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## EFFECT OF USING CONCEPT MAPPING STRATEGY FOR HYDROCARBONS LESSONS ON STUDENTS' ACADEMIC ACHIEVEMENT IN CHEMISTRY

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### ABSTRACT

This study investigated the effect of the concept mapping strategy in the teaching of hydrocarbons lessons on students' academic achievement in chemistry. Quasi experimental research design was adopted and purposive sampling technique was used to select Obio/Akpor Local Government Area out of the twenty three (23) local government areas in Rivers State. Simple random sampling by balloting was used to obtain two (2) senior secondary schools. A second round of simple random sampling was used to obtain a sample size of one hundred and twenty (120) SS2 Chemistry student comprising 50 males and 70 females that participated in the study. Chemistry Achievement Test (CAT) was used for data collection. The data collected were analysed by using mean and standard deviation to answer all the research questions while Analysis of Covariance (ANCOVA) was used to test the hypotheses at .05 level of significance. The study found that, there is significant difference between the mean achievement scores of students exposed to hydrocarbons lessons by using concept mapping and lecture methods,  $P < .05$ . Gender do not have significant effect on students exposed to both concept mapping and lecture methods in chemistry,  $P > .05$ . the study recommends that, chemistry teachers should often use concept mapping strategy in their classrooms as it is gender friendly and can boost academic achievement of students in chemistry.

## **Introduction**

Chemistry as a branch of science is a veritable pivot of scientific literacy. It is a central science which a nation with vision can use to impact into the citizens, right technological knowledge, sustainable entrepreneurial skills, and the understanding of their environment that, will enable them live happily in order to perfect enviable self esteem. It is this vein that Akpan (2008) asserted that, nations at the forefront of modern development are those that invested enormous resources in three major areas which include; establishment and meeting of a stable, well supported science and technology system, promotion of mission oriented research in basic sciences, coupled with long term strategy for technology development; and institution of a large scientifically and technology literate workforce.

Furthermore, the immense importance of chemistry as a central science and as the hub of most technological activities cannot be ignored. To develop sound basis for the understanding of chemistry and modern technology among students, chemistry students at the secondary school level have to be taught chemistry topics with good innovative strategies. This step of using innovative strategies to teach chemistry topics is essentially needed for lessons on hydrocarbons that may look abstract to students. The use of innovative strategies like concept mapping, discovery cooperative and problem solving strategies can give human face to the lesson and make it to look quite real. The findings of many eminent scholars for the poor state of chemistry education have implicated poor teaching method as one of the major contributory factors for the decline in enrolment and poor achievement of students in chemistry.

Although, the research efforts of some scholars recommended the following useful strategies; Guided-enquiry by Nwagbo(1999); Demonstration by Ogologo and Wagbara (2013); problem solving by Chinwe (2014) and concept mapping by Ezeugo and Agwagah (2000) for effective teaching of the students. Okoye (1998) buttressed this idea by asserting that strategy is a design or steps used to achieve desired aims, objectives and goals of a lesson. Also, Igboegwu (2012) reported that, teachers' success in the classroom lies on the use of appropriate teaching strategies that can impart knowledge to the students.

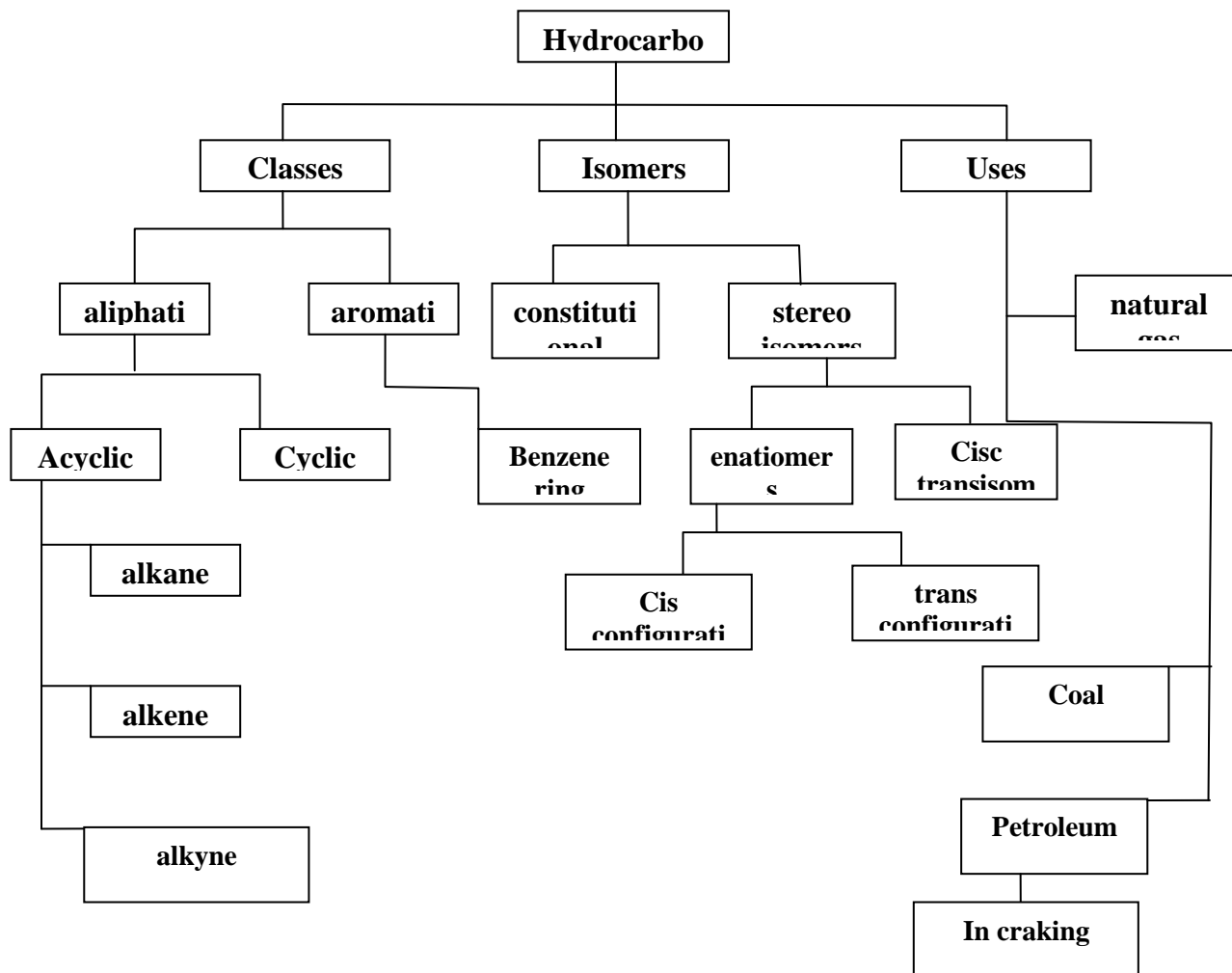
Furthermore, the fact that, chemistry is a subject that is made up of concepts that requires deep and complex mental process that involves visualizing, manipulating, analyzing, abstracting and associating ideas (Egbutu, 2014). It becomes pertinent to investigate the effect of using concept mapping in the teaching of lessons on hydrocarbons in chemistry. According to Ossai (2004) concept mapping is a graphical concept to show meaningful relationship among ideas being studied. Also, Inonnesia and Umeru (2003) asserted that concept mapping is an instructional strategy which extends the elements of observation inferring and classification to hierarchical structuring and construction. Okoro (2011) referred to concept mapping strategy as target task approach.

For this study, concept mapping is the graphical presentation of the key contents of the lesson in heuristic manner of using line graph to link th ideas or concepts from one to the other in a concise form for easy understanding of the students in chemistry. Concept mapping can be constructed by

- Listing the concepts, ideas in phases to be used.
- Arranging the concept main ideas in hierarchical order (enclosed in cycle or spheres)
- Link each concept to the other by using arrows or lines.
- Use a linkage word for describing the branch.

In the course of teaching hydrocarbon lesson by the use of concept map, the graphical representation of the following steps to define hydrocarbons could be used (classes, isomers and uses).

**FIG 1: A typical concept Map on hydrocarbons**



Another variable adopted in this study is gender. Gender is a social construct that could influence students' achievement in chemistry. Ferguson (2000) referred to gender as socially related qualities of masculinity and femininity which are attributed respectively to males and females. The concept of gender in this study was defined as the socially constructed characteristics or relationship between men and women in terms of both perception and material. Thus, Obi and Newen (2016) reported that a gender analysis of biographical data in Nigeria and many other countries shows that, the female gender is grossly under enrolled in the scientific and technological field. Okoli (2012) supported this idea by asserting that, relatively few women venture into men dominated disciplines, such as science, technology, engineering and other science base professions. In view of this, it becomes pertinent to also determine the gender effort of using concept mapping and lecture method for hydrocarbon lessons on students' academic achievement in chemistry.

## **Statement of the Problem**

Students' achievement in chemistry have been observed to be poor in terms of enrolment and academic performance in chemistry in internal and external examinations like WASSCE and NECO. A situation which was ascribed to ineffective teaching methods. In response to the above situation, several teaching methods have been suggested by science educators to uplift students' academic achievement in chemistry. In modern times there is a paradigm shift as instructional process has shift from teacher centered to student-centered-approach. Hence, teaching of science should be more activity oriented for maximum self development and fulfillment of the learners. In line with the above view the constructivist instructional approach like concept mapping which involves students into practical activities can improve their achievement in chemistry. Also, concept mapping may be suitable for the teaching of lessons on hydrocarbons as the students claim that hydrocarbons lessons are abstract in nature. In view of the above, the problem of this study border on the effect of concept mapping and lecture method on academic achievement of students in chemistry.

## **Purpose of the Study**

The mean purpose of this study was to investigate the effect of using concept mapping strategy for hydrocarbons lessons on students' academic achievement in chemistry.

Specifically the study sought to

1. determine the effect of concept mapping and lecture method in the teaching of hydrocarbon lessons on students' academic achievement in chemistry.
2. determine the effect of gender on academic achievement of students taught hydrocarbons lessons in chemistry by the use of lecture method.
3. determine the effect of gender on academic achievement of students taught hydrocarbons lessons in chemistry by the use of concept mapping strategy.

## **Research Questions**

The following research questions were formulated to guide the study:

1. What are the mean achievement scores of students exposed to hydrocarbons lessons in chemistry by the use of concept mapping strategy and those taught by the use of lecture method?
2. What are the mean achievement scores of male and female students exposed to hydrocarbons lessons in chemistry by the use of lecture method?
3. What are the mean achievement scores of male and female students exposed to hydrocarbon lessons in chemistry by the use of concept mapping strategy?

## **Hypotheses**

The following null hypotheses which were tested at .05 level of significance guided the study

HO<sub>1</sub>: There is no significant difference between the mean achievement scores of students taught hydrocarbons lessons in chemistry by using concept mapping and lecture methods.

HO<sub>2</sub>: There is no significant difference between the mean achievement scores of the male and female students taught hydrocarbons lessons in chemistry by using lecture method.

HO<sub>3</sub>: There is no significant difference between the mean achievement scores of the male and female students taught hydrocarbons lessons in chemistry by using concept mapping strategy.

## Methodology

Quasi experimental research design was adopted for this study. The research study was carried out in Obio/Akpor local government area of Rivers State. The local government area is in Rivers State central educational zone in Nigeria. Purposive sampling technique was used to select Obio/Akpor local government area out of the twenty three (23) Local Government Areas in Rivers State. Simple random sampling by balloting was used to select two(2) schools out of the twenty three(23), senior secondary schools in Obio/Akpor Local Government Area.

A sample size of one hundred and twenty (120) SS2 chemistry students comprising 50 males and 70 females participated in the study. The sample size was obtained by a second round of simple random sampling by balloting. Chemistry Achievement Test (CAT) was used to collect data for the study. The data collected were analyzed by using mean and standard deviation to answer all the research questions while the analysis of covalence (ANCOVA) was used to test the hypotheses at .05 level of significance.

## Results

### Research Question I

What are the mean achievement scores of students exposed to hydrocarbons lessons in chemistry by the use of concept mapping strategy and those taught by the use of lecture method?

**Table I: Mean and standard deviation achievement scores of students taught hydrocarbon lessons in chemistry by the use of concept mapping strategy and those taught by the use of lecture method.**

Teaching Method	N	Pretest Mean SD	Post-test Mean SD	Mean Gain
Concept Mapping	60	34.62 8.17	82.82 4.17	48.2
Lecture	60	34.42 8.4	82.23 10.2	47.81
Mean Difference				0.39

Table 1 has shown that, the mean score of the pretest in the concept mapping group was 34.62 with associated standard deviation of 8.17, while the mean score of the post test was 82.82 with standard deviation of 4.17. In the lecture method group, the pretest score was 34.42 with associated standard deviation score of 8.14 while, the mean score of the posttest was 82.23 with standard deviation of 10.2. The mean gain of the concept mapping group was 48.2 while that of lecture method group was 47.81. that shows that, the concept mapping group had a higher mean than the lecture method group with mean difference of 0.39. This indicates that, the students exposed to concept mapping strategy in the learning of hydrocarbons lessons did better than the exposed to lecture method in chemistry.

### Hypothesis 1

There is no significant difference between the mean achievement scores of students taught hydrocarbons lessons in chemistry by using concept mapping and lecture methods.

**Table 2: Analysis of Covariance (ANCOVA) of students' academic achievement mean scores in hydrocarbons lessons of those taught by the use of concept mapping and those taught by using lecture method.**

Source	Type III sum of squares	df	Mean Square	F	Sign.
Corrected	113121.451	2	5656.25	88.49	.000

model					
Intercept	33244.660	1	33244.660	578.100	.000
Pretest	2.242	1	2.242	.035	.852
Method	11273.223	1	11273.223	175.687	.000
Error	7507.474	117	64.16		
Total	650005.000	120			
Corrected					
Total	1881.925	119			

a.RSquare = 6011(Adjusted R.Squared = 594)

The result of Table 2 was used to determine whether the students' academic achievement scores of those taught by using concept mapping had any significant difference from those exposed to lecture method in hydrocarbons lessons in chemistry. Table 2 shows that an F-ratio of 175.68 with associated probability value of .00 were obtained. The probability value of .00 was compared with .05 and it was found to be significant as .00 was found to be significant as .00 was less than .05 ( $P < .05$ ). The null hypothesis one, ( $H_0$ ) was therefore rejected and inference drawn that, there is a significant difference between the mean achievement mean scores of students taught hydrocarbons lessons in chemistry by using concept mapping and lecture methods.

**Research Question 2:** What are the mean achievement scores of male and female students exposed to hydrocarbons lessons in chemistry by the use of lecture method?

**Table 3:** Mean and standard deviation achievement scores of male and female students exposed to hydrocarbons lessons in chemistry by using lecture method

Gender	N	Pretest		Post-test		Mean Gain
		Mean	SD	Mean	SD	
Male	25	29.44	7.62	61.96	5.350	32.52
Female	35	124.7	5.06	63.34	4.66	50.87
		Mean Difference				18.35

Table 3 shows that, the mean score of the males in the pretest group was 29.4 with associated standard deviation of 7.62 while, the mean score of the males in the post test group was 61.96 with standard deviation of 53.50.

The females of the pretest group had a mean score of 12.47 with associated standard deviation of 5.06 whereas the mean score of the posttest group was 63.34 with standard deviation of 4.66. this shows that, the females had a higher mean given as the mean given of the females was 50.87 while that of the males was 32.52 with mean difference of 18.35. This indicated that the females taught hydrocarbons lessons using lecture method did better than the males.

### Hypothesis 2

There is no significant difference between the mean achievement scores of male and female students taught hydrocarbons lessons in chemistry by using lecture method.

**Table 4:** Analysis of Covariance (ANCOVA) on significant difference between the mean

achievement scores of male and female students taught hydrocarbons lessons in chemistry by using lecture method.

Source	Type III sum of squares	df	Mean Square	F	Sign.
Corrected model	39.343	2	19.672	7.92	.458
Intercept	220840.573	1	220840.573	8893.596	.000
Pretest	11.455	1	11.455	.461	.500
Method	311.881	1	3.981	1.288	.261
Error	1415.390	.57	24.831		
Total	237838.000	60			
Corrected Total	1454.733	59			

a.RSquared=.027 (Adjusted RSquared=.007)

The result of Table 4 was used to determine whether gender has effect on achievement mean score of students who were taught hydrocarbon lessons in chemistry by using lecture method. Table 4 shows that, an F-ratio of 1.28 with associated probability value of .261 were obtained. The probability value of .216 was compared with .05 and it was found not to be significant because .216 was greater than .05 ( $P > .05$ ). The null hypothesis two, HO2 was therefore accepted and inference drawn that, there is no significant difference between the mean achievement scores of male and female students taught hydrocarbons lessons in chemistry by using lecture method.

### Research Question 3

What are the mean achievement scores of male and female students exposed to hydrocarbons lessons in chemistry by the use of concept mapping strategy?

**Table 5:** Mean and standard deviation achievement scores of male and female students taught hydrocarbons lessons in chemistry by using concept mapping strategy.

Gender	N	Pretest Mean SD	Post-test Mean SD	Mean Gain
Male	25	29.44 7.62	80.76 11.15	48.96
Female	35	124.7 5.06	82.51 10.07	48.40
		Mean Difference		0.56

Table 5 shows that, the mean score of the male students in the pretest group was 31.80 with associated standard deviation of 8.10 whereas, the mean score of the male students in the posttest group was 80.76 with standard deviation of the pretest group had a mean score of 34.11 with associated standard deviation of 8.37 while, the mean score of the posttest group was 82.51 with standard deviation of 10.07.

The result in Table 5 indicates that, the male group had a mean gain of 48.96 while the mean gain of the female group was 48.40. This shows that, the male students had a higher score with mean score difference of 0.56 in favour of the male students.

### Hypothesis 3

There is no significant difference between the mean achievement scores of the male and female students taught hydrocarbons lessons in chemistry by using concept mapping strategy.

**Table 6:** Analysis of Covariance (ANCOVA) of achievement mean scores of male and female

students taught hydrocarbons lessons in chemistry by using concept mapping strategy

Source	Type III sum of squares	df	Mean Square	F	Sign.
Corrected model	54.263	2	27.131	242	.786
Intercept	21976.402	1	21976.402	196.282	.000
Pretest	9.382	1	9.382	.084	.773
Gender	38.541	1	38.541	.344	.560
Error	8381.921	57	111.964		
Total	40774.000	60			
Corrected Total	643648.3	59			

a.RSquared=.008 (Adjusted RSquared=.062)

The result of Table 6 was used to determine whether gender have significant effect on academic achievement of student taught hydrocarbons lessons in chemistry. Table 6 shows that, an F-ratio of 344 with associated probability value of .56 were obtained. The probability of .56 was compared with .05 and it was found not to be significant as .56 was greater than .05 ( $P > .05$ ). the null hypothesis three,  $H_{03}$  was therefore accepted and inference drawn that, there is no significant difference between the mean achievement scores of the male and female students taught hydrocarbons lessons in chemistry by using concept mapping strategy.

### Discussion

The result of the analysis of covariance which was used to test hypothesis one,  $H_{01}$  was shown in Table 2 and yielded an F-ratio of 175.68 with associated probability value of .00. The result shows that  $P < .05$  which means that, there is significant difference between the mean achievement scores of students taught hydrocarbons lessons in chemistry by using concept mapping and lecture methods. Hence, the null hypothesis one,  $H_{01}$  which states that, there is no significant difference between the mean achievement scores of students taught hydrocarbons lessons by using concept mapping and lecture methods in chemistry was rejected. The findings of this study agree with the findings of Orji, Orevaoghene and Ndidi (2017) as they reported that, concept map strategy is superior to lecture method in promoting students' attitude towards motion in physics. This study have confirmed that concept map strategy have more significant effect on students' mean score in hydrocarbons lessons in chemistry than lecture method. Njoku and Bob-Manuel (2013) also supported the findings of this study as they asserted that concept mapping is an effective teaching method to pass information in Biology easily to the students.

Table 4 shows that an F-ratio of 1.288 with associated probability value of .26 were obtained. The result showed that gender does not have significant effect on achievement scores of the students taught hydrocarbons lessons using lecture method in chemistry as  $P > .05$ . Hence, the null hypothesis two which states that, there is no significant difference between the mean achievement scores of male and female students taught hydrocarbons lessons in Chemistry by using lcture method was accepted. The result of this study have confirmed that, there was no significant difference between the mean achievement scores of the male and female students exposed to hydrocarbons lessons by using lecture method.

Table 6 has shown that an F-ratio of .34 and associated probability value of .56 were obtained. The result of the study do not have significant effect on the students in the learning of hydrocarbons lessons by the use of concept mapping strategy as  $P > .05$ . Hence, the null



hypothesis three, (HO3) which states that, there is no significant difference between the mean achievement scores of the male and female students exposed to hydrocarbons lessons in chemistry by using concept mapping strategy was accepted. The findings of this study was in line with the findings of Orji, Orevaoghene & Ndidi (2017) as they asserted that gender do not have significant effect on students in the learning of motion in physics by the use of concept mapping strategy. This study have confirmed that, there is no significant difference between the mean achievement scores of the male and female students taught hydrocarbons lessons in chemistry by using concept mapping strategy.

### **Conclusion**

Firstly, the result of this study shows that, there is significant difference between the mean achievement scores of students exposed to hydrocarbons lessons by using concept mapping strategy and lecture method. The students taught by using concept map did better than those taught by the use of lecture method. Secondly, the result of the study found that gender do not have significant effect in the mean scores of students who were exposed to lecture method in hydrocarbons lessons in chemistry. Thirdly, gender do not also, have significant effect on academic achievement mean scores of students who were exposed to hydrocarbons lessons in chemistry by using concept mapping strategy.

### **Recommendations**

1. Teachers should imbibe the knowledge of the use of concept map as a common teaching method that should often be used in the classroom as it is activity based teaching strategy and gender friendly.
2. Teachers should undergo training on how to use concept mapping strategy in teaching for better mastery of the usage of concept map.

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