

Impact of Concept Mapping Instructional Approach on Learners' Academic Attainment in Chemistry, Senior Secondary Schools, Katsina Metropolis, Nigeria

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Abstract

The impact of concept mapping instructional strategy on the academic attainment of Chemistry students' in Katsina Metropolis was explored in this study. The difference in average achievement data of those exposed to the periodic table unit of instruction utilizing concept mapping and those exposed to lecture technique before and after treatment were analyzed, as well as the disparity in mean score among students based on gender. The study's population consisted of 11,094 Senior Secondary 2 students from 11 public schools in Katsina. Sample for the study comprised 128 Chemistry learners. For proper guidance, three questions and three hypotheses were investigated. The samples for the study were randomly allocated to two classes for treatment and non-treatment. The researcher altered the Chemistry Performance Test (CPT) statistical collection. Descriptive statistics was used in answering the research question while a t-test was used for testing the hypotheses at 0.5. There was no difference in mean attainment among learners during the pre-test but a significant difference was recorded among them after the post-test. The mean score of those exposed to the periodic table idea utilizing concept mapping was higher than those exposed to the same unit of learning using the traditional approach. It also showed no disparity in average mean attainment between the sexes who were exposed to the periodic table concept employing therapy. The study advocated for the incorporation of the instructional approach in the school system for effective teaching of Chemistry at the secondary level.

Key words: Concept Mapping, Chemistry Teaching, Academic Achievement.

1. Introduction

Chemistry is a vital science subject that takes centre stage in most educational curricula. It is one of the science subjects taught in the Nigerian school system. It studies the composition, characteristics, and actions of organic, and inorganic substances, as well as different elementary forms of matter (Senese, 2018). A

concept map is a representation of an idea or knowledge schematically to show relationships between concepts (Novak & Godwin, 1989).

Concepts are placed in nodes and linked together by propositions, which represent and identify the interactions between the nodes. From the most general to the most specific and focused ideas, concept maps are grouped hierarchically (sub-

concepts). When a teacher uses concept mapping in a classroom situation, it is considered an active learning method. Its approach to classroom situations are practical, allowing students to practically participate in the learning activities. The use of concept mapping in secondary school Chemistry classes could be of benefit since it would encourage students to actively participate in classroom activities, making the process more engaging and practical.

Chemistry plays an important role in the economic development of societies as it serves as a means of achieving technological advancement in many countries. For a country to remain economically sustainable, it must improve the content as well as instructional strategies in imparting science and technology in the school system (Gero, 2015).

Consequent upon the above, there is a need for effective teaching of Chemistry education using an instructional approach that would make learning concrete, activity-based and interesting among the learners (Saage, 2010). Despite its relative importance, learners' academic attainment in the subject in examinations remained low, which has been a major concern among educators, curriculum planners, and students themselves. (Okoye, 2013). Academic attainment refers to a student's capacity to demonstrate that he or she has met the academic objectives for which learning experiences were created. Academic attainment among learners is a critical factor that has been linked to teaching methods that enhance assimilation. Based on the foregoing Ibe (2014) and Opara (2015) are of opinion that the teaching approach influences students' Chemistry performance, while Harbor-Peter (2001) observed that students are more likely to succeed in a subject in which they are interested.

Gender, on the other hand, may have an impact on learners' attainment in Chemistry. Gender is a socio-culturally assigned characteristic that distinguishes feminine from masculine behavior (Imoko, 2016). According to Onwukwe (2013) gender refers to the natural and social qualities of people which are opposed to the biological composition of human beings. Gender is believed to influence learners' academic attainment in science subjects. There is still debate about the impact of gender on student academic attainment, as there are numerous studies that contradict one another.

According to the finding of studies conducted by Joseph (2014); Jahun and Momoh (2011); Ifeakor (2017) & Mari (2019), male students score better in Chemistry than female students Aiyedum, (2012); Danmole and Adeoye (2017) on the other hand, showed no significant differences in student academic attainment owing to gender. Instead, they claimed that teaching and learning styles can affect the academic attainment of both male and female learners, and therefore called for the adoption of pragmatic teaching methods that would improve all learners' academic attainment in the school system.

The classical teaching technique such as the lecture method of teaching does not encourage the active participation of learners in classroom activities (Akinsola & Igwe, 2017). It is a method in which contact between the teacher and the pupils is generally one-way. As a result, it is known as a didactic technique because the teacher does the majority of the talking and learners listen passively. In support of this, Obeka (2012) noted that in most schools, the conventional lecture mode of teaching still exists. The researcher further maintained that when students are exposed to traditional lecture method of teaching; it makes it more difficult for learners to grasp relevant concepts compared to methods

that are hands-on in nature. Classical teaching strategies do not actively involve the learners, this inhibits the exercise of their domains. They also encourage rote learning due to the lack of proper assimilation.

Teachers, according to Aboye (2011), Asiyai (2015), and Akinsola & Igwe (2017), should use instructional approaches that can help learners improve their performances and acquire skills so that they can address social concerns. They believe that affective and psychomotor stimulating teaching strategies such as activity, inquiry, and discovery could be utilized.

2. Statement of the Research Problem

Chemistry has received a lot of attention due to its significant contributions towards technological development. However, students have continued to do poorly in the Senior Secondary Certificate Examination in it over the years. A review of learners' academic attainment in the subject among SSS Chemistry students in Nigeria shows a high level of low performance. For example, out of 171,232 students that sat for the West African Examination Council only 40,582 had credit passes. When compared with the previous year i.e. 2012 only 20.7 per cent had credit passed. Even though the percentage of students who passed increased to 36 percent in the following year, it still went down to 33.5 and 25.3 percent in 2015 and 2016 respectively. The situation was the same in 2017 and 2018. (WAEC, 2018). This situation is particularly discouraging given that Chemistry is a core science subject, and the National University Commission (NUC) requires a credit pass in it before admitting students to any science-related professional field in the university.

Consequent upon the above, better teaching approaches are required to assist students in improving and correcting their academic

performance in SSS Chemistry. The study, therefore, intends to find out the impact of concept mapping instructional approach on learners' academic attainment in Chemistry in senior secondary schools in Katsina metropolis, Nigeria.

3. Purpose of the Study

The general purpose of the study is to find out the impact of the concept mapping instructional approach on learners' academic attainment in Chemistry, in senior secondary schools, in Katsina metropolis, Nigeria.

Specifically, the study seeks to:

1. determine the disparity in the average academic attainment of learners exposed to the periodic table using the treatment and those exposed to the same unit of instruction using the classical method of teaching based on pre-test.
2. find out the disparity in the average academic attainment of learners exposed to the periodic table using the treatment and those exposed to the same unit of instruction using the classical method of teaching based on the post-test.
3. examine the disparity in the average academic attainment of learners exposed to a periodic table using the treatment and those exposed to the same unit of instruction using the classical method of teaching based on gender.

4.0 Research Questions

The research questions that guides the study are as follow:

1. What is the disparity in the average academic attainment of learners exposed to the periodic table using concept mapping and those exposed to the same unit of instruction using the classical method of teaching before treatment?

2. What is the disparity in the average academic attainment of learners exposed to the periodic table using concept mapping and those exposed to the same unit of instruction using the classical method of teaching after treatment?

3. What is the disparity in the average academic attainment of learners exposed to the periodic table using concept mapping and those exposed to the same unit of instruction using the classical method of teaching on gender?

4.1 Hypotheses Testing

These formulated hypotheses were tested:

H01: Significant disparity does not exist in the average academic attainment of learners exposed to the periodic table using the treatment and those exposed to the same unit of instruction using the classical method of teaching before treatment.

H02: Significant disparity does not exist in the average academic attainment of learners exposed to the periodic table using the treatment and those exposed to the same unit of instruction using the classical method of teaching after treatment.

H03: Significant disparity does not exist in the average academic attainment of learners exposed to the periodic table using the treatment and those exposed to the same unit of instruction using the classical method of teaching based on gender.

5. Methodology

The investigation was conducted using a quasi-experimental design. The study adopted a pre and post-test. The population for the study comprised 11,944 SS II chemistry students in public schools in Katsina Metropolis. The sample comprised 128 SS II Chemistry students randomly

selected from 2 public schools and were assigned experimental and control groups.

The Chemistry Performance Test (CPT) served as a pre-test to determine subject equivalence and a post-test to ascertain the level of academic attainment of learners based on the periodic table concept. Experts reviewed the instrument and gave approval.

Research questions that were answered descriptively were three, and three hypotheses were formulated and tested using t-test statistics at 0.05.

6. Results

Question One: What is the disparity in the average academic attainment of learners exposed to the periodic table using concept mapping and those exposed to the same unit of instruction using the classical method of teaching before treatment?

Table 1

	Number	$\bar{X}$	Stand. D	M.D
Experimental Group	64	10.33	2.01	0.19
Control Group	64	10.51	1.67	

Table 1: Table I above shows that the experimental group had a mean of 10.33 and a standard deviation of 2.01 while the control group had a mean of 10.51 and a standard deviation of 1.67. A mean disparity of 0.19, or about 0.00, indicates that there was no change in performance between students exposed to the same unit of instruction before treatment. Individual performance scores in both groups are closer to one other, although individual academic

performance scores in the control group are a little closer to each other.

Question Two: What is the disparity in the average academic attainment of learners exposed to the periodic table using concept mapping and those exposed to the same unit of instruction using the classical method of teaching after treatment?

Table 2:

	Number	$\bar{X}$	Std. Deviation	Mean Difference
Experimental Group	64	15.55	2.20	3.80
Control Group	64	11.75	1.98	

Table two above showed that the experimental group had a mean of 15.55 and a standard deviation of 2.20 while the control group had a mean of 11.75 and a standard deviation of 1.98. A mean disparity of 3.8 indicated that the experimental group attained higher academic achievement after being exposed to treatment.

Question Three: What is the difference in the mean performance scores of male and female students taught periodic table concepts in Chemistry using concept mapping?

Table 3:

Gender	Number	Mean	Stand. D	M.D
Boys	24	15.71	2.03	0.26
Girls	40	15.45	2.32	

Table 3: Table three above showed that boys averagely scored 15.71 and 2.03 standard deviation while girls score 15.45, with 2.32 as the standard deviation. The mean difference of 0.26 indicates that students who were taught the periodic table concept in Chemistry utilizing concept mapping did equally well. The standard deviations reveal similarities in their individual performance scores.

Hypotheses

H₀₁: Significant disparity does not exist in the average academic attainment of learners exposed to the periodic table using the treatment and those exposed to the same unit of instruction using the classical method of teaching before treatment.

Table Four: t-test analysis

Group	N	Mean	S.D	M.D	D.F	T- value	P-value	Remark
Experimental	64	10.33	2.01					
				0.19	126	0.574	0.567	Retained
Control	64	10.51	1.67					

$\alpha \leq 0.05$

Table Four: t-value of academic attainment of learners exposed to the unit of instruction using the treatment and those exposed to the same unit of instruction using the classical method of instruction showed a calculated value of 0.574 and table value of 0.567 at an alpha value of 0.05. Since the calculated value is greater than the alpha value the hypothesis is retained.

H02: Significant disparity does not exist in the average academic attainment of learners exposed to the periodic table using the treatment and those exposed to the same unit of instruction using the classical method of teaching after treatment.

Table: Five

	N	Mean	S.D	M.D	D.F	T- value	P-value	Remark
Experimental Group	64	15.55	2.20					
				3.80	126	10.24	0.000	NOT RETAINED
Control Group	64	11.75	1.98					

Table Five: t-value of academic attainment of learners exposed to a unit of instruction using the treatment and those exposed to the same unit of instruction using the classical method of instruction showed a calculated value of 10.24 and table value of 0.000 at an alpha value 0.05. Since the calculated value is less than the alpha value the hypothesis is not retained.

H03: Significant disparity does not exist in the average academic attainment of learners exposed to the periodic table using the treatment and those exposed to the same unit of instruction using the classical method of teaching based on gender.

Table Six: t-test analysis.

	N	Mean	S.D	M.D	D.F	T- value	P-value	Remark
Boys	24	15.71	2.03					
				0.26	62	0.451	0.653	RETAINED
Girls	40	15.45	2.32					

 $\alpha \leq 0.05$

Table 3: t-value of academic attainment of learners exposed to a unit of instruction using the treatment and those exposed to the same unit of instruction using the classical method of instruction showed a calculated value of 0.451 and table value of 0.653 at an alpha value of 0.05. Since the calculated value is less than the alpha value the hypothesis is retained.

7. Discussion

The study demonstrated similarity among the sampled students in their academic attainment during the pre-test. However, there was a disparity in the average academic attainment between those exposed to the unit of instruction using the treatment and those exposed to the same instruction using the classical strategy of teaching.

The study goes in line with the findings of Ezeudu (2012), which maintained that idea mapping had an impact on learners' overall performance in chosen subjects. In terms of student performance in Chemistry ideas, concept mapping seemed to be significantly and efficiently impactful compared to traditional teaching strategy. It also corroborated the finding of Ezeugo and Agwagah (2000) which favoured concept mapping against traditional teaching techniques.

Data revealed no significant disparity in the average academic attainment among both sexes in Schools in the Katsina metropolis, when taught periodic table ideas in Chemistry using concept

mapping. The finding contradicts that of Ezeugo and Agwagah (2000), which posited that boys attain higher academic levels than girls when exposed to the unit of instruction using a concept map.

8. Conclusion

The study, therefore, concluded that disparity exists between learners exposed to learning activities using concept maps and those exposed to the same unit of instruction using classical teaching strategies. Significant disparity does not exist in academic attainment between male and female learners when exposed to learning activities using a concept map.

9. Recommendations

Considering the findings, the study recommends the following:

- Concept mapping should be incorporated into the school system for effective teaching and learning.
- On-job training programmes should be continually organised for teachers to update them on current strategies of teaching to enhance their performances.
- Deliberate efforts should be made by providing the necessary material that would facilitate the development and production of concept maps.
- Efforts should be made to encourage hard-working teachers in terms of promotion and other remuneration packages.

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