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CONCEPT MAPPING: A 21st CENTURY STRATEGY IN BIOLOGY INSTRUCTION.

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ABSTRACT

The research investigated the use of concept mapping as a 21st century strategy in biology instruction. Descriptive survey design was adopted for the study. The study was carried out in Owerri North local government area. The population of the study was 3,943 biology students located in sixteen secondary schools in the study area. 214 SS2 students in seven secondary schools randomly selected from the population formed the sample size. Questionnaire was used as instrument for data collection. The instrument was validated as appropriate and its reliability ascertained accordingly. The researchers collected data from the seven schools designated for the survey. Data collected were subjected to arithmetic mean for analysis. The results among others revealed that concept mapping was applied in teaching especially of ambiguous topics in biology, such as Genetics and aspects of Plant evolution. And that it helped to demystify such subject matters. It was however found that most teachers lack competence in the use of concept mapping. The study among others, recommends the introduction of Artificial Intelligence (AI) to help mentor the regular class room teachers in the use of concept mapping as a strategy in 21st century biology instruction.

Key words: Concept mapping, 21st Century Strategy, Biology instruction.

INTRODUCTION

Science and its twin brother Technology can only be effective through proper science education. Science education embodies all processes aimed at providing unlimited opportunities for learners to understand necessary knowledge, skills and attitudes required to utilize novel ideas to function effectively in a scientific and technological society. Towards this end, there's need to produce the required large pool of experts for science and technology which will help bring about the much needed socio-economic development of the nation. These experts can only be produced through a well organized and efficient science and technology education, (Aboagye, 2012; Okeke, 2017).

Concept maps are graphic tools for organizing and representing knowledge (Novak, 2014). Gastenera & Bognera (2016), defined concept mapping as pictorial arrangement of key concepts that are unique to specific subject. It's a kind of visual network showing regularity in events or objects designated by some label (Ezeugo,2009). Imako (2015), defined concept mapping as one way of representing concepts hierarchically showing their relationships. In view of these definitions, concept mapping can be explained as a method of organizing and presenting key concepts in such a way that their relationships are maintained hierarchically or in an orderly form.

Concept maps possess certain unique features which among others includes;

i, the graphical two dimensional display of knowledge that comprise concepts usually represented within boxes or circles connected by arcs encoding brief relationships - These relationships usually consist of verbs with prepositions or phrases for each pair of concepts (Wikipedia, 2020). The simplest concept map would consist of two words connected by an arch representing a simple sentence such as ‘grass is green’, but can become intricate.

ii, the inclusion of cross links - These are relationships or links between concepts in different segments or domains of the map. Cross-links help the learners to see how a concept in one domain of knowledge represented on the map is related to another concept in different domain (Imako, 2015). He further emphasized on two essential features of concept maps that facilitate creative thinking to include; hierarchical structure that is represented in good map and the ability to search for and characterize new cross-links.

iii, the presentation of specific examples of events or object that help to clarify the meaning of a given concept- The structure of a concept map is dependent on context, hence maps having similar concepts may vary in context and thus idiosyncratic (Oguamanam, 2021). The strength of concept maps lies in their ability to measure a particular person's knowledge about a given topic.in a specific context. Thus concept maps constructed by different persons on the same topic are necessarily different as each represents its creator's personal knowledge. Therefore, no particular concept map is preferred to the other since there can be many different representations of the topic that are correct (Oguamanam, 2021). According to Novak (2014), in a well constructed concept map, each pair of concepts together with the adjoining linking phrase can be read as an individual statement or preposition that makes sense. Thus concepts linking phrases are as short as possible, preferably a single word.

Historically, concept maps were developed by Novak in 1972 in course of his research programme at Cornell University, USA where he sought to follow and understand changes in children knowledge of science , (Novak and Muosanda, 2011). During the research many children were interviewed and it was discovered that children find it difficult to understand and identify certain changes in them. The primary objective of his research was to develop a model to overcome the problem of rote learning of concepts in science. Concept mapping construction becomes more significant as the learner makes effort to link the concepts to form prepositions. The structuring of these prepositions into a map is a reflection of his understanding of the domain. Mapping techniques are employed to help students " learn how to learn" by bringing to the surface cognitive structure and self constructed knowledge (Novak and Godwin, 2012). It was noted that when learners are able to construct their own knowledge, it makes learning more interesting and students thereby experience higher academic achievement.

This research was aimed at studying concept mapping as a 21st century strategy in Biology Instruction.

JUSTIFICATION OF THE STUDY

Biology teachers in secondary schools use different teaching methods which they are familiar with even when such techniques are not relevant to the topic of discussion. Besides, the traditional methods as lecture method hardly give students opportunity for active participation in the teaching and learning process, because it's teacher oriented. This is because the teacher is seen as possessor of knowledge to be transferred to the students. The method make students to learn by rote or memorization and not effective in learning difficult concepts, (Nwosu, 2012; Guisti, 2014 ;Oguamanam, 2021). Generally the achievement of Biology candidates in SSCE and relevant examinations has remained consistently low over the years (WAEC Chief Examiner's Report, 2010). These poor achievements is attributable to a number of factors including students lack of interest, use of ineffective teaching methods and their inability to retain learned concepts received via rote learning technic. Ofoegbu (2013)and Ige (2017), carried a research to find out reasons for poor performance of students in Biology. The results identified the following; class size, inadequate facilities and time factor among others. However, Young (2016), Akinsola and Popoola (2014) attributed students poor academic performance in SSCE Biology to ineffective teaching methods.

Arising from the foregoing, Biology Educators or Instructors and teachers alike are making frantic efforts towards enhancing students' achievements through the use of effective teaching methods and approaches which are 21st century compliant that will stimulate their interest and fast track learning outcomes. Thus this research was aimed at studying Concept mapping as a 21st century strategy in Biology instruction.

Study objectives

The study specifically sought to:

i. Investigate the role of concept mapping as an instructional strategy for teaching secondary school Biology in Owerri North LGA.
ii. Find out the capability of Biology teachers in the use of concept mapping in secondary schools in Owerri North LGA.
iii. Ascertain the challenges facing the use of concept mapping in teaching Biology in secondary schools in Owerri North LGA.

Research questions

i. What is role of concept mapping as an instructional strategy in secondary schools in Owerri North LGA?
ii. What is the capability of the Biology teacher in use of concept mapping in secondary schools in Owerri North LGA?
iii. What challenges face Biology teachers in the use of concept mapping in secondary schools in Owerri North LGA?

Research methodology

The design adopted for this research was descriptive survey. The study was carried out in Owerri North LGA. Owerri North Local Government Area comprise fifteen (15) senior secondary schools with a population of 3,943 biology students. A sample size of 214 SS2 students comprising 50% of the population of seven randomly selected schools out of the fifteen in the study area. The instrument for data collection was structured questionnaire designed in 4-point Likert scale of Strongly Agree (SE), Agree (A), Disagree (D) and Strongly Disagree (SD). The instrument was validated by three experts in Measurement and Evaluation. The administration of the instrument was carried out by the researchers themselves who visited the seven schools mapped out for survey. The questionnaires were filled by the respondents under the supervision of the researchers to ensure 100% returns. Data collected were analysed using arithmetic mean with the formula:

$$\frac{\sum fx}{N}$$

∑ = summation sign

F = frequency

X = score

N = total number of respondents

X = nominal value (4- point Likert value of category)

Normative/arithmetic mean = 4+3+2+1 =10 ÷ 4 = 2.5

Where 2.5 is the criterion mean.

Results

The results of the data analysis are presented in tables below in line with the research questions stated earlier.

Research Question One: What is the role of concept mapping as an instructional strategy in teaching biology in secondary schools in Owerri North LGA?

Table 1: Responses on the role of concept mapping in teaching and learning of biology

S/N	Items	SA	A	D	SD	Total	Mean	Decision
1	It enhances students' interest in the study of biology.	85 340	69 207	50 100	10 10	214 657	3.1	Accepted
2	It makes for active participation of students in learning biology	89 356	75 225	35 70	15 15	214 666	3.1	Accepted
3	It enables the students' to understand even ambiguous topics in Biology	94 376	75 225	35 70	10 10	214 681	3.2	Rejected
4	It gives room for both the fast and slow learners to properly perceive the lesson	100 400	68 204	30 60	16 16	214 680	3.2	Accepted
	Cumulative Mean						**3.2**	

Table 1 above shows that the research question one was generally accepted indicating that teachers in the surveyed schools recognize the important role of concept mapping in teaching Biology in Owerri North LGA, Imo State.

Research Question Two: What is the capacity of biology teachers in using concept mapping?

Table 2: Ability of biology teachers in the use of concept mapping.

S/N	Item	SA	A	D	SA	Total	Mean	Decision
1	Most teachers possess competence to use concept mapping	15 60	35 105	75 150	89 **89**	214 **304**	1.4	Accepted
2	Most biology teachers are well informed on teaching with concept mapping	30 120	45 **135**	49 98	80 30	214 **383**	1.8	Accepted
3	Concept mapping is under-utilized in the teaching and learning of Biology	96 384	69 207	35 70	14 14	214 675	3.2	Accepted
4	Nonuse of concept mapping hinders the teaching of some topics	1040	5 15	100 200	107 107	222 362	1.6	Rejected
	Cumulative Mean						2.0	rejected

Table 2 displays the analysis of data on the ability of biology teachers in using concept mapping as an instructional strategy. The cumulative mean of 2.0 shows that most biology teachers do not possess the ability to utilize concept mapping as a strategy in teaching biology in secondary schools in Owerri North LGA.

Research Question Three: What are the challenges facing the use of concept mapping in teaching biology in secondary schools?

Table 4:3 Responses on the challenges in the use of concept mapping in teaching of biology.

S/N	Items	SA	A	D	SD	Total	Mean	Decision
1	It is time wasting	96 384	70 210	30 60	18 18	214 672	3.1	Accepted
2	It is not used to teach all topics	129 516	50 150	25 50	10 10	214 726	3.4	Accepted
3	Not all teachers have the skills of concept mapping	97 388	75 225	30 60	12 12	214 685	3.2	Accepted
4	Insufficient time makes it difficult to use	100 400	70 210	33 66	11 11	214 687	3.2	Accepted
	Cumulative Mean						3.2	

The analysis of research question three as presented in Table 3 above confirms a number of challenges which hinder the use of concept mapping in the teaching and learning of biology. with the cumulative mean of 3.2, the research question three was generally accepted that such factors as time constraints, teachers lack of skills among others affect the use of concept mapping strategy in teaching biology.

Discussion of Findings

On the basis of the finding in research question one, concept mapping is used in the teaching especially of ambiguous concepts. This is in line with the finding of Ajaja (2011), which posited that concept mapping could serve as an appropriate alternative for studying biology since what is learned through it can be retained for a long time. Biology teachers in many schools use strategies that are only known to them, even when these strategies are not relevant to the concept under discussion. The findings also agree with the findings of Karakuyu (2010), who observed that drawing concept map as a strategy in biology instruction was more effective than traditional method

enhancing achievement students. Hence, the overall findings support the assertion that concept mapping makes a difference in students' learning.

Furthermore, regarding the ability of biology teachers in using concept mapping, From Table 2, the respondents confirmed lack of skills on the part of most teachers in using concept mapping. This is in line with the finding of Alaiyemola, Jegede and Okebukola (2012) and Oguamannam (2021), who reported that concept mapping as one of the innovative methods of teaching sciences is dependent on the teachers capacity towards its application. This assertion according to them was based on their finding that a vast number of teachers lack requisite exposure in the utilization of this all important innovation.

The results of this research equally parallels the assertion of Gerstnera and Bognera (2006), Habor-Peters (2011), that concept mapping despite providing opportunity for active involvement of students in their learning process was being under utilized in schools.

Lastly, based on the cumulative mean of 3.2 observed in Table 3, the respondents confirmed the existence of certain challenges in the use of concept mapping to include time wasting, not relevant in all topics, teachers lack of skills and insufficient time. This is in line with Ezeudu (2014), who stated that many students found it difficult to identify specific changes in the understanding of science concepts. Furthermore, Oguamanam (2021), in his own report emphasized on the need for government and Secondary Education Management Board to ensure a seem-less and comprehensive application of 21st century teaching strategies including concept mapping to achieve more enduring educational outcome and indeed the advancement of science and technology.

Conclusion

From the findings of this study, the authenticity of concept mapping as a 21st century innovation in biology instruction was confirmed. Thus among other findings, it was noted to be a relevant strategy in the teaching of ambiguous concepts, teachers lack of

skills in the utilization and insufficient space in the time table were part of the high points Furthermore, Ukpai *et al.*(2024) and Oguamnam (2021), reported some inherent challenges in the use of concept mapping in teaching of biology in secondary schools, such as non-inclusiveness, incompetence on the part of most teachers etc..

In terms of recommendation, the ministry of education should equip serving Biology teachers with requisite knowledge and competences on the utilization of concept maps in teaching and learning, this could be through in-service training. Also professional bodies like Science Teachers Association of Nigeria (STAN) can sensitize their members on the use of concept mapping via their annual conferences and workshops. Lastly and most importantly, the use of Artificial Intelligence (AI), a 21st century technological innovation in coaching serving Biology teachers on the application of concept mapping in teaching is highly recommended.

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