012). This is in line with the schools science curriculum which emphasizes the presentation of basic science to students in a way that they could conduct their inquiry into the nature of things.

In Nigeria at present, most behavioural practices are in vogue in schools where students are passive instead of been active, and the classroom environment is mostly teacher dominated (Igbal, 2011). The national curriculum 2006 emphasizes paradigm shift from behaviourism to constructivism so as to enhance conceptual learning in science and development of positive attitudes towards learning of science. This curriculum demands such teaching learning strategy that may involve students in their own knowledge construction, placing them as centre of learning activity while the teacher act as a facilitator.

Concept mapping is one of the teaching/learning strategies under constructivism having its orientation in Ausubel assimilation theory (2011) of cognitive learning, aimed at fostering meaningful learning by students. Concept mapping as a learning strategy, uses rich social environment where learners work both individually and in groups, to scaffold and mediate learning of each other (Novak and Canas 2017; Ausubel (2011). Concept mapping is a teaching technique of visually representing the structure of information, concept, and their relationships (Nesbit and Adesope, 2016; Novak and Canas, 2017). According to Juall and Moyet (2015), concept mapping is an educational teaching technique that uses diagrams to demonstrate the relation of one concept or situation by linking the central concept better. So concept maps are presented as pyramids seen from above and they are arranged hierarchically with the super-ordinate concept at the top of the map, and subordinate ones at the bottom which are less inclusive than higher ones. Novak and Canas (2017) viewed concept maps as graphical tools for organizing and representing knowledge. Construction of good concepts maps by the students depends largely on effective planning and sequential teaching by the teacher (Ikeobi, 2010). Novak (2014) opined that the process of concept mapping can reduce the need for rote memory, and make learning more meaningful. Johnson and Otis (2016) suggested that concept mapping should be treated as a very personal and special tool for learning because of its effect and great importance in the teaching/learning processes. Some of its numerous advantages in the study of basic science are listed below:

1. It can be used as an advanced organizer to improve learners' achievement in basic science
2. It aids the development of deep meaningful teaching moving towards critical thinking; rather than surface approaches.
3. It provides teachers with a meaningful and practical structural approach.
4. It allows students organize their thought and visualize the relationship between the key concept in a sematic way,

5. It also allows students to reflect on their own understanding and take ownership of their learning (Ikeobi, 2010)

Gender is another factor perceived to have contributed to poor academic achievement in basic science which this study investigated. Gender difference in performance in science has been a long debated issue. Various studies have found male students performing on average better than their female counterparts. Few researchers have focused gender differences in the use of concept mapping so as to examine the possible differential effect of this strategy on the academic achievement of male and female students.

Academic achievement, according to Igbal (2011) is the totality of what an individual (student) is able to learn on particular subject contents over a specified period of time. Gyuse (2010) defined academic achievement as the overall information and skills acquired by student through experience or education. When the students become active in the teaching/learning process, greater academic achievement is bound to take place. This advocate why researchers are calling for a paradigm shift from behaviourist, learning approaches such as the conventional teaching method which encourages rote learning to a constructivist approach such as concept mapping, which is learner-centered methods that can enhance students' achievement. This necessitated the present study which investigated the effect of concept mapping on students' achievement in junior secondary school basic science.

Purpose of the Study

The general purpose of this study was to investigate the effect of concept mapping on students' achievement in junior secondary school basic science. To achieve this purpose, the following specific objectives were posed.

1. To determine the mean achievement scores of students taught atomic structure using concept mapping and those taught using conventional teaching method

2. To determine the mean achievement score of male and female students taught the concept of atomic structure using concept mapping strategy

Research Questions

The following research questions guided the study

1. What are the mean achievement scores of basic science students taught the concept of atomic structure using concept mapping strategy and their counterparts taught using conventional teaching method?

2. What are the mean achievement score of male and female students taught the concept of atomic structure using concept mapping strategy?

Research Hypotheses

The following hypotheses guided the study

1. There is no significant difference in the mean achievement scores of basic science students taught the concept of atomic structure using concept mapping strategy and their counterparts taught using conventional teaching method.

2. There is no significant difference in the mean achievement score of male and female students taught the concept of atomic structure using concept mapping strategy.

Methods

This study adopted quasi-experimental design of pretest-posttest non-equivalence groups. These two groups are the experimental group and the control group. This design was chosen because it is the most suitable design for the study. The study was carried out in Uyo Local Education Committee (LEC) of Akwa Ibom State, Nigeria. The population was a total of 202 JS3 students offering Basic Science. The sample size for this study was a total of 90 Basic Science students. This sample is the total number of all the JS3 basic science students in two of the fifteen coeducational government secondary schools in Uyo Local Government Area. The instrument for data collection was a 20-item multiple choice Basic Science Achievement Test (BSAT). The instrument was trial tested and the reliability coefficient was determined to be 0.74 using Pearson product moment correlation.

Simple random sampling technique was used to sample Uyo LEC from the 8 Local Government Areas in Uyo senatorial district. Simple balloting was also used to sample 2 schools from the 15 coeducational secondary schools in Uyo Local Government Area. The Basic Science Achievement Test was administered on the students as pretest and posttest. The researcher with the aid of the basic science teacher in each of the two sampled secondary schools who acted as research assistant were involved in the administration of the research instrument and collection of data. The research questions were answered using mean, while the hypotheses were tested at .05 level of significance using Analysis of Covariance (ANCOVA). Testing the hypotheses at .05 level of significance implies that at $p < .05$, the result is significant, while at $p > .05$, the result is not significant.

Results

Research Question 1

What are the mean achievement scores of basic science students taught the concept of atomic structure using concept mapping strategy and their counterparts taught using conventional teaching method?

Table 1: mean achievement score of basic science students taught the concept of atomic structure for the experimental and control groups

Group	N	Pretest mean	Posttest mean	Mean Gain
Experimental	45	23.78	71.11	47.33
Control	45	23.53	51.00	27.47

Note: N is the number of students

From table 1 above, the mean achievement scores of the students for the experimental and control groups when taught the concept of atomic structure are 71.11 and 51.00 respectively. The mean gain in achievement of the experiment group was 47.33 while that of the control group was 27.47.

Research Question 2

What are the mean achievement score of male and female students taught the concept of atomic structure using concept mapping strategy?

Table 2: mean achievement score of male and female basic science students taught the concept of atomic structure for the experimental group only

Gender	N	Pretest mean	Posttest mean	Mean Gain
Male	25	25.10	78.40	53.30
Female	20	24.59	62.00	37.41

Note: N is the number of students

From table 2 above, the mean achievement scores of male and female students for the experimental group when taught the concept of atomic structure are 78.40 and 62.00 respectively. The mean gain in achievement of the male was 53.30 while that of female was 37.41.

Hypothesis 1

There is no significant difference in the mean achievement scores of basic science students taught the concept of atomic structure using concept mapping strategy and their counterparts taught using conventional teaching method.

Table 3: Analysis of covariance on the mean achievement scores of students in experimental and control groups

Source	Type III sum of squares	df	Mean square	F	Sig.	Partial Eta squared
Correlated Model	34384.020	4	8596.005	305.626	.000	.935
Intercept	2836.092	1	2836.092	100.836	.000	.543
Pretest	22194.465	1	22194.465	789.111	.000	.903
Groups	5126.797	1	5126.797	182.280	.000	.682
Error	2390.702	85	28.126			
Total	372275.000	90				
Corrected Total	**36774.722**	**89**				

$P < .05$

Data presented in table 3 showed a significant difference in the mean achievement scores of experimental group exposed to concept mapping and control group exposed to conventional teaching method. F-value for teaching methods (groups) is 82.280 with a P-value of .000 which is within the significance level of .05. The null hypothesis was rejected and the alternative hypothesis of significant difference in the mean achievement scores of experimental and control groups was upheld.

Hypothesis 2

There is no significant difference in the mean achievement score of male and female students taught the concept of atomic structure using concept mapping strategy.

Table 4: Analysis of covariance on the mean achievement scores of male and female students exposed to concept mapping strategy

Source	Type III sum of squares	df	Mean square	F	Sig.	Partial Eta squared
Correlated Model	39936.652	4	9984.165	214.050	.000	.910
Intercept	1832.852	1	1832.852	39.395	.000	.316
Pretest	2032.141	1	2032.141	43.567	.000	.339
Gender	2553.506	1	2553.506	54.745	.000	.392
Error	3964.737	45	46.644			
Total	281575.000	45				
Corrected Total	**143901.389**	**44**				

P < .05

Data presented in table 4 revealed a significant difference in the, mean achievement scores of male and female students exposed to concept mapping strategy. This is shown by gender F-value (54.745) and P-value of .000 which is within the significance level of .05. The null hypothesis was rejected while the alternative hypothesis of significant difference in the mean achievement scores of male and female students exposed to concept mapping was upheld.

Discussion of the Findings

The result in table 1 and 3 showed that the students in the experimental group exposed to concept mapping achieved significantly higher than their counterparts in the control group exposed to the conventional teaching method. The higher mean achievement score of the students exposed to concept mapping suggests that the strategy enhances meaningful learning and reduces rote learning by establishing a link among the major concepts in the topic taught. This finding gives credence to Otor (2013), Quararch (2010) and Chema and Mirza (2013) who found that students taught some concepts in Basic Science, chemistry and physics respectively using concept mapping achieved higher than their counterparts who were taught using the conventional teaching methods.

Results on table 2 and 4 revealed a significant difference in the mean achievement scores of male and female students exposed to concept mapping strategy and this difference was in favour of the males. The significant difference in favour of male students suggests that concept mapping should be better used in single-sex schools and not in coeducational schools. This findings conflict with the report of Otor (2013) who found a significant difference in the performance of male and female students taught some basic science concepts. The difference was in favour of the females.

Conclusion

The following conclusions were made

There is a significant difference in the mean achievement scores of students exposed to concept mapping and those exposed to the conventional teaching method and this difference is in favour of the experimental group exposed to concept mapping. There is a significant difference in the mean achievement scores of male and female students exposed to concept mapping and this difference is in favour of the males.

Recommendations

On the basis of the findings of this study, the following recommendations were made

1. Textbooks authors should include concept maps and concept mapping activities in their textbooks as textbooks are known to be the primary tools used to deliver the instructional content to the students.

2. Curriculum planners should incorporate concept mapping in the curriculum of pre-service teachers' education programs.

3. Professional bodies such as STAN should provide researchers to opportunities to showcase their findings like efficacy of the use of concept mapping strategy in teaching basic science at their annual conferences and workshops for in-service teachers.

4. Examination bodies like the junior WAEC, WAEC, NECO and NABTEB should include concept mapping as an evaluation tool in their examinations. This will certainly promote concept mapping as an evaluation tool in formative and summative assessment in schools.

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