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Effect Of Concept Mapping On Biology Students' Achievement In Secondary Schools In Onitsha North Local Government Area, Anambra State

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ABSTRACT
The research studied the effect of concept mapping on students' achievement in biology. The research design was quasi- experimental design .The population of the study comprises all the ss1 students in the sixteen(16)public schools in Onitsha North Local Government Areas of Anambra state. The sample of the study consists of 120 students randomly selected from four schools- two male school and two female schools, two of the sampled schools of 60 students were the experimental group received the instruction using concept mapping method while the remaining two comprising of 60students were the control group. Received instruction using the conventional method (lecture method). The instrument used for data collection was biology achievement test (BAT) which was validated and the reliability co-efficient of 0.84 was obtained using pearson product moment. The test was administered to the two groups before treatment as pre-test. After the treatment the test was re-administered after rearranging as post test. The result was analysed using mean and standard deviation. Z test was used to analyze the hypothesis which was tested at 0.05 level of significance. The findings showed that the group taught biology using concept mapping method performed significantly better than those taught using lecture method. Also, it was revealed that male students taught through concept mapping performed better than the female students. It was also found that concept maps help in improving achievement of the students and make learning more meaningful so that retrieval is possible. Recommendations were also made and conclusion drawn
Keywords: concept mapping, biology achievement test (BAT), Conventional method and gender **.**

INTRODUCTION

Science emanates from Latin- Scientia" meaning knowledge. According to Malachy (2016), "science is the key that unlocks the door to technological advancement". It is also the foundation upon which the bulk of present technological breakthrough is built. Through the application of science, man ensures longevity of his existence. Also Ogunleye (2010), observed that "science is a dynamic human activity concerned with understanding which helps man to know more about the universe". Owolabi (2014), described "science as an integral part of human society". Its impact is felt in every sphere of human life, so much that it intricately linked with a nation's development. Science as a field of study has done a lot for mankind that life had been made easier for man. According to Academic press dictionary of science and technology (2012), "science is an intellectual activity carried on by the human that is designed to discover information about the natural world in which human live and to discover the ways in which this information can be organized into meaningful pattern". Okeke (2018),

defined "science as organized body of knowledge in form of concepts, law and theories which ensures the use of scientific knowledge".

Science education enriches the young with facts, principles and skills as tools for building the natural world. According to NPE (2014), science education curriculum content includes the following subjects. Mathematics, Physics, Biology, Chemistry, Health Science etc. of all these, biology occupies the central position because of its nature and role in man's survival. According to Robert (2012), biology is a natural science concerned with the study of life and living organisms including their structure, function, growth, evolution, distribution and taxonomy.

The National Policy in Education (NPE,2014) and the biology curriculum sees biology as a practical enquiry oriented subject that should be taught practically(involving students in the art of doing things) . When the students are involved in doing science, science process skills such as careful observations, interpreting, predicting, events, designing experiments, organizing information reporting and generalization will be acquired.

The role of biology cannot be over-emphasized. Biology prepares an individual for different vocations like medicine, teaching, pharmacy, laboratory technology, nursing, agriculture etc, it also helps one to develop interest in biology related enterprises like raising a poultry, farming or vegetation interest in biology-related enterprises like raising a poultry, farming or vegetation gardens. The study of biology has helped humans to understand the similarities among all forms of life. For example, the genetic code that helped doctors to keep people health and fight diseases. Biologists have learnt the things called pathogens which are themselves other living entities. Biology plays an important role in the understanding of complex forms of life involving humans, animals and plants, understanding these intricate details of life helps human in understanding how to care for themselves, animals and plants in the proper manner. Through studying biology, physiologists understand the human body, the functions of various organs, how diseases affect the body and way to effectively control it. Studying biology is the foundation of all characteristics of life on earth. Apart from creating solution to the challenges many living organisms face, it paves the way for inventions and discoveries that improve the quality of life. "Life science, weber state museum of Natural Science" community weber.edu.Retrieved2013-10-02.

A concept, according to Novak (1970), is regularity in events or objects designed to some label. Concept mapping instruction involves class discussion, practical, demonstration and concept mapping activities. During such lesson, concept are dragged in hierarchical manner and related concepts linked in such a way as to make learning meaningful through logical interpretation of individual properties. Through concept mapping strategy or method is relatively new in Nigeria.

Concept map was discovered by Joseph Novak in the 1970's as a means of representing the emerging science knowledge of students. It has subsequently been used as a tool to increase meaningful learning in the science and other subjects as well as to represent the expert knowledge of individual and teams in education government and business. According to Novak (2006), concept map is a diagram showing are relationship among concepts. It is a graphical tool for organizing and representing knowledge. Concept usually represented as boxes or circles are connected with labeled arrows in a downward branch hierarchical structure. The relationship between concepts can be articulated in linking phrases such as "give rise to" result 'in' or "contributes to" Novak (1970), opined that concept mapping is the technique for visualizing the relationships between ideas, images or works in the same way that a sentence diagram represent the grammar of a sentence. In a concept map each word or phrase is connected to another and linked back to the original idea, word or phrase. Concept maps are a way to develop logical thinking and study skill by revealing corrections and helping students see how individual ideas form a large whole.

Concept mapping is a teaching strategy which involves the use of schematic device to represent a set of concept meanings embedded in a framework of propositions (Novak and Gowin, 1984), these schematic devices are the concept maps. Concepts maps according to Ossai (2014), are a graphical arrangement of key concepts to show meaningful relationship among concepts or ideas being studied. Meaningful learning using concept maps requires that the materials to be learned must be conceptually clear and presented with language and examples related to the learners prior knowledge. Concept maps are effective in identifying both valid and invalid ideas held by students (Wikipedia, the free encyclopedia, 2015). They also help students to find relationship between ideas. Against this

backdrop the traditional method of instruction (lecture method) has some short coming in ensuring students participation and interest. Hence this study wants to investigate, if the use of concept mapping instructional approach to teaching can have positive influence on students' achievement in biology.

Obodo (2015), stated that academic achievement of students in biology is at a very poor state. The result of students in biology at graduating classes of every level of education kept on deteriorating. Also the achievement of students who took biology in the West African Senior School Certificate Examination was very poor and this has adverse effects on academic achievement of those students who gained admission into universities and colleges of education. Poor academic achievement according to Ogbonna (2013), is an achievement that is below expected standard. Poor achievement has been observed in school subjects of which biology is not an exception (Eze, 2015). He stressed that poor achievement is not only frustrating to the students and parents but its effects are equally grave on the society in terms of shortage of man power in all spheres of the sciences in the country.

Since biology is seen as a bridge of the science, according to Ibole(2010), it requires that it must be effectively taught at all levels of education and also with an effective method Ejezie (2017), posited that if excellent performance is expected from our biology teachers, more teachers should be employed and are capable of employing innovative pedagogical methods and utilizing resource materials available in their classroom teaching. The pedagogical method by teachers have a long way to go in determining the extent to which the students can learn (Ibe in Udogu, 2012). Eze (2010), summarized the pedagogical methods as all aspect of what goes on in the classroom during a teaching learning session and even before and after classroom encounter. Kane (2013), clearly maintained that effective learning is the product of effective teaching and learning, appropriate methods must be used. He posited that when good teaching methods are employed, learners are inspired to discover and develop their talents and hence retain and achieve higher.

Inomesia and Unero(2013), showed that lecture method of instruction have not yielded desirable results in students understanding of concept. It limits the amount of student's participation and is not an effective method for maintaining students interest (The Drill Pad, 2015). Because of these lapses and short comings in the traditional method of instruction (Lecture method), which is most often adopted by teachers for instruction, it becomes pertinent to use and alternative and innovative method of instruction (such as concept mapping) which hopefully may promote students participation during lesson presentation.

Statement of Problem

According to Bernard (2014), Poor achievement in the subject bother in external and internal examination. To this effect, professional bodies, educators and researchers are highly challenges to discover more effective instructional methods that will enhance the teaching and learning of biology. In spite of all these efforts made by researchers like Nwosu(2010), Lawal (2016), and Udogu (2010), in discovering some of the innovative methods (co-operative, Advanced organizer, demonstration, problem solving etc), which are found to be efficacious, poor performance of student in biology is still reported. Scarcity of data still persist on the use of concept mapping in biology. Hence we embark on this study to generate more information to fill in the gaps.

Purpose of the study

The main purpose of this study is to investigate the effect of concept mapping on student's achievement in secondary school's biology.

This study specifically intends to:

1. Determine the mean achievement scores and standard deviation of senior secondary school students taught using concept mapping.
2. Determine the mean achievement score and standard deviation of senior secondary biology school students taught using conventional method.
3. Ascertain the mean achievement score of male and female senior secondary schools biology students taught using concept mapping and those taught using conventional method (lecture method).

Research questions

The following research questions were formulated to guide this study in order to ensure that the purpose of the study was achieved.

1. What are the mean achievement scores and standard deviation of senior secondary schools biology students taught using concept mapping instructional strategy and those taught using conventional method? (lecture method)
2. What are the mean achievement scores and standard deviation of senior secondary biology students taught using concept mapping instructional strategy?
3. What are the mean achievement scores and standard deviation of senior secondary biology students taught using conventional method (Lecture method)..

Research hypotheses

1. There is no significant difference between the mean achievement scores of students taught biology with conventional method (Lecture method)
2. There is no significant difference between the mean achievement scores of male and female biology students taught with concept mapping method.

METHOD

The research design for the study was a quasi experiential design involving pre-test, post-test and control groups. The groups were exposed to different conditions concept mapping and conventional method (Lecture Method)

This study was conducted in Onitsha north local government with it's headquarter at the GRA. The instrument used in this study was biology achievement test (BAT) the BAT was used for both the pre-test and the post test. The reliability of the biology achievement test (BAT) was established by carrying out a pilot testing using students from schools not involved in the study by the split half method. The result obtained was used to determine the reliability of the instrument using pearson product moment correlation coefficient formula which was found to be at 0.84. Prior to the treatments, the topics cellular organization and energy flow in an ecosystem were taught to the experimental group using concept mapping strategy (CMS) while the control group were taught the same topics using lecture method. The population was all the public secondary school biology in Onitsha North Local Government Area of Anambra State comprising of sixteen public secondary schools. A total of 4,068. SS 1 students from Onitsha North Local Government Area formed the population of the study. (PPSSC, Onitsha Zone,2017). The sample for this study comprises of students from four selected secondary schools. Two schools were males while the other two females. One male and one female schools were randomly selected and exposed to the teaching using concept mapping method, these served as experimental group while the other, one male and one female served as the control group who received instructions by conventional method (Lecture Method).

Table I Distribution of subject by gender and treatment.

Gender	Taught by concept mapping	Taught by conventional method
Male	E1 = 20	C 1 = 20
Female	E2 = 20	C2 = 20
	40	40

The treatment lasted for four weeks. After treatment the two groups were post-tested with the biology achievement test (BAT) in a rearranged format. From their scores, the post-test scores were generated. The pre-test was administered to the students in both experimental and control groups before treatment to determine students' previous knowledge on the liques, cellular organization and energy flow in an ecosystem. The post-test which second test after re-organizing the pre-test to measure their achievement after treatment was administered to the groups.

Mean and standard deviation were used to answer the research questions while the z-test was used as an analytical tool to test the hypotheses at 0.05 level of significance.

RESULTS

Results of the study are presented in tables according to research questions and hypotheses.

Research question 1. *What are the mean achievement scores of senior secondary school biology students taught using concept mapping instructional strategy and those taught using conventional method (Lecture Method)?*

Table 1. Summary of the pre-test and post-test mean score and standard deviation of both experimental and control groups.

Variables	Pre-test		Post- test	
	Mean	SD	Mean	SD
Concept mapping method (experimental group)	12.60	4.17	15.50	1.97
Conventional method (control group)	12.18	4.01	12.35	3.34

From the table above, the mean score and standard deviation of the students in pre-test are 12.60 and 4.17 for experimental group. For control group, the mean and standard deviation are 12.18 and 4.01 respectively. Then, in the post-test, the mean scores and the standard deviation of the experimental group are 15.50 and 1.97 while that of the control group are 12.35 and 3.54 respectively. Since the mean score of students in the experimental group are greater than that of the control group, therefore the students in the experimental group performed better than the control group students.

Research questions 2: *What are the mean achievement scores and standard deviation of senior secondary school biology students taught using concept mapping instructional strategies?*

Table 2. Summary of the pre-test and post- test mean scores and standard deviation of male and female biology students taught using concept mapping instructional strategy.

Variables	Pre-test		Post- test	
	Mean	SD	Mean	SD
Concept mapping method for male students	12.4	4.12	16.35	2.72
Conventional mapping for female students	12.8	4.21	14.65	1.22

From the table above, the mean and standard deviation of the male students in the pre-test are 12.4 and 4.12 while that of the female students are 12.8 and 4.21 respectively. Then in the post-test, the mean and standard deviations of male students are 16.35 and 2.72 while that of the female students are 14.56 and 1.22 respectively.

In the case, the male students taught using concept mapping method performed better than the female students taught using concept mapping method.

Research question 3: *What are the mean achievement scores and standard deviation of senior secondary school biology students taught using conventional method?.*

Mean achievement score and standard deviation of male and female students taught using conventional method (lecture method)

Variables	Pre-test		Post- test	
	Mean	SD	Mean	SD
Concept method for male students	12.1	3.92	12.15	3.88
Conventional method for female students	12.25	4.09	12.55	3.20

From the table above, the mean and standard deviation of the male students in the pre-test are 12.1 and 3.92 while that of the female students are 12.25 and 4.09 respectively. Then, in the post-test, the mean and standard deviations of male students are 12.15 and 3.88 while that of the female students are 12.55 and 3.20 respectively.

Research Hypothesis 1

There is no significant difference between the mean achievement scores of students taught biology with concept mapping method and those taught biology with conventional method (lecture method)

Table 4

The mean achievement scores of students taught using concept mapping method and lecture method

Achievement Scores	**Mean**	**SD**	**N**	**Level**	**Z cal**	**Z crit**
Concept mapping method	16.35	2.72	20	0.05	3.96	1.96
Conventional method (Lecture Method)	12.15	3.88	20			

From the table above, the z calculated for the concept mapping and conventional method (lecture method) was found to be 3.96 which is greater than the z critical value 1.96, this shows that there is a significant difference between the mean achievement scores of students taught using concept mapping method and lecture method. Therefore the null hypothesis is rejected.

Research Hypothesis II

There is no significant difference between the mean achievement scores of male and female biology student taught with concept mapping method.

Table 5

The mean achievement scores of male and female biology students taught using concept mapping method.

Achievement Scores	Mean	SD	N	Level	Z cal	Z crit
Concept mapping method for male student	16.35	2.72	20	0.05	2.55	1.96
Conventional mapping method for female students	14.65	1.22	20			

From the table above, the mean and standard deviation of male students are 16.35 and 2.72 respectively while that of the female students are 14.65 and 1.22 respectively. The z-calculated was found to be 2.55 which is greater than the z critical which is 1.96 at 0.05 level of significance. Therefore, we reject the null hypothesis and accept the alternative hypothesis that is there is a significant difference between the mean achievement scores of male and female biology student taught with concept mapping.

DISCUSSION OF FINDINGS

Table 1 shows that there is a significant difference between the academic performance in the mean achievement scores of senior secondary school biology students taught using concept mapping instructional strategy and those taught using conventional method. This is in accordance with Toby(1997) who stated that the individual or group mean achievement scores should serve as a basis for making judgment on whether an individual or group has achieved a pre-determined stated objective or not. He also stated that mean achievement score should be regarded as a reliable performance indicator of the treatment given (instructional method) i.e the effectiveness of instructional method employed by the teacher can be evaluated based on the obtained mean achievement score of the group.

Table II shows the mean achievement scores and standard deviation of senior secondary school biology students taught using concept mapping instructional strategy. The result reveals that male students taught Biology using concept mapping performed better than female biology students taught using concept mapping method. Concept mapping as a teaching tool is more effective for the male students than the female students with respect to achievement in biology achievement test. Hence gender has moderating role in defining the effect of concept mapping on academic achievement in the subject of biology. This is reported by Boujaoude and Attieh (2013) on the use of concept mapping as study tool in chemistry and biology in 10^{th} grade.

Table III shows the mean achievement scores and standard deviation of senior secondary school biology students taught using conventional method (lecture method). The result reveals that female students taught biology using conventional method performed better than male students taught Biology using the same method. Female students surpassed male students in accordance with Brandi (2011) who reported that students with low pretest scores show significantly larger gain scores than those with pre test.

Table IV and V were used to test hypothesis I and II. Table IV reveals that there is a significant difference between the mean achievement scores of student taught Biology with concept mapping method and those taught biology with conventional method (lecture method). The results of this study extent the findings of Hall and O dennell (2016). The major reason is that concept mapping provides opportunity for active involvement of students in their learning process and hence enhances their thinking ability while cross questioning and thinking for seeking solutions. Concept mapping facilitates and even stimulates imaginations of the learner.

Table V above shows that there is a significant difference between the mean achievement scores of male and female Biology students taught with concept mapping method.

CONCLUSION

The teacher's persistent use of conventional method which is too didactic, rigis and expository in Biology teaching is one of the major causes of students' poor achievement and retention in the

subject. This is why Kane (2013), clearly maintained that effective learning is the product of effective teaching and in order to have effective teaching and learning, appropriate teaching method suitable for the instruction must be used. He posited that when good teaching methods are employed, learners are inspired to discover and develop their talents and hence achieve more. The use of concept mapping method will enhance students achievement in Biology and change the failure rate trend in Biology achievement test.

RECOMMENDATIONS

On the basis of findings of this study and the discussions, it is recommended that concept mapping is beneficial in enhancing students' achievement in Biology.

Therefore, it is recommended that

1. Curriculum developers may incorporate this strategy in curriculum guidelines for achievement of intended learning outcomes and content development for meaningful and higher order learning.
2. Textbook being a primary tool to develop the concept to the students lays a heavy responsibility on the textbook writers to develop a balanced textbook in terms of content methodology, practical activities and assessment exercises. The textbook writers are urged to include concept maps and concepts mapping activities in the textbooks.

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