

## EFFECTS OF CONCEPT MAPPING STRATEGY ON SENIOR SECONDARY TWO STUDENTS' RETENTION IN REDOX REACTIONS IN JOS NORTH, PLATEAU STATE, NIGERIA

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### ABSTRACT

*The study investigated the effects of concept mapping strategy on senior secondary two students' retention in redox reactions in Jos North, Plateau State, Nigeria. Two research questions and two hypotheses guided the study. The study adopted Quasi-experimental design of the non-equivalent control; group design. The population of the study comprised 3088 students for 2022/2023 academic session studying Chemistry as a subject. A sample of 167 students, consisting of 82 female and 85 male students were drawn from two public senior secondary schools. Purposive sampling technique was used to select the two public senior secondary schools. The instrument used for data collection was Redox Reaction Retention Test (RRRT) with reliability coefficient of 0.77. RRRT was adopted from the West African Examination Council past questions and answers. The test consisted of 25 objective items. Mean and standard deviation (SD) were used to analyze the collected data to answer the research questions, ANCOVA was used to test the null hypotheses at 0.05 level of significance. The findings of the study revealed that there was a significant difference in the mean retention scores of students taught redox reaction using concept mapping strategy and those taught using lecture method in favour of the student taught using concept mapping. With respect to gender, there was a significant difference in the mean retention score of male and female students taught Chemistry using concept mapping teaching strategy. Going by the findings, it was concluded that, the use of concept mapping teaching strategy enhanced students' retention in Chemistry more than the lecture method. It was therefore, recommended that Chemistry teachers should be encouraged to use concept mapping in teaching and learning to improve students' retention in redox reaction.*

**KEYWORDS: Gender, Redox Reaction, Retention, Teaching Strategy**

### INTRODUCTION

Chemistry is widely perceived as an abstract and difficult subject by both students and teachers. As such, most students essentially engage in rote learning (Boujaoude, & Barakat, 2000). Ojokuku (2012) stressed that chemistry occupies a central position among the sciences due to its remarkable contribution in medicine, pharmacy, textile industry, engineering, petroleum and agriculture, among others. In the sciences, effective teaching strategies are important for fostering deep understanding and retention of complex concepts. Redox reactions, a fundamental topic in chemistry, often pose significant challenges for students due to their abstract nature and the intricate balance of oxidation and reduction processes. The instructional strategies are important determinants of students' retention. This is due to the fact that various topics to be taught, as well as students' cognitive readiness, behaviour, and abilities to be developed, necessitate a wide range of teaching methodologies. To this effect, some researchers (e.g. Omeiza, 2019; Okoro, 2011) propose the use of activity-based teaching strategies, rather than teacher-centered instructional methods. The authors maintained that activity-based teaching strategies such as concept mapping, among others, stand a greater chance of positively promoting learners' retention

Concept mapping, a visual representation of knowledge, has been suggested as a potential strategy to enhance comprehension and retention (Karakuyu, 2010). Concept Mapping (CM) is a model of instructional strategy developed by Novak and his associates at Cornell University in the early 70s as a means of organizing and representing knowledge (Novak, 1998). It is a strategy by which concepts are organized by showing their relationship from more inclusive to more specific concepts using concept maps (Novak & Gowin, 1984; Chiou, Lee, & Wang, 2017). This enables both teachers and students not only to select, organize, and represent subject matter concisely but also to observe, infer, classify and construct meanings from concepts in hierarchy easily and meaningfully (Filgona et al., 2016). As forms of graphical organizers, concept maps help students to visualize the relationship between various concepts and their meanings and how the concepts are exemplified in theory and practice. To make a decent concept map, the authors propose connecting the concepts with a line and labeling the lines with one of a few linking words that clarify the relationship between the two concepts so that they may be interpreted as a statement or proposition (Novak, 1998). A study indicated that redox reaction poses unique and formidable challenges to students.

Redox (Oxidation and reduction) reaction is a very fundamental topic in Chemistry. Redox is a term coined from the words reduction and oxidation. An oxidation-reduction chemical reaction (or redox reaction) involves the transfer of electrons between two reactants. Oxidation is the loss of electrons. Reduction is the gain of electrons. Oxidation-reduction reaction is any chemical reaction in which the oxidation number of a molecule, atom, or ion changes by gaining or losing an electron. (Gutierrez, & Ross, 2023). The term "redox" is a short form of reduction-oxidation. All the redox reactions can be broken down into two different processes: a reduction process and an oxidation process (Main, 2021). The author further opined that electron-accepting species which tend to undergo a reduction in redox reactions are called oxidizing agents. An electron-donating species which tends to hand over electrons can be referred to as a reducing agent. Traditional teaching methods sometimes fail to address challenges, leading to retention. Retention is the foundational engine that propels individuals and organizations towards progress and innovation. We cannot change, grow or improve without it. Indeed, this process is at the heart of all effective learning and skill acquisition. Retention is our ability to preserve information or skills learned over time. This goes beyond short-term memorisation (Clope, 2024).

Gender refers to the socially constructed roles and relationships, personality traits, attitudes, behaviors, values, relative power and influence that society ascribes to sexes on a differential basis. Gender is relational and refers not simply to women or men, but to the relationship between them (Educationlinks, 2018). The author further refers to gender as the biological characteristics that define humans as female or male.

## **STATEMENT OF THE PROBLEM**

The concept of redox reaction has been a challenging topic for most Senior High School students, and many of students' lack understanding in writing chemical symbols and formulae. Through different activities like class work, individual and group activities, and tests on the redox reactions. The students perform poorly in the concept of writing chemical formulae as well as reactions. It was also observed through class exercises that 30% of the students could write correctly the ionic chemical symbol and oxidation number. (Mayeem, Somarid, & Abu, 2023). In addition, the WASSCE Chief Examiner's Report on Chemistry has continuously identified the concept of oxidation-reduction reactions as one of the difficult areas for most students. For instance, in 2016, the Chief Examiner's Report explained that although candidates were able to correctly identify the oxidation and reduction reaction, the candidates could not write the correct balanced half-cell reactions.

Redox reactions are common and vital to some of the basic functions of life, including photosynthesis, respiration, combustion and corrosion or rusting (Christopher, Christina & Luvleen, 2016). Many factors were considered to influence the retention of chemistry students; among these are teachers and students' attitude, instructional strategies and traditional teaching method employed by chemistry teachers. This necessitated the researcher to investigate the effects of concept mapping strategy on senior secondary two students' retention in Redox reaction in Jos North, Plateau state. Nigeria.

**OBJECTIVES OF THE STUDY**

1. To ascertain the difference in the retention mean scores of students taught redox reaction using concept mapping strategy and those taught using lecture method?
2. To determine the effect of gender on the retention mean scores of students taught redox reaction using concept mapping strategy and those taught using lecture methods.

**RESEARCH QUESTIONS**

1. What is the difference in the retention mean scores of students taught redox reaction using concept mapping strategy and those taught using lecture method?
2. What is the effect of gender on the retention mean scores of students taught redox reaction using concept mapping strategy and those taught using lecture method

**HYPOTHESES**

The following hypotheses were stated and tested at 0.05 levels of significance.

1. There is no significant difference in the retention mean scores of students taught redox reaction using concept mapping teaching strategy and those taught using lecture methods.
2. There is no significant effect of gender on the retention mean scores of Students taught redox reaction using concept mapping teaching strategy and those taught using lecture methods

**RESULTS**

**Research Question One:** What is the difference in the mean retention scores of students taught redox reaction using concept mapping teaching strategy and those taught using lecture method?

Data in Table 1 are used to answer this research question.

**Table 1: Analysis of Retention Posttest Means and Standard Deviations Scores for Redox Reaction Retention Test RRRT of the Experimental and Control Groups**

	Group	N	Mean	Std. Deviation	Std. Error Mean	Mean Difference
	Experimental	85	79.84	2.454	.266	40.45
	Control	82	39.39	7.043	.778	

Table 1 revealed that the post- post-test means and standard deviations of students for RRAT scores of experimental group were 79.84 and 2.454 while that control group had 39.39 and 7.043. The mean score difference was 40.45 in favour of the experimental group

**Research Question Two:** What is the effect of gender on the mean retention scores of Students taught redox reaction using concept mapping teaching strategy and those taught using lecture method

Data presented in Table 2 were used to answer research question two.

**Table 2: Analysis of Retention Post-Test Means and Standard Deviations Scores for RRRT in the Experimental Group for Male And Female Students**

	Group	N	Mean	Std. Deviation	Std. Error Mean	Mean Difference
	Female	41	79.85	2.51	.391	0.035
	Male	44	79.82	2.43	.367	

Table 2 revealed that the post-post-test mean scores and standard deviations of students of RRAT for male students were 79.85 and 2.506 while that of female students were 79.82 and 2.43. The mean score difference was 0.03 in favour of female students.

**Hypothesis One:** There is no significant difference in the mean retention scores of students taught redox reaction using concept mapping teaching strategy and those taught using lecture method

To test hypothesis three, the scores of experimental the control and groups were subjected to Analysis of Covariance (ANCOVA). The result in Table 3 were used to test hypothesis one.

**Table 3: ANCOVA Analysis of the Retention Post-test Mean Scores for RRRT of the Experimental and Control Groups**

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	68300.261 <sup>a</sup>	2	34150.131	1245.78	.000
Intercept	20742.825	1	20742.825	756.693	.000
Pretest	27.563	1	27.563	1.006	.317
Group	67940.338	1	67940.338	2478.44	.000
Error	4495.643	164	27.412		
Total	673516.000	167			
Corrected Total	72795.904	166			

R Squared = .938 (Adjusted R Squared = .937)

Table 3 revealed that the F-value obtained was 2478.44; adjusted R Squared observed was 0.855 and the p-value of 0.000 was observed. Since the obtained p-value of 0.000 is less than the alpha value of 0.05, thus the study rejected the null hypothesis three, that says there is no significant difference in the mean retention scores of students taught redox reaction using concept mapping teaching strategy and those taught using lecture methods. The decision implies that, there is significant difference in the mean retention scores of students taught redox reaction using concept mapping teaching strategy and those taught using lecture methods in favour of experimental group. This indicated that treatment has effect on retention in redox reaction ( $F(1, 166) = 2478.44, P = 0.00$ ).

**Hypothesis Two:** There is no significant effect of gender on the mean retention scores of Students taught redox reaction using concept mapping teaching strategy and those taught using lecture method

Data in Table 4 were used to test this hypothesis.

**Table 4: ANCOVA Analysis of the Retention Posttest Mean Scores for RRRT in the Experimental Group of Male and Female Students**

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	11.946 <sup>a</sup>	2	5.973	.992	.375
Intercept	16763.743	1	16763.743	2784.06	.000
Pre-test	11.919	1	11.919	1.980	.163
Group	.025	1	.025	.004	.949
Error	493.748	82	6.021		
Total	542268.000	85			
Corrected Total	505.694	84			

R Squared = .024 (Adjusted R Squared = .006)

Table 4 revealed that the F-value obtained was 0.04; adjusted R Squared observed was 0.006 and the p-value of 0.949 was observed. Since the obtained p-value of 0.949 is greater than the alpha value of 0.05, thus the study retained the null hypothesis four, that says there is no significant effect of gender on the mean retention scores of Students taught redox reaction using concept mapping teaching strategy and those taught using lecture method. The decision implies that, male and female students performed significantly similar in retention for redox reaction after treatment with concept mapping teaching strategy. This indicated that treatment has no effect on students' retention for redox reaction with gender ( $F(1, 85) = 0.004, P = 0.949$ )

## DISCUSSION

The findings of the study indicated that there was significant difference in the mean retention scores of students taught redox reaction using concept mapping teaching strategy and those taught using lecture method in favour of the experimental group. This indicated that treatment had effect on retention in redox reaction. The findings agree with Agaba, (2013) whose work dealt with the effect of concept mapping instructional strategy on students' retention in Biology in Enugu Educational Zone, Enugu state, Nigeria.

Finally, the finding revealed that there was no significant effect of gender on the mean retention scores of students taught redox reaction using concept mapping teaching strategy and those taught using lecture method. This finding means that male and female students performed significantly similar in retention for redox reaction after treatment. This finding agrees with that of Adeniran, Ochu, and Atoo, (2018) which examined the effect of concept mapping strategy on students' retention in Basic science. However, the result contradicts that of Yakubu, Samuel, Abdulkadi, and Yakubu, (2019), whose study determined the effects of concept - mapping strategy on achievement and retention in mole concept among secondary school students in Kaduna state.

## CONCLUSION AND RECOMMENDATIONS

Based on the findings of the research, it can be concluded that concept mapping teaching strategy improves students' achievement in redox reaction of students. Concept mapping teaching strategy fosters students' retention in redox reaction of students, as there was significant difference between the post-test achievements mean scores of the control and experimental groups in redox reaction retention mean scores. Concept mapping teaching strategy is a gender friendly strategy for enhancing the retention of students, as it revealed no significant gender difference in retention mean scores

Based on the findings, the following recommendations are made:

1. Since concept mapping is found to be an effective strategy and enhances achievement and retention among chemistry students, teachers need to use it in the classroom.
2. Concept mapping method should be incorporated in the teaching of chemistry and other science subjects for meaningful.
3. Workshops should be organized for in-service and practicing teachers on how to use concept mapping strategy
4. Teachers of senior secondary schools should expose students to concept mapping instructional strategy to promote the retention of both male and female students.

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