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# Effect of Metacognitive Teaching Strategies on Chemistry Students' Academic Performance in Organic Compounds Nomenclature in Senior Secondary School in Ikwerre Local Government Area

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**ABSTRACT**
The study examined the effect of metacognitive teaching strategy such as modelling thinking and explicit metacognitive strategy on chemistry students academic performance in organic compounds nomenclature. To achieve the purpose of the study, the researcher formulated four (4) objectives of the study, four (4) research questions and four (4) null hypotheses that guided the study. The research design used was a quasi-experimental design. The population of the study consists of 3,685 of SS2 students in Ikwerre Local Government Area of Rivers State. The sample size of the study was 359 SS 2 students. The sampling technique used was purposive sampling technique. One instrument and three lesson packages were developed for the study. The data gathered were analyzed using mean and standard deviation for the research questions while inferential statistics (analysis of variance, ANOVA and post hoc analysis) were used for the test of hypotheses at 0.05 level of significance. Based on the data analysis, the findings of the study revealed that there is significant effect of modelling thinking as a metacognitive teaching strategy on student academic performance in organic compounds nomenclature compared to discussion strategy and there is positive effect of explicit teaching as a metacognitive teaching strategy on student academic performance in organic compounds nomenclature compared to discussion strategy. However, the researcher recommends that: The teachers should adopt modeling thinking as a Metacognitive teaching strategy, hence it helps to improve students academic performance and government, through the school management should organize seminar or workshop programme for teachers on the effect of explicit teaching as a metacognitive teaching strategy.
**Keywords**: Effect, Metacognitive, Teaching Strategy, Modelling Thinking, Explicit, Chemistry Students

## INTRODUCTION

Chemistry is a branch of science that deals with the study of matter, its composition, structures, properties and uses of matter, it probes into the principles governing the changes that matter undergo. Chemistry holds a pivotal position as a pure science due to its profound applications across various

other scientific disciplines. It is the bedrock of technological advancement which has brought dramatic improvements in the standard of living of men. Chemistry helps to develop in the individual, the skills of critical observation, experimentation, manipulation of variables, critical analysis as well as making deductions which are very important in the investigation of scientific processes (LongJohn & Pepple, 2010). Organic chemistry is the study of the structure, properties, composition, reactions, and preparation of carbon containing compounds. It is a field that is also important to technology. It is the chemistry of dyes, drugs, paper and ink, paints plastics, gasoline and rubber. It is the chemistry of the food we eat and the cloths we wear.

The poor performance in chemistry at the secondary school level is attributed to dearth in science resources. They assert that for students to achieve better performance in chemistry, instructional materials should be provided in chemistry because chemistry requires real objects and activities/experiment that can convert topics that seem imaginary to concrete for students understanding. Students see the sciences especially chemistry and physics as hard subjects. This lead to a decline in interest for sciences. Okeke (2010) found out that poor and ineffective instructional strategies are major factors responsible for the recorded poor performance and declined interest in chemistry.

West Africa Examinations Council Chief Examiners report of 2019-2021 indicate that candidates' poor performance in organic chemistry as a result of their inability to draw correct structure of organic compounds and name them using the IUPAC nomenclature. It indicates that the instructional strategies adopted by the teacher are a major cause of poor performance in chemistry. Such methods have been in use by chemistry teachers for many decades. They include: lecture, discussion, questioning, problem-solving, play way, field trip, discovery, demonstration and projects method among others.

Discussion method is a free and unrestricted consideration of a problem or problems by a cooperative group of persons talking together under the direction of the teacher. Ogbeba & Adagba (2013) defines discussion method of teaching as the method that involves group of students who interact to exchange ideas, facts, opinions and verbal expression about a topic of interest or outmost concern under the guidance of a teacher. Discussion method gives every member of the class or group the freehand to freely express his or her views. Chinda (2011) asserts that discussion method enables learners to acquire critical and evaluative thinking and listening skill and affords them some confidence through active participation.

**Concept of Metacognition**

Ormod (2004) defines metacognition as what we know about our cognitive process and how we use these processes in order to learn and remember. It is ones knowledge concerning one's own cognition process and products or anything related to them. It is a higher order of thinking about thinking. Metacognition is generally defined as the activity of monitoring and controlling one's cognition. It is a regulatory system that helps a person understand and control his or her own cognitive performance, Metacognition is a process which the learner uses to enhance his performance. It can be perceived as skills, abilities and attitudes the learner uses to achieve a desired goal. Metacognition involve critical thinking above the ordinary level of thinking. Metacognition is a self regulatory, intrinsic and inner motivation of a learner to learn. It is a cognitive force which drives a learner to learn. It is the awareness of a learner on how he can perform his cognitive tasks.

According to Koch (2001), metacognition is a hidden level of behaviour that involves focusing on thinking about thinking and its relation to intellectual performances. In another development, Rickey and Stacy (2000) see metacognition as monitoring and controlling one's mental processing. Metacognition is derived from the Greek word "Meta" meaning moving something or some idea from one place to another. Metacognition literally means a moving cognition i.e. cognition that is put in action or active thinking.

Metacognition helps students to develop meaningful skill such as; manipulative skills, creative skills, retaining information and using information to solve identified problems in metacognitive learning students develop a plan for learning the content, monitor their learning process through reflection, and

adjust their plan accordingly, (self-regulate) in order to ensure deeper, more durable and more transferable learning. Metacognition is important for successful learning; the learner can manage their cognitive skills and determine ways of correcting their weakness by providing, cognitive skills.

Metacognitive regulation is another component of metacognition. It involves the various actions or skills that help to control one's thinking or learning. It is the higher order control of one's cognition or process, a learner implores in order to control his or her own cognition. Metacognitive regulation involves setting goals and planning, monitoring and controlling, learning and evaluating ones own regulation (assessing results and strategies used) (Malamed, 2015). Regulation and control involves planning, monitoring and evaluation.

**Self-regulation**

Self- regulation is another term synonymous to metacognitive regulation. It is the ability to control your behaviour and manage your thoughts and emotions in appropriate ways. Most researchers like Zimmerman (2002) see self- regulation as a separate emit. Self- regulation refers to self-generated thoughts, feelings and actions that are planned and systematically adopted to affect one's learning and motivation. It is refers to as the ability to control one's behavior, emotions, and thoughts in the pursuit of long term goals. Self- regulation is also a set of activities that help learners to control their learning.

Self- regulation is a metacognitive, motivational and behavioural process which makes learners to learn. Self- regulation is an inner drive that compels a learner to learn at a higher interest. It can also be referred to as intrinsic motivation interspersed with metacognitive regulation. Self- regulation is constructed by the individual, aided by the integration of learning goals in order to enhance performance. Self-regulation refers to individual learner's ability to understand and control one's own learning environment (Cetin, 2015).

**Importance of Metacognition**

Metacognition which is an inner awareness of a persons cognitive process can be used to achieve success from primary school through the university. It also allows students to be more expert-like in their thinking and more effective and efficient in their learning. Metacognition helps a learner to think critically about our cognitive process. Metacognition will help us to think about cognitive strategies that can help learning take place. It helps learners to be in charge of their own learning.

Metacognition gives students the opportunity to plan their learning through the use of their prior knowledge as they explore, develop and reinforce their understanding of principles. Metacognition helps learners to monitor and control their mental processes since the learner is personally involved and can provide strategies that can control his or her mental process. Loveth (2016) finds out that students who believe that they could succeed academically have higher motivational persistence in learning tasks. She adds that making students aware, that is, self-regulation can make their brain "smarter"

Self- regulation affects children's ability to successfully function in the school setting in two ways. Social and emotional self regulation makes it possible for children to conform to classroom rules and benefit from learning in various social content; it could be one- to- one interaction to larger groups. The cognitive self-regulation allows children to use and further develop the process necessary for academic learning and problem solving. Metacognition helps students to transmit their knowledge and understanding across tasks and contexts, including reading comprehension and writing.

Metacognition helps in the evaluation of cognitive processes. It involves finding out whether a cognitive process has achieved the desired goals. When these goals have been achieved, it means the learner is in charge of his cognitive process. Metacognition helps learners to develop meaningful skills such as manipulative skills, retaining information, applying information and using information to solve identified problems. It 'encourages learners to find out strategies they will employ to perform tasks easier and better. These strategies are known as metacognitive strategies.

**Metacognitive Teaching strategies**

Metacognitive strategies empowers students to think about their own thinking. They are techniques that helps students develop an awareness of their thinking processes as they learn. It is a term used in information processing theory to indicate "executive function" and it refers to strategies that are used by learners to manage and evaluate their learning activities. They are skills that the teacher and learner use to achieve desired goals. Metacognitive teaching strategies are strategies the teacher uses to help the learner plan, monitor aid evaluate his or her cognitive activities. However, Jayapraba (2013) sees metacognitive strategies as a sequential processes used to provide control in learning and in reaching ones goal. She adds. that metacognitive strategies are ordered processes used to control one's own cognitive activities and to ensure that a cognitive goal has been met. These strategies stare up learners thinking and lead to high performance.

**Importance of Metacognitive Teaching Strategies**

Metacognitive strategies are strategies which the teacher and learners use to develop metacognitive processes in the course of learning. China (2011) say that metacognitive teaching strategies fall under constructive perspective teaching style which holds that students must be actively engaged in the learning process and that they should not be reduced to the level of passive receivers of information

The use of metacognitive strategies empowers the students with tools that they need in order to learn and develop meaningful skills such as retaining information, applying information and creativity in problem solving. The use of these strategies in teaching helps learners to plan, monitor and evaluate their learning which lead to a self -regulated learner It empowers the learner to know which strategy suits him or her in any lesson that is to be learnt. The learner is empowered to evaluate himself or herself before the evaluation by the teacher. Metacognitive strategies in chemistry teaching will help students to improve on their competence with regard to solving complex problems. A study conducted by Koch (2001) to see whether general chemistry students would in1prove their performance after being taught metacognitive learning skill shows that it made chemistry students to learn better, retain and apply knowledge which improves their performance. In the same vein, Cetin (2015) found out that students taught metacognition in the classroom performed better on the last examination as opposed to those who were taught using the traditional lecture method.

Based on the importance of metacognitive strategies in teaching and learning, this study is to find out the effect of self- assessment and thinking aloud metacognitive teaching strategies on chemistry students' academic performance in organic compounds nomenclature. Metacognition refers to the awareness and understanding of ones' own thought processes. Metacognitive teaching strategies aim to help students develop their metacognitive skills, which can lead to improved learning outcomes. Modelling thinking is showing the students your thinking process by demonstrating it practically and aloud right there in front of the class. it refers to showing the students what you want them to do by doing it yourself.

**Statement of the Problem**

Chemistry is an important subject in science, over the years the academic performance of students in chemistry has been poor. The West Africa Examination Council (WAEC 2019, 2020, 2021) Chief Examiners annual report in chemistry specifically noted that questions on organic chemistry were not of popular choice among chemistry students and candidates who attempted it did not perform well. From the chief examiners report it was quite clear that candidates had difficulties writing and naming organic structures. According to the report, students inability to accurately draw organic compound structures and name them using the IUPAC nomenclature is the reason for failure in organic chemistry. However, the students inability to name organic compounds could be attributed to instructional strategies adopted by teachers of chemistry. Therefore, the problem of this study is to examine the effectiveness of modelling thinking and explicit Metacognitive teaching strategies on the academic performance of secondary school students in chemistry, with a particular focus on their understanding and mastery of organic Compounds nomenclature.

**Purpose of the study**

The purpose of this study is to determine the effect of metacognitive teaching strategy such as modelling thinking and explicit metacognitive strategy on chemistry students academic performance in organic compounds nomenclature. Specifically, the study aimed at determining:

1 The effect of modelling thinking as a metacognitive teaching strategy and discussion method on students academic performance in organic compounds nomenclature.
2 The effect of explicit teaching as a metacognitive teaching strategy and discussion method on students academic performance in organic compounds nomenclature.
3 The academic performance of male and female students taught using modelling thinking as a Metacognitive teaching strategy and discussion method in organic compounds nomenclature.
4 The academic performance of male and female students taught using explicit teaching as a metacognitive teaching strategy and discussion method in organic compounds nomenclature.

**Research Questions**

The research is guided by the following questions:

1 what is the effect of modelling thinking as a metacognitive teaching strategy and discussion method on student academic performance in organic compounds nomenclature.
2 What is the effect of explicit teaching as a metacognitive teaching strategy and discussion method on student academic performance in organic compounds nomenclature.
3 What is the academic performance of male and female students taught using modelling thinking as a Metacognitive teaching strategy and discussion method in organic compounds nomenclature.
4 What is the academic performance of male and female students taught using explicit teaching as a Metacognitive teaching strategy and discussion method in organic compounds nomenclature.

**Hypothesis**

The following null hypothesis were raised as a guide to this study.

1 There is no significant difference between pretest and post test scores of students who were taught organic compound nomenclature using the modelling thinking metacognitive teaching strategy compared to those taught using discussion strategy.
2 There is no significant difference between pretest and post test scores of students taught organic compounds nomenclature with explicit metacognitive teaching strategy compared to those taught using discussion strategy.
3 There is no significant difference between pretest and post test scores of male and female students who were taught using modelling thinking as a Metacognitive teaching strategy and those taught using discussion strategy in organic compounds nomenclature.
4. There is no significant difference between pretest and post test scores of male and female students who were taught using explicit teaching as a Metacognitive teaching strategy and those taught using discussion strategy in organic compounds nomenclature.

**METHODOLOGY**

The design for this study is a quasi-experimental designs. Nwankwo (2013) defined quasi –experimental design as partly true experimental design but it does not employ randomization procedure during assignment of subjects to groups. Specifically, this study adopted the pre-test post-test control group. The population of this study comprises of all the senior secondary two (SS2) chemistry students in all public schools in Ikwerre Local Government Area of Rivers State. There were 3,685 of SS2 students in Ikwerre Local Government Area. Total number of male students consist of one thousand seven hundred and fifty one (1,751) and total number of female students consist of one thousand nine hundred and two students (1,902). (Rivers State Senior Secondary Schools Board 2023). The sample size for the study was 359 from 3 senior secondary two (SS2) students selected using purposive sampling technique. Simple random sampling technique was then used to draw 3 senior secondary schools out of 16 public secondary schools in Local Government.

Thereafter, the SS2 classes of the selected secondary schools constituted the respondents for the study. The three schools and their SS2 students were randomly assigned to experimental and control groups. The schools were: Experimental group 1 with 171 SS2 students**,** Experimental group 2 with 100 SS2 students**,** Control group with 88 SS2 students and Giving a total of 359 SS2 students. The instrument for data collection was Organic Chemistry Nomenclature Performance Test (OCNPT). The data collected for the study were analyzed using mean and standard deviation to answer the research questions, while Inferential statistics (Analysis of Variance, ANOVA and Post hoc Analysis) were used to test the hypotheses at 0.05 level of significance.

**RESULTS**

**Research Questions** 1: *What is the effect of modelling thinking as a metacognitive teaching strategy and discussion method on student academic performance in organic compounds nomenclature?*

**Table 1: Mean and Standard Deviation analysis on the effect of modelling thinking as a metacognitive teaching strategy and discussion method on student academic performance in organic compounds nomenclature.**

| S/No | Group | | Pre-test | | Post-test | | Grand Mean |
|---|---|---|---|---|---|---|---|
| | | N | Mean $\overline{X}$ | SD | Mean $\overline{X}$ | SD | |
| 1. | Modelling Thinking Learning (Experimental group) | 271 | 2.74 | 0.82 | 2.86 | 0.84 | 0.83 |
| 2. | Discussion Method (Control Group) | 88 | 2.52 | 0.79 | 2.58 | 0.80 | 0.80 |

**Source:** Field Survey 2024.

The data analysis in table 1 above reveals that grand mean score of 0.83 and 0.80 was achieved between modelling thinking as a metacognitive teaching strategy and discussion method in their pretest and post test scores. This implies that there is positive effects of modelling thinking as a metacognitive teaching strategy on student academic performance in organic compounds nomenclature over the discussion method.

**Research Question 2:** *What is the effect of explicit teaching as a metacognitive teaching strategy and discussion method on student academic performance in organic compounds nomenclature?*

**Table 2: Mean and Standard Deviation analysis on the effect of explicit teaching as a metacognitive teaching strategy and discussion method on student academic performance in organic compounds nomenclature.**

| S/No | Group | | Pre-test | | Post-test | | |
|---|---|---|---|---|---|---|---|
| | | N | Mean $\overline{X}$ | SD | Mean $\overline{X}$ | SD | Grand Mean |
| 1. | Explicit Teaching (Experimental group) | 271 | 2.80 | 0.84 | 2.90 | 0.85 | 0.85 |
| 2. | Discussion method (Control Group) | 88 | 2.70 | 0.82 | 2.80 | 0.84 | 0.83 |

**Source:** Field Survey 2024.

The data analysis in table 2 above indicates that the grand mean of 0.85 and 0.83 was achieved between explicit teaching as a metacognitive teaching strategy and discussion method in their pretest and post test

scores. This implies that there is significant effect of explicit teaching as a metacognitive teaching strategy on student academic performance in organic compounds nomenclature compared to discussion strategy.

**Research Questions 3**: *What is the academic performance of male and female students taught using modelling thinking as a Metacognitive teaching strategy and discussion method in organic compounds nomenclature?*

**Table 3: Mean and Standard Deviation Analysis on the academic performance of male and female students taught using modelling thinking as a Metacognitive teaching strategy and discussion method in organic compounds nomenclature**

| S/No | Group | | Pre-test | | Post-test | | Grand Mean |
|---|---|---|---|---|---|---|---|
| | | N | Mean $\overline{X}$ | SD | Mean $\overline{X}$ | SD | |
| 1. | Male Students (Experimental group) | 271 | 2.86 | 0.85 | 2.94 | 0.86 | 0.86 |
| 2. | Female Students (Control Group) | 88 | 2.58 | 0.80 | 2.62 | 0.81 | 0.81 |

**Source:** Field Survey 2024.

The data analysis in table 3 above reveals that grand mean score of 0.86 and 0.81 was achieved between male and female students in their pretest and post test scores. This implies that there is positive academic performance of male students taught using modelling thinking as a Metacognitive teaching strategy in organic compounds nomenclature over the female students.

**Research Question 4:** *What is the academic performance of male and female students taught using explicit teaching as a Metacognitive teaching strategy and discussion method in organic compounds nomenclature?*

**Table 4: Mean and Standard Deviation analysis on the academic performance of male and female students taught using explicit teaching as a Metacognitive teaching strategy and discussion method in organic compounds nomenclature**

| S/No | Group | | Pre-test | | Post-test | | |
|---|---|---|---|---|---|---|---|
| | | N | Mean $\overline{X}$ | SD | Mean $\overline{X}$ | SD | Grand Mean |
| 1. | Male Students (Experimental group) | 271 | 2.70 | 0.82 | 2.90 | 0.85 | 0.84 |
| 2. | Female Students (Control Group) | 88 | 2.55 | 0.80 | 2.70 | 0.82 | 0.81 |

**Source:** Field Survey 2024.

The data analysis in table 4 above indicates that the grand mean of 0.84 and 0.81 was achieved between the academic performance of male and female students taught using explicit teaching as a Metacognitive teaching strategy in organic compounds nomenclature. This implies that the mean score of the male students academic performance was higher than the female mean score.

**Test of Hypothesis**

Salkind (2010) gives the following parameters as the benchmark for interpreting correlation coefficient (r)

± 0.80 - 1.00 Very Strong Relationship
±0.60 - 0.79 Strong Relationship
±0.40 - 0.59 Moderate relationship
±0.20 - 0.39 Weak relationship and

±0.01 - 0.19 Very Weak relationship

The positive sign (+) in the value (r) implies a direct positive relationship while a negative sign (-) indicates an inverse relationship.

**Static Regression Analysis**

A total of four hypothesized bivariate association was postulated in the study; all stated in the null form of no association. In an attempt to actualise the eclectic objective of the research work, we employ regression analysis as a prerequisite in testing our hypotheses considering the fact that it gives a synchronise account of the relationship between the variables under investigation, US log SPSS software package.

**Decision Rule**

If the probability value (PV) in the coefficient table is less than 0.05 alpha level, we Reject the null hypotheses and accept significant relationship.

If the probability value (PV) is greater than 0.05 alpha levels we accept the null hypothesis and accept no significant relationship.

**Model 1**

**$Ho_1$**. There is no significant difference between pretest and post test scores of students who were taught organic compound nomenclature using the modelling thinking metacognitive teaching strategy compared to those taught using discussion strategy.

**Table 5: Presentation of regression analysis output for the significant difference between pretest and post test scores of students who were taught organic compound nomenclature using the modelling thinking metacognitive teaching strategy compared to those taught using discussion strategy**

**Model Summary**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | .739[a] | .621 | .586 | .534 |

a. Predictors: (Constant), Modelling Thinking Metacognitive Teaching Strategy

**ANOVA**

| Model | | Sum of Square | DF | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 17.529 | 1 | 17.529 | 61.454 | .000[b] |
| | Residual | 42.786 | 150 | .285 | | |
| | **Total** | **60.316** | **151** | | | |

a. Dependent Variable: Discussion Strategy

b. Predictors: (Constant), Graphics and Textual Advance Organizer Strategies

**Coefficients***

| Model | | Unstandardized Coefficients | | Standardized Coefficients | T | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| | (Constant) | 5.130 | .103 | | 49.654 | .000 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 | Modelling Thinking Metacognitive Teaching Strategy | -.217 | .030 | -.539 | -7.839 | .000 |

a. Dependent Variable: Discussion Strategy

**Source**: SPSS Out/put (Based on questionnaires' Data 2019)

Accordingly, the result of the static regression analysis stated in table 5 above stating from 'the model summary reveals that Our R2 stood 0.621 which implies that about 62.1% variation in the dependent variable (Discussion Strategy) is attributed to changes in the independent variable (Modelling Thinking Metacognitive Teaching Strategy). The ANOVA table shows that the F-value is 61.454 and a P-value of 0.000 indicating that difference in the academic performance of students has a significant relationship with students taught with Modelling Thinking Metacognitive Teaching Strategy. The coefficient table shows that difference in the academic performance of students maintains a probability value of 0.000 and a negative coefficient of -0.217 which suggest that there exist a significant relationship between Modelling Thinking Metacognitive Teaching Strategy and Discussion Strategy. On this back drop, we conclude that students taught with Modelling Thinking Metacognitive Teaching Strategy is capable in producing impact in academic performance of students. Hence, we reject the null hypotheses and accept the alternative hypotheses of significant difference between pretest and post test scores of students who were taught organic compound nomenclature using the modelling thinking metacognitive teaching strategy compared to those taught using discussion strategy.

**$Ho_2$.** There is no significant difference between pretest and post test scores of students taught organic compounds nomenclature with explicit metacognitive teaching strategy compared to those taught using discussion strategy.

**Table 6: Presentation of regression analysis output for the significant difference between pretest and post test scores of students taught organic compounds nomenclature with explicit metacognitive teaching strategy compared to those taught using discussion strategy**

| **Model** | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | .865 | .727 | .621 | .625 |

a. Dependent Variable: Discussion Strategy

**ANOVA**

| **Model** | | **Sum of Square** | **DF** | **Mean Square** | **F** | **Sig.** |
|---|---|---|---|---|---|---|
| 1 | Regression | 16.646 | 1 | 16.646 | 60.928 | .002[b] |
| | Residual | 42.670 | 150 | .284 | | |
| | Total | 60.316 | 151 | | | |

a. Dependent Variable: Discussion Strategy

b. Predictors: (Constant), Explicit Metacognitive Teaching Strategy

**Coefficients***

| **Model** | | **Unstandardized Coefficients** | | **Standardized Coefficients** | **T** | **Sig.** |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| | (Constant) | 4.659 | .138 | | 33.672 | .000 |
| 1 | Explicit Metacognitive Teaching Strategy | -0.077 | .037 | -.165 | -2.051 | .002 |

a. Dependent Variable: Discussion Strategy

**Source**: SPSS Out/put (Based on questionnaires' Data, 2019)

The result of the static regression analysis stated in table 6 above stating from the model summary reveals that our R2 stood 0.727 which implies that about 72.7% of changes in the dependent variable (Discussion Strategy) is explained by the independent variable (Explicit Metacognitive Teaching Strategy). The coefficient table shows that students taught using Explicit Metacognitive Teaching Strategy maintains a probability value of 0.002 and a negative coefficient of -0.077 which suggest that there exist a significant difference in the academic performance of students taught using Explicit Metacognitive Teaching Strategy than those taught with Discussion Strategy in public senor secondary schools in Rivers State. On this back drop, we conclude that there is a significant difference in the academic performance of students taught using Explicit Metacognitive Teaching Strategy. Hence, we reject the null hypotheses and accept the alternative hypotheses of significant difference between pretest and post test scores of students taught organic compounds nomenclature with explicit metacognitive teaching strategy compared to those taught using discussion strategy.

**Model 2**

**$Ho_3$.** There is no significant difference between pretest and post test scores of male and female students who were taught using modelling thinking as a Metacognitive teaching strategy and those taught using discussion strategy in organic compounds nomenclature.

**Table 7: Presentation of Regression Analysis Output for the significant difference between pretest and post test scores of male and female students who were taught using modelling thinking as a Metacognitive teaching strategy and those taught using discussion strategy in organic compounds nomenclature**

**Model Summary**

| **Model** | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | .839[a] | .691 | .586 | .534 |

a. Predictors: (Constant): Modelling Thinking as a Metacognitive Teaching Strategy

**ANOVA**

| **Model** | | **Sum of Square** | **DF** | **Mean Square** | **F** | **Sig.** |
|---|---|---|---|---|---|---|
| 1 | Regression | 17.530 | 1 | 17.530 | 61.454 | .000[b] |
| | Residual | 42.786 | 150 | .285 | | |
| | **Total** | **60.316** | **151** | | | |

a. Dependent Variable: Discussion Strategy

b. Predictors: (Constant): Modelling Thinking as a Metacognitive Teaching Strategy

**Coefficients***

| **Model** | | **Unstandardized Coefficients** | | **Standardized Coefficients** | **T** | **Sig.** |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| | (Constant) | 3.006 | .190 | | 15.847 | .000 |
| 1 | Modelling Thinking | -0.321 | .055 | -.412 | -5.546 | .000 |
| | | | | | | |

a. Dependent Variable: Discussion Strategy

**Source**: SPSS Out/Put (Based on questionnaires' Data 2019)

From table 7 above, the model summary reveals that our R2 maintain a value of 0.691 which means that 69.1% of changes in academic performance of students taught using Modelling Thinking as a Metacognitive Teaching Strategy. The coefficient column shows that students taught using Modelling Thinking as a Metacognitive Teaching Strategy maintains a significant probability value of 0.000 and a negative coefficient

of -0.32 1 which suggest that there is a significant difference in the academic performance of students taught using Modelling Thinking as a Metacognitive Teaching Strategy and Discussion Strategy in public secondary schools in Rivers State. Hence, we reject null hypothesis and accept the alternative hypotheses which state that there is a significant difference between pretest and post test scores of male and female students who were taught using modelling thinking as a Metacognitive teaching strategy and those taught using discussion strategy in organic compounds nomenclature.

Ho4. There is no significant difference between pretest and post test scores of male and female students who were taught using explicit teaching as a Metacognitive teaching strategy and those taught using discussion strategy in organic compounds nomenclature.

**Table 8: Presentation of Regression Analysis Output for the significant difference between pretest and post test scores of male and female students who were taught using explicit teaching as a Metacognitive teaching strategy and those taught using discussion strategy in organic compounds nomenclature**

**Model Summary**

| **Model** | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | .625[a] | .526 | .495 | 1.049 |

a. Predictors: (Constant): Male and Female Students who were Taught Using Explicit Teaching as a Metacognitive Teaching Strategy

**ANOVA[a]**

| **Model** | | **Sum of Square** | **DF** | **Mean Square** | **F** | **Sig.** |
|---|---|---|---|---|---|---|
| 1 | Regression | 17.530 | 1 | 17.531 | 61.454 | .000[b] |
| | Residual | 42.785 | 150 | .285 | | |
| | Total | 60.316 | 151 | | | |

a. Dependent Variable: Academic performance of male and female students

b. Predictors: (Constant): Male and Female Students who were Taught Using Explicit Teaching as a Metacognitive Teaching Strategy

**Coefficients***

| **Model** | | **Unstandardized Coefficients** | | **Standardized Coefficients** | **T** | **Sig.** |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| | (Constant) | 3.349 | .232 | | 14.437 | .000 |
| 1 | Male and Female Students | -0.213 | .063 | -.225 | -2.832 | .000 |

a. Dependent Variable: Academic Performance of Male and Female Students

**Source**: SPSS Out/Put (Based on questionnaires' Data 2019)

The output of the static regression result in table 8 shows that there exist a significant difference in the academic performance between the male and female students taught with Explicit Teaching as a Metacognitive Teaching Strategy in public senior secondary schools as justifies by the significant probability value of male and female students taught with Explicit Teaching as a Metacognitive Teaching Strategy which stood at 0.000 coupled with a negative coefficient value of -0.213 which suggest an inverse relationship. On this premise, we reject null hypothesis and thus conclude that there exist a significant difference between pretest and post test scores of male and female students who were taught using explicit teaching as a Metacognitive teaching strategy and those taught using discussion strategy in organic compounds nomenclature.

## DISCUSSION OF FINDINGS

The finding of the study in research question one: what is the effect of modelling thinking as a metacognitive teaching strategy and discussion method on student academic performance in organic compounds nomenclature revealed that there is a significant effect of modelling thinking as a metacognitive teaching strategy on student academic performance in organic compounds nomenclature compared to discussion

strategy. This finding is in collaboration with Cetin (2015) who admitted that modelling thinking as a metacognitive teaching strategy promotes more positive attitudes towards instructional experience than discussion strategy. It enhances students working together to achieve a common goal. Kochi (2001) also noted that modelling thinking as a metacognitive teaching strategy has positive effects on student's to acquire critical thinking skills in cooperative learning strategies.

The study in research question two: What is the effect of explicit teaching as a metacognitive teaching strategy and discussion method on student academic performance in organic compounds nomenclature indicated that there is positive effect of explicit teaching as a metacognitive teaching strategy on student academic performance in organic compounds nomenclature compared to discussion strategy.

The finding of the study in research question three: What is the academic performance of male and female students taught using modelling thinking as a Metacognitive teaching strategy than those taught using discussion method in organic compounds nomenclature showed that there is a significant effect on the academic performance of male and female students taught using modelling thinking as a Metacognitive teaching strategy than those taught using discussion method in organic compounds nomenclature. This finding is in collaboration with Ezeudu & Obi (2013), Chinda (2012) who admitted that the issue of gender difference in academic performance at all levels of education has been a great concern to many researchers and that many reasons have also been advanced for differences in performance in science between males and females. These reasons include differences in significance attachedto academic success for male and female; peer and family pressure to do well is stronger for male than for female.

The study in research question four: What is the academic performance of male and female students taught using explicit teaching as a Metacognitive teaching strategy than those taught using discussion method in organic compounds nomenclature revealed that there is a positive effect on the academic performance of male and female students taught using explicit teaching as a Metacognitive teaching strategy than those taught using discussion method in organic compounds nomenclature. This study is in the same view with Lovett (2016) who stressed that, for females to have the same opportunities as males in educationand labour market, it is important for them to be equally well prepared academically. Authentic academic performance covers individuals' academic abilities and skills in applying practical abilities. Zimmerman (2002) also observed that explicit metacognitive teaching strategies involve directly instructing students on how to monitor and regulate their own thinking processes to enhance learning and problem-solving skills.

## CONCLUSION

The effect of metacognitive teaching strategy such as modelling thinking and explicit metacognitive strategy on chemistry students academic performance in organic compounds nomenclature cannot be over-emphases. Based on the findings of the study, the researcher concludes that there is significant effect of modelling thinking as a metacognitive teaching strategy on student academic performance in organic compounds nomenclature compared to discussion strategy and there is positive effect of explicit teaching as a metacognitive teaching strategy on student academic performance in organic compounds nomenclature compared to discussion strategy. The study also deduced that there is a significant effect on the academic performance of male and female students taught using modelling thinking as a Metacognitive teaching strategy than those taught using discussion method in organic compounds nomenclature and there is a positive effect on the academic performance of male and female students taught using explicit teaching as a Metacognitive teaching strategy than those taught using discussion method in organic compounds nomenclature.

## RECOMMENDATIONS

Based on the findings of the study, the following recommendations were made to ensure that the study achieves its objectives:

1. The teachers should adopt modelling thinking as a metacognitive teaching strategy hence it improve academic performance of the students.

2. Government, through the management of senior secondary schools board should organize seminar or workshop programme for teachers on the effect of explicit teaching as a metacognitive teaching strategy on the academic performance of the students.
3. School management should organize in-service training or workshop programme for the teachers on how to encourage the female students in studying Chemistry
4. The teachers should always simplify their teaching when using explicit teaching method to encourage the female students.

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