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CONCEPT MAPPING TEACHING STRATEGY ON STUDENTS' ACHIEVEMENT IN BASIC SCIENCE

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ABSTRACT: The study investigated the effect of concept mapping teaching strategy on students' achievement and retention in Basic Science in Imo State. The subjects in the experimental group were taught Heat Transfer concepts using the Concept Mapping teaching strategy and their achievement and retention abilities were compared with that of the control group who were taught same concepts using lecture method. Pretest, posttest and postpose test data were analyzed to determine the group equivalence, achievement and retention abilities of the students in the experimental and the control groups. Three research questions were answered and three hypotheses were tested using t-test statistics of P-value 0.05 and the following major findings were made: Students exposed to Concept Mapping teaching strategy i.e. (Experimental group) achieved significantly higher than their counterparts taught using lecture method. Students exposed to Concept Mapping instructional strategy retained the learnt concepts significantly better than their counterparts exposed to lecture instructional strategy; there was no significant difference in academic achievement between the male and female students exposed to Concept Mapping and lecture instructional strategies. Form the findings, some recommendations were made, one of which is that teachers of Basic science should use Concept Mapping instructional strategy in their teaching as it enhances achievement and retention among JSS3 students.

Key words: concept mapping, lecture method, achievement and retention.

INTRODUCTION

Background of the Study

Science Education plays a key role in the future of societies. Globally, countries have persistently tried to better the tone of science education, particularly developing nations, Nigeria is not left out; there has been a revolutionary transformation in views of primary and secondary school educational activity and learning. Science can be envisioned as a gateway to solving societal problems. Effective

teaching is so crucial to learn that the products of teaching such as knowledge, skills and attitude acquisition are much dependent on the teacher's effective teaching. As observed by Afurobi, Izuagba, Obiefuna, & Ifegbo, (2015), the teaching of science is mainly by lecture method and copying of lecture notes. Due to the role played by the teacher in the conventional teaching method, students do not engage in critical thinking. Effectiveness of a teacher and students learning can be enhanced through the appropriate strategy adopted in a learning situation.

Studies have shown that students exhibit very poor science skills (Igboegwu 2006), hence, students' achievements in science subjects are usually below expectation at the Senior Secondary Certificate Examination (Ifeakor 2006; Udo, 2008). Researchers have made several efforts towards designing techniques and methods for more effective teaching of science subjects. Several techniques and methods for diverse situations in the classroom have been suggested. The need to inculcate in the learner creative abilities, improve their self-esteem, eliminate difficulties while learning and make them active participants in the classroom has given rise to tremendous interest by researchers towards developing teaching methods that can capture the above-stated qualities. Some innovative teaching methods that are better than the conventional lecture method in acquisition of scientific knowledge include guided inquiry, constructivist based learning Ukoh & Saheed (2018), problem-solving, demonstration, cooperative learning and concept mapping. All these methods rely on various form of teacher-student activities. However, some are more activity-oriented than others. These activities in science as contained in the Federal Republic of Nigeria (FRN 2004) which states that one of the goals of science education is to give the child opportunities for developing manipulative skills that will enable the child to function effectively in the society within the limits of the child's ability. Therefore, effective teaching must involve hands-on-activities during instruction. It is necessary to apply strategies that will employ approaches capable of enhancing better academic achievement of

students in the science subjects such as the cooperative learning and concept mapping methods in which students actively control their learning process.

Concept mapping serves as a tool to help learners organize their cognitive frameworks into more powerful integrated patterns. In this way, it serves as a metaknowledge and a meta-learning tool. The heuristic of concept mapping -a kind a metacognitive strategy assists learners in understanding concepts and relationships between them, and in seeing the hierarchical, conceptual, propositional nature of knowledge (Klausmeier, Ghatala & Frayer, 1974; Derbentseva et al 2004; Hibberd et al 2002 Novak, Gowin & Johanson 1983) The proponents of the concept mapping strategy posit that meaningful learning ensues when a learner is aware of and can control, the cognitive processes associated with learning. Indeed, some research on concept mapping seems to demonstrate that meaningful learning results from its use in science classrooms (Stewart, Vankirk & Rowell, 1979; Novak & Gowin, 1984; Ault, 1985; Cliburn, 1987; Okebukola & Jegede, 1988; 1989; Jegede, Alaiyemola & Okebukola 1990 Kunchin 2000; Markow & Lonning 1998).

Basic science, formerly known as Integrated Science, is the first form of science a child comes across at the secondary school level; hence basic science prepares students at the Junior Secondary School level for the study of core science subjects at the Senior Secondary School level (Olarewaju 1994). This implies that for a student to be able to study single science subjects at the Senior Secondary School level successfully, such student had to be well-grounded in basic science at the Junior Secondary School level. Because of this, basic science is given great emphasis in the Junior Secondary School curriculum. The principal reasons why Nigerian Government started Basic Science teaching in Nigerian secondary schools are as follow:

1. To provide students at the Junior Secondary School level a sound basis for continuing science education either in single science subjects or further integrated science;
2. To enhance the scientific literacy of the citizenry;
3. To allow students to understand their environment in its totality rather than in fragments;
4. To allow the students to have a general view of the world of science;
5. The processes of science serve as a unifying factor for the various science subjects. It is, therefore, necessary for the learner to know these processes through an integrated approach to learning science.

In an attempt to improve the standard of science teaching and learning, a lot of research studies had been carried out. Studies in Basic science education have reported that many students at the Junior Secondary School level have developed a negative attitude towards the subject (Morrell & Lederman 2010). Many of the students at this level, because of their dismal performance in the subject, are not benefiting much from the basic science curriculum (Odetoyinbo 2004). This has prevented many of them from offering core science subjects or performing better in the core science subjects at the Senior Secondary School level. The West African Examination Council in 2011 released West African Examination result that showed a high failure rate in sciences. Also, the analysis of Integrated Science result of the Junior Secondary (JSS) level examination, of some state government-controlled Junior Secondary Schools in Jos North Local Government Area of Plateau state in Nigeria for five consecutive years is no better. Presently, the current statistics on the students' academic performance in the Junior Secondary School Certificate Examination (JSSCE) in Ebonyi State tends to show that the teaching and learning of basic science as a subject at the Junior Secondary School level is still inadequate. All these are shreds of evidence of lack of performance and could be asserted that the old or traditional method has not yielded good fruit as yet the results of the students in the Junior Secondary School Certificate Examination

(JSSCE) has not been encouraging. The poor performance in their certificate examination denied them the opportunity of being admitted to a higher institution for further studies. This has become a challenge to the stakeholder in the educational industry and entire society.

STATEMENT OF PROBLEM

Many thought has been going through about the poor performance of students in the Basic School Certificate Examination in Basic Science. Could it be the terminology of the abstract nature of the concept, teacher's teaching methodology, ability to retain knowledge or gender influence? Research has also reported that teachers find it very difficult to teach some Basic Science concepts, the reasons range from the abstract nature of some Basic Science concepts, lack of teaching aids and complexity. The situation calls for a search for innovative teaching technique that will guarantee effective and meaningful learning. Since the fundamental characteristic of meaningful learning is the integration of new knowledge with the learner's previous concept and propositional frameworks, this makes concept mapping learning the possible alternative and that is the essence of this study.

Aim and Objectives of the Study

The study aims to investigate the effect of Concept Mapping teaching strategy on academic achievement and retention among Junior Secondary three students with Lecture Teaching Strategies as control.
Specifically, the study has the following objectives to:

1. Determine the effects of using Concept Mapping teaching strategy on students' academic achievement among Basic Science Students of Junior Secondary Schools.
2. Establish whether Concept Mapping teaching strategy of teaching Basic science enhances retention ability among Basic science students of Junior Secondary Schools.

3. Find out whether the effect of Concept Mapping teaching strategy is appropriate for learning Basic Science concepts among male and female students.

Research Questions

The following research questions are to guide the study;

Research Question 1: What is the effect of Concept Mapping teaching Strategy and lecture method on students' academic performance among Basic Science students of Junior Secondary Schools?

Research Question 2: What is the effect of concept mapping teaching strategy on retention ability of basic science Students compared to the traditional method?

Research Question 3: What is the difference in academic performance between male and female students taught basic science using the concept mapping teaching strategy?

Null Hypotheses

The study has the following null hypotheses:

HO1: There is no significant difference in academic performance between students taught Basic Science using Concept Mapping strategy and their counterparts taught the same concepts using lecture teaching method.

HO2: There is no significant difference in retention ability between students taught Basic science using Concept Mapping teaching strategy and their counterparts taught using lecture method.

HO3: There is no significant difference in academic performance between male and female students taught Basic Science using Concept Mapping teaching strategy.

Significance of the Study

This research investigated the effect of Concept Mapping teaching strategy on academic achievement and retention in Basic Science concepts among junior secondary three students. The findings of the study provide empirical evidence for further research in the area of the study. Besides, teachers of Basic Science would have insight and

awareness of the effectiveness of each of the two teaching strategies being compared in the study. Curriculum designers would hopefully benefit from the findings of this study, fitting in concept maps and activities to topics that require activity. Such findings may be developed in the future curriculum. Textbook writers will find this study relevant to their profession since the effectiveness of the teaching strategies being investigated in Basic Science would be incorporated into their publications for effective teaching and learning. Stakeholders in education would hopefully benefit from this study in that teachers, lecturers will be aware of the topics that required concept mapping and activities in their teaching.

METHODOLOGY

The study adopted quasi-experimental with pretest, posttest, post post-test experimental and control groups. Experimental and control groups were pretested before exposure to treatment for 2 weeks and at the end of which post-test was administered to determine students' achievement and one week later, post post-test was administered to determine their retention level. The population for this study comprises all junior secondary three Students registered in public secondary schools in Owerri Municipal L G A. A random sampling technique was used in this study to select schools. The sample groups include the experimental group and the control group totalling 80 students. The experimental group was exposed to concept mapping learning strategy in Basic Science while the control group were taught the same concepts using Lecture method. The instrument used for this study is the Basic Science Achievement Test which is specifically titled (BSAT) developed by the researcher on the topic 'Heat Transfer'. This topic is derived from the National Curriculum for junior secondary school JS 3 Basic Science. The topic was selected because it features in JS 3 Basic Science curriculum and can be taught using the Concept Mapping,. Forty (40) test items were administered by the researcher in person in the form of objective questions. The results were subjected to t-test analysis.

The content of the Basic Science Achievement Test (BSAT) was validated by two experts in Basic Science and Curriculum Development from Alvan Ikoku Federal College of Education owerri. These experts examined teaching materials and measuring instruments for face and content validity. Their constructive criticisms and feedback were used to improve the quality of BSAT. The reliability of the instrument for this study was obtained by subjecting responses of the pilot study to a statistical analysis using the Cronbach alpha technique. Consequently, a reliability coefficient of 0.98 was obtained.

Research question 1: What is the effect of Concept Mapping teaching Strategy and lecture method on students' academic performance among Basic Science students of Junior Secondary Schools?

Table 1: Mean and standard deviation showing performance of students exposed to concept mapping

Teaching methods	N	Pretest		Post test	
		Mean	Std.dev	Mean	Std.dev
Concept mapping	40	20.75	3.54	39.20	2.82
lecture	40	22.70	4.03	29.00	2.56

Table 1 shows that the pretest mean scores for the experimental and control groups are 20.75 and 22.70 respectively while the post-test mean scores for the experimental and control groups are 39.20 and 29.00

Research Question 2: What is the effect of concept mapping teaching strategy on retention ability of basic science Students compared to the traditional method?

Table 2: Mean and standard deviation showing the retention ability of students exposed to concept mapping

Teaching methods	N	Post-test		Post-post test	
		Mean	Std.dev	Mean	Std.dev
Concept mapping	40	39.20	2.82	47.00	1.43
lecture	40	29.00	2.56	30.80	3.22

Table 4.2 reveals that the mean post-post test scores 47.00 of students exposed to the experimental group was higher than the post-test score 39.20 while the mean post-post test scores 30.80 of students exposed to lecture method was slightly higher than post test scores 29.00 in the control group

Research Question 3: What is the difference in academic performance between male and female students taught basic science using the concept mapping teaching strategy?

Table 4.3: Mean and standard deviation academic performance between male and female students taught basic science using the concept mapping teaching strategy

Gender	N	Mean	Std.dev
Male	23	39.34	2.65
Female	17	39.00	3.10

Table 4.3 reveals that male students taught basic science with concept mapping had a mean score 39.34 ±2.65 while their female counterparts had a mean score 39.00 ± 3.10.

HO1: There is no significant difference in academic performance between students taught Basic Science using Concept Mapping strategy and their counterparts taught the same concepts using lecture teaching method.

Table 4: t-test analysis of mean scores of post-test of Experimental Group taught using Concept Mapping and Control Group taught using Traditional Lecture Method

Teaching methods	N	Mean	Std.dev	df	t-crit	t-cal	Sig	decision
Concept mapping	40	39.20	2.82	78	1.98	16.92	0.000	Sig
lecture	40	29.00	2.56					

Table 4 shows that the calculated t-value is 16.98 while its corresponding table value is 1.98 at 0.00 alpha level. The calculated value is greater than the critical value. This means that students exposed to concept mapping teaching strategy performed better than their counterparts who are exposed to lecture method. Therefore hypothesis 1 was rejected.

HO2: There is no significant difference in retention ability between students taught Basic science using Concept Mapping teaching strategy and their counterparts taught using lecture method.

Table 5: t-test analysis of mean scores of students' retention ability

Teaching methods	N	Mean	Std.dev	df	t-crit	t-cal	Sig	decision
Concept mapping	40	47.00	1.43	78	1.98	29.01	0.000	Sig
lecture	40	30.80	3.22					

Table 5 shows that the calculated t-value is 29.01 while its corresponding table value is 1.98 at 0.00 alpha level. The calculated value is greater than the critical value. This means that students' retention ability improved when exposed to concept mapping teaching strategy. Therefore hypothesis 1 was rejected.

HO3: There is no significant difference in academic performance between male and female students taught Basic Science using Concept Mapping teaching strategy.

Table 6: t-test analysis of mean scores of male and female students'

Gender	N	Mean	Std.dev	df	t-crit	t-cal	Sig	decision
Male	23	39.34	2.65	38	1.98	0.38	0.000	Sig
Female	17	39.00	3.10					

Table 6 shows that the calculated t-value is 0.38 while its corresponding table value is 1.98 at 0.00 alpha level. The calculated value is lesser than the critical value. This means that there is no significant difference in the performance of male and female students in integrated science. This implies that gender does not have any significance effect on the academic performance of JS 3 integrated science students. Therefore hypothesis 3 was not rejected.

DISCUSSION OF RESULTS

Hypothesis 1

The result of testing hypothesis one shows that the students in the Experimental Group (EG) who were taught Basic Science Concepts using the Concept Mapping performed significantly better and achieved higher than their counterparts in the Control Group (CG), the significant difference in achievement of mean scores of 39.20 and 29.00 in favour of the experimental group (EG) at a significance of 0.05 level is revealing a greater effectiveness of the Concept Mapping over the lecture (talk and chalk) as a teaching strategy. This is in agreement with Brekke, (2005) who says that there is a connection/link between teaching-learning, achievement and methodology in shaping the learners in science.

Hypothesis 2

The postpost test result showed that the experimental group exposed to concept mapping teaching strategy retained the taught Basic Science Concepts significantly better than their counterparts in the control group who were exposed to lecture method. The result showed that the experimental group (EG) had a postpost test mean score of 47.00 while their counterparts in the control group (CG) had the mean score of 30.30. The statistically significant difference between the two mean scores suggests that the Concept Mapping teaching strategy experience led to more effective learning and higher retention level than the traditional (lecture) method. According to Mari (1994) adequate and appropriate use of Activity-based method through a rich variety of stimulating experiences progress from concrete to abstract and then a powerful conceptualization maybe achieved. Thus learner would now reason or make hypothesis with symbolic or ideas rather than needing objects in the physical world as the basis for his thinking. The learner according to him can therefore use a hypothetical deductive procedure that no longer ties his thought to existing reality but consider all possible explanations to problem and can evaluate alternative explanation or solution to the problem.

This finding agrees with that of Abdullahi (2005) and Alaagib Musa & Saeed, (2019), who reported that the conventional lecture method used by most teachers is inferior in promoting effective learning. Teachers use it only for easy coverage of the school syllabus, teacher being active while students are always passive learners. It is further characterized by one – way flow of information and encourages rote learning and yields little retention. Meaningful and concretely learned concepts by students are always retained and even coded in the memory for easy recall when the need arises.

Hypothesis 3

Hypothesis 3 centered on gender – related differences in academic achievement in relation to the variables of the study. The results of testing this hypothesis showed that there is no statistically significant difference between the posttest mean scores of the male (39.34) and the female (39.00) in the experimental group. This implies that the level of achievement of the male students exposed to concept mapping is the same with their female counterparts. The result indicated that the concept mapping teaching strategy is gender friendly.

This finding agrees with the findings of Bichi (2002) and Stanley (2007) who said understanding and retention are products of meaningful learning, when teaching is effective and meaningful to the students whether male or female. Thus, meaningful learning is the product of student's involvement in act of learning like in Activity-Based teaching strategy.

Also this finding agrees with that of Abimbola in Stanley (2008) who observed that the type of instructional strategy used does not discriminate between male or female. Therefore, the Concept Mapping teaching strategy is gender friendly as far as this study is concerned. Concrete and meaningful learning appears to be gender-friendly.

SUMMARY OF RESULTS

The following findings were made in this study:

There was significant difference between the mean scores of the experimental group taught Basic Science concepts using Concept Mapping teaching strategy and the control group taught same concepts using traditional teaching strategy in favour of the experimental group.

There was a significant difference in the Postpost test mean scores of the experimental and control groups in favour of the experimental group. This implies that the experimental group retained the learned concepts better than the control groups.

There was no significant difference in the post test mean scores of the male and their female students exposed to Concept Mapping teaching strategy. This also implies that the concept mapping teaching approach is gender friendly.

SUMMARY

This study investigated effects of Concept Mapping teaching strategy on academic achievement and retention in Basic Science Concepts among Junior Secondary three students. It also investigated the effects of gender- related differences on students' academic achievement in the concept of Heat Transfer when taught using Concept Mapping method and Lecture methods. The sample comprised a total of 80 JSS 3 Basic Science students drawn from two Junior Secondary Schools in Owerri Municipal LGA of Imo State. They were selected by simple random sampling technique. A 40-item multiple choice instrument, The Basic Science Achievement Test (BSAT) was used to collect relevant data which were analyzed using t-test statistical package. The results obtained were presented. This study has the following major findings.

At the end of the study, the following findings were made:

there was a significant difference in the academic achievement of students taught Basic Science concepts using Concept Mapping teaching strategy (Experimental group) and their counterparts who

were taught same concepts using the lecture method (control group). The experimental group achieved significantly higher than the control group. There was a significant difference between the retention level of students taught Basic Science concepts using Concept Mapping teaching strategy and those taught same concepts using lecture method. The students exposed to concept mapping teaching strategy retained the taught concepts significantly better than their counterparts exposed to Lecture method. There was no significant difference in academic achievement between the male and female students taught Basic Science concepts using the Concept Mapping teaching strategy.

CONCLUSIONS

From the findings of this study, the following conclusions were drawn:

Teaching strategy that teachers employ in science teaching has significant effects on student's achievement. Concept mapping teaching strategy facilitates effective learning of Basic Science concepts. Students that were taught Basic Science concepts using concept mapping teaching Strategy retained the learned concepts significantly better than those taught the same concepts using conventional lecture teaching strategy. Neither the male nor the female students performed significantly better than the other when Basic Science concepts were taught to them using the concept mapping teaching strategy. Both teaching methods appear to be gender friendly. Lecture method of teaching science appear to be inferior to concept mapping teaching strategy in the teaching of Basic science concepts as they affect negatively on the student's academic achievement and retention of the learned science concepts.

RECOMMENDATIONS

On the basis of the findings and conclusions reached in this study, the following recommendations are made:

The teaching of Basic Science should be conducted in such a way that students effectively learn and retain the concepts presented to them.

The use of the Concept Mapping teaching strategy seems to be relevant in achieving this goal. It should therefore be incorporated into the teaching of Basic Science at the secondary school level. There should be in service training programmes for Basic science teachers in form of seminars, workshops and conferences should be conducted on how to use Concept Mapping teaching strategy in teaching of Basic Science concepts

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