EFFECTS OF SELF-REGULATED LEARNING STRATEGY ON CHEMISTRY STUDENTS' ACHIEVEMENT AND ATTITUDE IN SENIOR SECONDARY SCHOOLS IN DELTA NORTH SENATORIAL DISTRICT

AKUDO, Cletus Olise

DELTA STATE UNIVERSITY, ABRAKA

OCTOBER, 2018

EFFECTS OF SELF-REGULATED LEARNING STRATEGY ON CHEMISTRY STUDENTS' ACHIEVEMENT AND ATTITUDE IN SENIOR SECONDARY SCHOOLS IN DELTA NORTH SENATORIAL DISTRICT

AKUDO, Cletus Olise
PG/13/14/222912

A DISSERTATION SUBMITTED TO THE POSTGRADUATE SCHOOL FROM THE DEPARTMENT OF SCIENCE EDUCATION, FACULTY OF EDUCATION, IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF EDUCATION (M.Ed) IN SCIENCE EDUCATION (CHEMISTRY)

DELTA STATE UNIVERSITY ABRAKA,

OCTOBER, 2018

DECLARATION

I, AKUDO, Cletus Olise declare that this dissertation "Effects of Self-Regulated Learning Strategy on Chemistry Students' Achievement and Attitude in Senior Secondary Schools in Delta North Senatorial District" was written by me, in the Department of Science Education, Delta State University, Abraka. This dissertation had not been submitted to this Institution or any other Institution for the award of a degree.

……..... ……

AKUDO, Cletus Olise Date

PG/13/14/222912

CERTIFICATION

This is to certify that this dissertation "Effects of self-regulated learning strategy on chemistry students' achievement and attitude in senior secondary schools in Delta North Senatorial District" was written by **AKUDO, Cletus Olise,** in the Department of Science Education, Delta State University, Abraka.

…….... ……

Prof. O. P. Ajaja **Date**
Project Supervisor

…… ……..

Prof. O. P. Ajaja Date
Head of Department

…… ……..
Prof. E. P. Oghuvbu Date
Dean, Faculty of Education

DEDICATION

I dedicate this research work to Almighty God, the Everlasting Father for His Provisions.

ACKNOWLEDGEMENTS

I am grateful to God Almighty for His grace and provision, leading to the successful completion of this research. Our God indeed is a God of possibilities. It was all a dream when I started this programme but God of infinite mercies has made it a reality for me.

I wish to express my utmost appreciation to my Supervisor, Prof. O. P. Ajaja, who despite his busy schedule found time to diligently go through this work and offered appropriate corrections as and when due. He was always ready to guide me during the course of this study. May God reward him and his family bountifully for his fatherly love.

I sincerely appreciate the Head of Department, Rev. (Dr.) E. O. Oyovwi and all the lecturers of the Department of Science Education: Prof. E. A. Inomesia, Prof. N. S. Okoye, Prof. E. Kpangban, Asso. Prof. T. E. Agboghoroma, Dr. (Mrs) J. I. Iroriteraye-Adjekpovu, Dr. S. B. Ijeh and Dr. U. L. Ezenweani (now of blessed memory), for the knowledge they imparted to me during my study and also for their tireless corrections and contributions at the various stages of the dissertation defence. May God bless them all.

I will not forget to appreciate the Faculty of Education Questioners to the Department of Science Education, Prof. Patrick Ekezie Egbule, Prof. John N. Odili and Prof. Kennedy Odu Oji, for their contributions. May God bless them all.

My profound gratitude also goes to my parents, Chief and Madam Wilson Akudo, for their prayers and support all through my studies. I wish to appreciate my siblings, Ambrose Akudo and Opute Akudo, and my friend, Augustine Ufeli Osagu, for their advice, encouragement and financial support.

To my lovely wife, Mrs Charisa Ashinedu Akudo, I say “a big thank you” for her love, support and encouragement all through my studies. Also to my wonderful children, Oyiye, Favour, Blessing, Glory and Peace Akudo, I say “a big thank you” for their sacrifice, support and understanding during the course of my studies.

I express my immense gratitude to my friends, Mr. Andrew I. Ebiguvwere, Mrs. Maria Obinne and Mr. Francis Emerhiona, for their advice and contribution. I remain grateful to all the school Principals, Chemistry teachers and students used in this study and to all authors whose works were cited.

TABLE OF CONTENTS

CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATIONS

LIST OF TABLES

ABSTRACT

This study examined the effects of self-regulated learning strategy on Chemistry students' achievement and attitude in senior secondary schools in Delta North Senatorial District. Six research questions and six hypotheses guided the study. The quasi-experimental design was used, specifically the non-equivalent pre-test, posttest control group design. The population of the study was 5,813 SSII Chemistry students in the 146 public senior secondary schools in Delta North Senatorial District. A sample size of 252 senior secondary two (SS II) Chemistry students randomly selected from four public mixed secondary schools in Delta North Senatorial District was used for the study. The instruments used for data collection were Chemistry Achievement Test (CAT) and Chemistry Attitude Questionnaire (CAQ). The reliability of the CAT and CAQ were established, using Kuder-Richardson Formula 21 and Cronbach Alpha respectively, which yielded coefficient of internal consistencies of 0.79 for CAT and 0.88 for CAQ. Data were collected by administering the Chemistry Achievement Test (CAT) and Chemistry Attitude Questionnaire (CAQ) as pretest and posttest. The data obtained were analyzed using mean, standard deviation, Analysis of Variance (ANOVA) and Analysis of Covariance (ANCOVA). The results showed that there was a significant difference between the mean achievement scores of students taught Chemistry using self-regulated learning strategy and those taught using the lecture method, in favour of self-regulated learning; there was no significant difference between the mean achievement scores of male and female students taught Chemistry using self-regulated learning strategy; there was a significant difference between the mean attitude scores of students' taught Chemistry using self-regulated learning strategy and those taught using lecture, in favour of students taught using self-regulated learning strategy; there was no significant difference between the mean attitude scores of male and female students taught Chemistry using self-regulated learning strategy; and there was no significant effect of interaction between teaching method and sex on students' achievement and attitude in Chemistry. It was thus recommended that Chemistry teachers should adopt the use of self-regulated learning strategy in teaching Chemistry at the Secondary School level. Also, Chemistry teachers should be trained by Government on how to construct lesson plans on self-regulated learning strategy and other innovative teaching strategies.

CHAPTER ONE

INTRODUCTION

Background to the Study

Chemistry is science which deals with the study of properties of matter and materials around us. It deals with the investigation of substances, their components, properties and reactions, and the use of products (New substances) of such reactions. The central purpose of science learning is conceptualized as developing scientific literacy in students (Dani, 2009). This involves chemists and students learning Chemistry to be actively engaging in the practices and being able to master reaction processes and manage the knowledge of Chemistry to provide personal and societal needs. Mulemwa (2002) pointed out that the fast changing applications of science and technology and the global reliance on its processes and products in all areas of human endeavor have made them so invaluable that any society or country without them risks being alienated from the global village. This means that for an individual to be well-grounded in science which chemistry is one, and competent enough to face the challenges of life in his society, he or she must have gone through a science programme that is well planned, assessed and implemented.

The subject Chemistry is of great relevance to national development. Jimoh (2007) noted that the importance of Chemistry in the development of any nation cannot be underrated especially in Nigeria where the national income rested on petroleum and petrochemical industries. Chemistry is central in the drive for global sustainable economic development. It plays the major roles in food (fertilizers and insecticides), clothing (textile fibers), housing (cement, concrete, steel, bricks), medicine (drugs),

transportation (fuel, alloy materials), and many more as cosmetics, paints, soaps, and so on. In addition, various careers exists in Chemistry in the health sector, food processing industries, extractive industries, petroleum and petrochemical industries among others.

Considering the role of Chemistry in national development, Federal Ministry of Education (1985) stated the following as the objectives of teaching Chemistry in Nigeria schools:

i. to facilitate a transition in the use of scientific concepts and techniques acquired in integrated science to Chemistry;

ii. to provide the students with basic knowledge of Chemistry concepts and principles through efficient selection of content and sequencing;

iii. to show Chemistry and its inter-relationship with other subjects;

iv. to show Chemistry and its link with industry, everyday life, benefits and hazards, and

v. to provide a course which is complete for pupils not proceeding to higher education, while it is at the same time a reasonably adequate foundation for a post-secondary Chemistry course.

The teaching of chemistry as a prerequisite for higher study of science and science related disciplines helps to imbibe scientific knowledge and stimulate science oriented attitudes in learners. These attitudes when directed to the world of work results in the development of the individual, the society and general standard of living of the citizenry (Igwe, 2015). According to the national policy on education, science education should develop in the child well defined abilities and values such as the spirit of inquiry, creativity, objectivity, the courage to question, and an aesthetic sensibility (Federal

Republic of Nigeria, 2004). In order to achieve the objectives of Chemistry, teaching approach should promote students to assume responsibility and control over their acquisition of knowledge and skills. Thus, students should become masters of their learning thereby controlling what, how, why and when they learn. One teaching method that has these attributes is Self-regulated learning.

Self-regulation generally refers to students' ability to understand and control their learning. It is the ability to monitor and control one's own behaviour, emotions, or thoughts, altering them in accordance with the demands of the situation (Kadivar, Manzari, & Sarami, 2012). Self-regulated learning strategy is an active, constructive process whereby learners set goals for their learning and attempts to monitor, regulate and control their cognition, motivation and behaviour guided by their goals and contextual features in the environment (Tang, 2012). It is an act of learning that is guided by meta-cognition (thinking about one's thought), strategic action (planning, monitoring and evaluating personal progress against standards) and motivation to learn taking the process of control and evaluating one's own learning and behaviour. In particular, self-regulated learners are cognizant of their academic strength and weaknesses and they have a repertoire of skills they appropriately apply to tackle the day to day challenges of academic tasks (Ejelue, 2017).

Self-regulated learning strategy has been shown in a number of studies to positively improve students' achievement in various subject areas (Barbara & Cirila, 2009; Gerard, Annemaree & Nan, 2013; Hamid, Zahra, & Seyed, 2015; Kadivar, Manzari & Sarami, 2012). This is because it gives students an explicit plan for improving upon their achievements in science subjects and also helps them to understand the relationship

between knowledge, skill and motivation. The use of self-regulated learning strategy poses some merit over the lecture method which has been used for teaching Chemistry over the years.

The classrooms in Nigeria are predominantly dominated by lecture method of instruction which does not encourage students to set goals for their learning and attempts to monitor, regulate and control their cognition, motivation and behaviour guided by their goals. Ajaja (2009) referred to the lecture method as a "talk-chalk" method. He further stated that the lecture method may be used for any class size but it is usually used for large classes. Lecture method of teaching is a teacher directed method of teaching where students receive instruction from the teacher with little or no participation (Roediger & Marsh, 2005). The students have little or no control of their learning. The adoption of the lecture method by teacher is predicated on the fact that it encourages completion of subject matter content within a limited time. Lecture method is a teacher-centred approach to teaching and learning in which the teacher is seen as an authority, dispensing knowledge to students who contribute little or nothing to the instruction. Lecture method has been criticized by Adegoke (2011) who posited that only hardworking students can benefit from it. This may have accounted for students' poor academic performance and attitude in chemistry.

Academic achievement according to Hattie (2009) is the performance outcomes that indicate the extent to which a learner has accomplished specific goals that were the focus of activities in instructional environments, specifically in school, College, and University. Academic achievement is the outcome of learning which expresses the extent to which instructional objectives have been met (Nwanze, 2016). Anene (2005) defined

students' academic achievement as performance in a school subject as designated by a score or mark obtained in a standard test. Self-regulated learning has shown in a number of studies to significantly improve students' academic achievement in different subject areas including chemistry (Olakanmi & Gumbo, 2017; Oruc & Arslan, 2016; Nwafor, Obodo & Okafor, 2015; Yigsaw & Fentle, 2013). The use of Self-Regulated learning not only improves students' academic achievement but also improve students' attitude.

Attitude according to Eagly and Chaiken (2007), is a psychological tendency that is expressed by evaluating a particular entity with some degree of favour or disfavour. Attitude is the opinion and feeling that you usually have about something (Della, 2008). Attitude is usually defined as a disposition of response favourably or unfavourably to an object, person, institution or event. Attitude towards study has great contribution in academic achievement and good study pattern. Research-based evidences have shown that self-regulated learning improves students' attitude to science subjects in general and chemistry in particular (Oruc & Arslan, 2016; Ozdemir & Arslan, 2016; Arsal, 2009; Schroeder, 2007).

Sex issues in science education have remained a point of interest for a numbers of researchers. There is a strong argument that sex is a prediction factor on achievement (Maduabum, 2006). Literature shows mixed results on the effect of self-regulated learning on male and female students' academic achievement and attitude. This controversy is one of the rationales for this study. That is to determine if self-regulated learning affects male and female students' achievement and attitude differently. However, sex in this study is a moderator variable.

It is against this background that the study sought to investigate the effects of self-regulated learning strategy on Chemistry students' academic achievement; and the effects of self-regulated learning strategy on students' attitude towards Chemistry in Delta North Senatorial District.

Statement of the Problem

A review of West African Examination Council (WAEC) Chief Examiner's reports from 2010-2016 have shown that students performance in Chemistry is on a continuous decline. Chemistry students' abysmal poor academic performance in SSCE has been attributed to poor teaching methods among others. The lecture method most commonly used in Nigerian secondary schools has made students to resort to memorization of chemistry contents as a result of their passive involvement in the teaching and learning process. The students in the lecture method classroom are not given the opportunity to set goals for their learning and attempts to monitor, regulate and control their cognition. This calls for the adoption of alternative teaching methods that are guided by metacognition (thinking about one's thought), strategic action (planning, monitoring and evaluating personal progress against standards) and motivation to learn taking the process of control and evaluating one's own learning and behaviour. Self-regulated learning strategy could be alternative method as it gives students opportunity to set goals for their learning and attempts to monitor, regulate and control their cognition.

Hence, the statement of the problem for this study is: will the use of Self-Regulated learning improve students' achievement and attitude towards Chemistry? Also, will the use of Self-Regulated learning strategy improve the academic achievement and attitude of male and female students in Chemistry?

Research Questions

The following questions guided the study.

1. Is there any difference between the mean achievement scores of students taught Chemistry using self-regulated learning strategy and those taught using lecture method?
2. Is there any difference between the mean achievement scores of male and female students taught Chemistry using self-regulated learning strategy?
3. Is there any difference between the mean attitude scores of students taught Chemistry using self-regulated learning strategy and those taught using lecture method?
4. Is there any difference between the mean attitude scores of male and female students taught Chemistry using self-regulated learning strategy?
5. Is there any effect of interaction between sex and teaching method on students' achievement in Chemistry?
6. Is there any effect of interaction between sex and teaching method on students' attitude towards Chemistry?

Hypotheses

The following hypotheses were tested at 0.05 level of significance.

1. There is no significant difference between the mean achievement scores of students taught Chemistry using self-regulated learning strategy and those taught using lecture method.
2. There is no significant difference between the mean achievement scores of male and female students taught Chemistry using self-regulated learning strategy.

3. There is no significant difference between the mean attitude scores of students taught Chemistry using self-regulated learning strategy and those taught using lecture method.
4. There is no significant difference between the mean attitude scores of male and female students taught Chemistry using self-regulated learning strategy.
5. There is no significant effect of interaction between sex and teaching method on students' achievement in Chemistry.
6. There is no significant effect of interaction between sex and teaching method on students' attitude towards Chemistry.

Purpose of the Study

The purpose of the study was to investigate the effects of self-regulated learning strategy on students' achievement and attitude in Chemistry.

Specifically, the study:

1. compared the mean achievement scores of students taught Chemistry using self-regulated learning strategy and those taught using lecture method;
2. compared the mean achievement scores of male and female students taught chemistry using self-regulated learning strategy;
3. compared the mean attitude scores of students taught Chemistry using self-regulated learning strategy and those taught using lecture method;
4. compared the mean attitude scores of male and female students taught Chemistry using self-regulated learning strategy;
5. determined if there is an effect of interaction between sex and teaching method on students' achievement in Chemistry; and

6. determined if there is an effect of interaction between sex and teaching method on students' attitude in Chemistry.

Significance of the Study

On completion of this study, the findings might be beneficial to students, teachers, parents, Ministry of Education, Chemistry Curriculum planners, school counselors and future researchers.

The findings of this study may be beneficial to the students as they may appreciate the effect of Self-Regulated learning strategy on students' achievement in Chemistry. It may give students insight to the benefits of the different domains of self-regulation and the cognitive engagements that could promote effective participation in Chemistry classes. This may incite them to adopt more self-regulatory skills during their study session in order to improve their achievement.

The findings of this study may enlighten teachers especially Chemistry teachers of the need to adopt skills based on students' cognitive style and level and also model such learning skill as self-regulatory learning skills for students. Chemistry teachers may be moved through the findings of the study to be flexible in their teaching methods to accommodate the needs of the learner, emphasize the need for self-regulation while at the same time, helping students to set goals with the attendant help necessary to achieve such set goals.

The findings of this study may also inform parents of the importance of students' engagement and responsibility in their own learning. Parents may be stimulated to supervise their children's academic endeavors and encourage in them the spirit of continual Self-Regulated learning.

To Ministry of Education, the findings of the study may draw their attention to the gap that exists between Chemistry instruction and students' achievement. This may enable ministry of education to provide meaningful instructional materials and conducive learning environment to schools in other to facilitate learning.

The findings of this study may draw the attention of Chemistry Curriculum planners and other stakeholders in education to the benefits of students' Self-Regulated learning. They may be informed through the findings of the study of students' varied cognitive engagements during their learning process. This may motivate them to include for various subject areas, Self-Regulatory learning activities that can guide students in their learning process under the guidance of the teachers.

The outcome of this study may enlighten school counselors on the effects of Self-Regulated learning strategy on students' academic and attitude in Chemistry. This may aid them in guiding students to develop appropriate self-regulatory skills to enhance conceptualization of Chemistry concepts.

The findings of the study may also serve as a foundation for future researchers to conduct further studies on the area of self-regulated learning. The findings of the study may provide them with a guide on further studies into students' self-regulated learning that could improve achievement particularly in the areas of method, materials and references.

Scope and Delimitation of the Study

The study focused on the effects of self-regulated learning strategy on senior secondary two (SSII) Chemistry students' achievement and attitude. The study also compared the effects of self-regulated learning strategy on male and female students'

academic achievement and attitude in selected Chemistry concepts. The content materials were selected from hydrocarbons, alkanes, alkenes, alkynes, benzene and alkanols in Organic Chemistry.

The study is delimited to all public senior secondary schools in Delta North Senatorial District of Delta State. Specifically, the study covered four public senior secondary schools in 4 Local Government Areas in Delta North Senatorial District.

Limitations of the Study

The major limitations of the study are:

1. The outcome of this study would have been more generalized if had covered all the schools in Delta North Senatorial District. The study only covered 4 schools in Delta North Senatorial District.
2. The time allocated to Chemistry in the school time table was too short to effectively implement self-regulated learning strategy to properly accommodate students of different ability level. This may have affected the achievement of the slow learners since were not used to this method of instruction.

Operational Definition of Terms

The following terms used in the study are operationally defined as follows.

Self-Regulated Learning: Self-Regulated learning strategy is a teaching strategy that enhances students' ability to understand and control their learning. It is an act of learning that is guided by meta-cognition (thinking about one's thought), strategic action (planning, monitoring and evaluating personal progress against standards) and motivation to learn taking the process of control and evaluating one's own learning and behaviour.

Lecture Method: lecture method is a teaching method whereby the teacher transmits knowledge to the students in the finite form giving students little or no opportunity to be actively involved during the teaching and learning process.

Academic Achievement: It refers to students' scores in standardized test or examination.

Attitude: It refers to students' opinion or feeling towards Chemistry

Sex: This could be male or female. For this study, sex refers to male and female Chemistry students in a school setting.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

This chapter presents a review of relevant related materials on the topic under investigation. The review was organized under the following sub-headings:

- Theoretical Framework of the Study
- Concept of Self-Regulated Learning
- Concept of Academic Achievement
- Concept of Attitude
- Empirical studies on the Effect of Self-Regulated learning on Students' Achievement in Chemistry
- Empirical Studies on the Effect of Self-Regulated Learning on students' Attitude in Chemistry
- Empirical Studies on Sex Differences in the Effects Self-Regulated Learning on Achievement in Chemistry
- Empirical Studies on Sex Differences in the Effects Self-Regulated Learning on Attitude in Chemistry
- Appraisal of the Reviewed Literature

Theoretical Framework of the Study

The study is anchored on two theories: Social Cognitive Theory (SCT) by Harold Chapman and Bruner's Theory of Discovery Learning

Social-cognitive Theory (SCT) by Chapman

The Social Cognitive theory was propounded by Harold Chapman Brown in 1931. Social Cognitive theory states that when people observe a model performing behaviour and the consequence of that behaviour, they remember the sequence of event and use this information to guide subsequent behaviour. One of the notable components of the theory

however holds that a person cannot learn to imitate until they are imitated. To be imitated therefore, an individual must put up behaviours with positive consequences as a reward and this forms the basis for self-regulation to achieve the best results from behaviours.

Social Cognitive theorists propose that self-regulated learning is not solely determined by the individual processes but these processes are also determined by the physical and social environment. Social cognitive theory thus concluded that self-awareness encompasses states of self-perception like self-efficacy and observation of one's behaviour. Social cognitive theorists focus on the relationship between modeling and self-regulated learning processes.

This theory has direct implication on this study in the sense that Social Cognitive theory sees self-relegated learning as being made up of three sub processes: self-observation, self-judgment, and self-reaction. Social Cognitive theory also takes for granted that students have pre-existing knowledge of the activities they learn from, acquire knowledge and solve problems. When students are aware of their capabilities, they know ahead of time the possible difficulties when doing something. This allows people to set goals and take the appropriate steps to accomplish them in order to obtain the wanted results (Bandura, 1991). Implicit in this theory is the concept of self-regulated learning. Social Cognitive theorists propose self-regulated learning by students as necessary for good achievement. There is the need therefore, to find out if such learning approach correlates with students' academic achievement.

Theory of Discovery Learning by Bruner

Jerome Bruner propounded his theory of discovery learning in 1997. The theory states that learners are capable of learning any material so long as the instruction is

organized appropriately. The theory provides bases for self-regulated learning as teachers can organize learning materials and objectives in meaningful order and give students directives on how to learn. Students who possess the skills of self-regulation can on their own learn such materials and improve on their achievement. Students who can manage learning resources can regulate their effort, study environment, seek help or learn from peers so long the resources are meaningful to them.

The implication of Bruner's theory is that with or without the teacher, the students can acquire information and improve achievement from learning materials appropriately organized if they can regulate their learning. This underscored the need to examine whether self-regulated learning will correlate academic achievement.

Concept of Self-Regulated Learning

Self-regulated learning (SRL) as defined by Good and Brophy (1995) are skills through which learners participate in the process of active learning and take responsibility for encouraging themselves to understand materials they deal with, to accomplish tasks, to monitor what they do, to assess their strengths and weaknesses, and to take corrective actions based on self-evaluation reports. Self-regulated learning, or self-regulation, is "an active, constructive process whereby learners set goals for their learning and then attempt to monitor, regulate, and control their cognition, motivation, and behaviour, guided and constrained by their goals and the contextual features in the environment" (Pintrich, 2000, pg. 8).

According to Molnar as cited in Mezei (2008), the teachers perceive self-regulated learning as one consisting of students initiated learning, students' autonomy and use of efficient learning, students' reflection on their work and intrinsic goal setting.Self-

regulated learning as used in this study refers to the students' active involvement in learning activities such as designing achievement goals, monitoring and evaluating their progress and adjusting their study skill to meet those goals. There has been a unanimous agreement among researchers that students' involvement in their learning process improve achievement. However, much of the students' involvement in their studies seems often to be limited to those directed by the teacher in the classroom. There is therefore the need to examine if students' involvement in activities directed towards learning and achievement through Self-regulated learning could affect their achievement in biology.

Zimmerman (2000) stated three phases of self-regulated learning process as follows; forethought phase (or planning stage), volition control phase (or monitoring stage) and self reflection phase (or evaluation stage).

These phases later developed by Callan (2014) unfold into four sequenced phases as follows:

1. Task perception phase.
2 Goal setting and planning phase.
3. Enacting phase.
4. Adaptation phase.

Task perception phase is when the learner identifies problem and assembles information about the task at hand and take the responsibility.

Goal setting and planning stage is the stage where learners focus on about how to succeed in the task. This involves stating goals out of the task perceived. The goals stated

guide the student to make plans to actualize the stated goals by utilizing study skills and other tactics in learning strategies.

Enacting phase is the processing stage of self regulation where all the planning is carried out in focus to already set goals. It is the stage of rigorous activities, action and reaction for the purpose of achieving the stated goals.

Adaptation stage which is the last phase is the evaluation of performance and observing the loopholes to modify so as to have greater performance in future. The stages are followed step-by-step intensively by students which lead to sure success in academics.

Self-Regulated Learning Skills

The self-regulated learning skills are broadly categorized by Pintrich (2000) into cognitive and metacognitive strategies and resource management skills.The cognitive and metacognitive skills are rehearsal, elaboration, organization, critical thinking and metacognitive self-regulation. The resource management skills include: time and study environment, effort regulation, peer learning and help seeking. Pintrich the developer of the self-regulated learning measurement instrument used in this study explained each skill as follows.

Basic rehearsal strategies involve reciting or naming items from a list to be learned. These strategies are best used for simple tasks and activation of information in working memory rather than acquisition of new information in long-term memory. These strategies are assumed to influence the attention and encoding processes, but they do not appear to help students construct internal connections among the information or integrate the information with prior knowledge.

Elaboration strategies help students store information into long-term memory by building internal connections between items to be learned. Elaboration strategies include paraphrasing, summarizing, creating analogies, and generative note-taking. These help the learner integrate and connect new information with prior knowledge. Organization strategies help the learner select appropriate information and also construct connections among the information to be learned. Examples of an organizing strategies are clustering, outlining, and selecting the main idea in reading passages. Organizing is an active, effortful endeavour, and results in the learner being closely involved in the task. This should result in better performance.

Critical thinking refers to the degree to which students report applying previous knowledge to new situations in order to solve problems, reach decisions, or make critical evaluations with respect to standards of excellence. Metacognition refers to the awareness, knowledge, and control of cognition. There are three general processes that make up metacognitive self-regulatory activities: planning, monitoring, and regulating. Planning activities such as goal setting and task analysis help to activate, or prime, relevant aspects of prior knowledge that make organizing and comprehending the material easier. Monitoring activities include tracking of one's attention as one reads, and self-testing and questioning: these assist the learner in understanding the material and integrating it with prior knowledge. Regulating refers to the fine-tuning and continuous adjustment of one's cognitive activities. Regulating activities are assumed to improve performance by assisting learners in checking and correcting their behaviour as they proceed on a task.

Besides self-regulation of cognition, students must be able to manage and regulate their time and their study environments. Time management involves scheduling, planning, and managing one's study time. This includes not only setting aside blocks of time to study, but the effective use of that study time, and setting realistic goals. Time management varies in level, from an evening of studying to weekly and monthly scheduling. Study environment management refers to the setting where the student does her class work. Ideally, the learner's study environment should be organized, quiet, and relatively free of visual and auditory distractions.

Self-regulation also includes students' ability to control their effort and attention in the face of distractions and uninteresting tasks. Effort management is self-management, and reflects a commitment to completing one's study goals, even when there are difficulties or distractions. Effort management is important to academic success because it not only signifies goal commitment, but also regulates the continued use of learning strategies.

Collaborating with one's peers has been found to have positive effects on achievement. Dialogue with peers can help a learner clarify course material and reach insights one may not have attained on one's own.

Another aspect of the environment that the student must learn to manage is the support of others. This includes both peers and instructors. Good students know when they don't know something and are able to identify someone to provide them with some assistance. There is a large body of research that indicates that peer help, peer tutoring, and individual teacher assistance facilitate student achievement.

Self-Regulated Learning Strategies for Students

To promote SRL in classrooms, teachers must teach students the self-regulated processes that facilitate learning. These processes often include: goal setting (Winne & Hadwin, 1998; Wolters, 2003), planning (Zimmerman, 2004; Zimmerman & Risemberg, 1997), self-motivation (Corno, 1993; Wolters, 2003; Zimmerman, 2004), attention control (Harnishferger, 1995; Kuhl, 1985; Winne, 1995), flexible use of learning strategies (van de Broek, Lorch, Linderholm & Gustafson, 2001; Winne, 1995), self-monitoring (Butler & Winne, 1995; Carver & Scheier, 1990), appropriate help-seeking (Butler, 1998; Ryan, Pintrich, & Midgley, 2001), and self-evaluation (Schraw & Moshman, 1995).

Goal Setting

Goals can be thought of as the standards that regulate an individual's actions (Schunk, 2001). In the classroom, goals may be as simple as earning a good grade on an exam, or as detailed as gaining a broad understanding of a topic. Short-term attainable goals often are used to reach long-term aspirations. For example, if a student sets a long-term goal to do well on an exam, then he or she also may set attainable goals such as studying for a set amount of time and using specific study strategies to help ensure success on the exam. Research also suggests that encouraging students to set short-term goals for their learning can be an effective way to help students track their progress (Zimmerman, 2004).

Planning

Similar to goal setting, planning can help students self-regulate their learning prior to engaging in learning tasks. In fact, research indicates that planning and goal

setting are complementary processes, as planning can help learners establish well thought out goals and strategies to be successful (Schunk, 2001). Planning occurs in three stages: setting a goal for a learning task, establishing strategies for achieving the goal, and determining how much time and resources will be needed to achieve the goal (Schunk, 2001). Teaching students to approach academic tasks with a plan is a viable method for promoting self-regulation and learning (Pressley & Woloshyn, 1995).

Self-Motivation

Self-motivation occurs when a learner independently uses one or more strategies to keep themselves on-track toward a learning goal. It is important to the process of self-regulation because it requires learners to assume control over their learning (Corno, 1993). Furthermore, self-motivation occurs in the absence of external rewards or incentives and can therefore be a strong indicator that a learner is becoming more autonomous (Zimmerman, 2004). By establishing their own learning goals and finding motivation from within to make progress toward those goals, students are more likely to persist through difficult learning tasks and often find the learning process more gratifying (Wolters, 2003).

Attention Control

In order to self-regulate, learners must be able to control their attention (Winne, 1995). Attention control is a cognitive process that requires significant self-monitoring (Harnishferger, 1995). Often this process entails clearing the mind of distracting thoughts, as well as seeking suitable environments that are conducive to learning (e.g., quiet areas without substantial noise) (Winne, 1995). Research indicates that students' academic outcomes increase with focused time spent on-task (Kuhl, 1985). Thus,

teaching students to attend to learning tasks should be a priority. Teachers can help their students control their attention by removing stimuli that may cause distractions, and providing students with frequent breaks to help them build up their attention spans.

Flexible Use of Strategies

Successful learners are able to implement multiple learning strategies across tasks and adjust those strategies as needed to facilitate their progress towards their desired goals (Paris & Paris, 2001). However, it is important to note that most students, especially those in the primary grades, typically do not have a large repertoire of learning strategies at their disposal (van de Broek et al., 2001). It takes time for students to learn and become comfortable with different learning strategies. By modeling how to use new strategies and providing appropriate amounts of scaffolding as students practice, teachers can help learners become independent strategy users.

Self-Monitoring

To become strategic learners, students must assume ownership for their learning and achievement outcomes (Kistner, Rakoczy & Otto, 2010). Self-regulated learners take on this responsibility by monitoring their progress towards learning goals. The process of self-monitoring encompasses all of the aforementioned strategies. In order for a learner to self-monitor their progress, they must set their own learning goals, plan ahead, independently motivate themselves to meet their goals, focus their attention on the task at hand, and use learning strategies to facilitate their understanding of material (Zimmerman, 2004). Teachers can encourage self-monitoring by having students keep a record of the number of times they worked on particular learning tasks, the strategies they

used, and the amount of time they spent working. This practice allows students to visualize their progress and make changes as needed.

Help-Seeking

Contrary to popular belief, self-regulated learners do not try to accomplish every task on their own, but rather frequently seek help from others when necessary (Butler, 1998). What sets self-regulated learners apart from their peers is that these students not only seek advice from others, but they do so with the goal of making themselves more autonomous (Ryan et al., 2001). Teachers can promote positive help seeking behaviors by providing students with on-going progress feedback that they can easily understand and allowing students opportunities to resubmit assignments after making appropriate changes.

Self-Evaluation

Students are more likely to become self-regulated learners when they are able to evaluate their own learning, independent of teacher-issued summative assessments (Winne & Hadwin, 1998). This practice enables students to evaluate their learning strategies and make adjustments for similar tasks in their future (Schraw & Moshman, 1995). Teachers can promote self-evaluation in the classroom by helping students monitor their learning goals and strategy use, and then make changes to those goals and strategies based upon learning outcomes (Zimmerman, 2004).

In summary, self-regulated learners are able to set short- and long-term goals for their learning, plan ahead to accomplish their goals, self-motivate themselves, and focus their attention on their goals and progress. They also are able to employ multiple learning strategies and adjust those strategies as needed, self-monitor their progress, seek help

from others as needed, and self-evaluate their learning goals and progress based upon their learning outcomes. Teachers at the primary and secondary levels can use the aforementioned strategies to promote self-regulation in their classrooms. However, teachers should understand that learners develop at various paces, and strategies that work best for one learner may not always work with the next

Concept of Academic Achievement

Academic achievement is the outcome of education, that is, the extent to which a student has achieved their educational goals (Magnuson, 2007). It could be seen as behavioural changes determined through standardized serial test. Achievement test is usually constructed and standardised to measure achievement in school subjects. What this means is that academic achievement is measured in relation to what is attained at the end of a course, since it is the accomplishment of medium or long term objective of education (Ejelue, 2017). Achievement as used in this study is the students' chemistry scores as measured from the chemistry achievement test. The students' achievement is affected by a number of factors of which the instructional skills are most implicated (Nwagbo, 2009). However, students' related factors that affect academic achievement have gained attention in recent studies. It is in this wise that this study sought to establish effect of self-regulated learning of students' chemistry achievement.

Concept of Attitude

Throughout the history of social psychology, attitudes have played central role in explanation of social behaviour (David, 2007). The word "attitude" came from the Latin word "aptus" meaning fitted or fit, and the Latin ending "tude," a feminine suffix for abstract nouns formed from adjectives (Oxford English Dictionary, 1984). Derived from

"aptus" attitude denoted fitness or adaptedness, hence the physical connotation, but like the word aptitude, attitude suggests a mental preparation for action as well (Ledbetter & Kuznekoff, 2011). An attitude is usually defined as a disposition of respond favourably or unfavourably to an object, person, institution or event. Attitude towards study has great contribution in academic achievement and good study pattern.

Once used to describe the spatial orientation of physical objects (Ledbetter, 2009), the concept of attitude has evolved to refer to a person's mental state of readiness (Breckler & Wiggins, 1989, p.407). The origin of attitude as a modern concept began at the start of the twentieth century. Before this point, attitude was a physical concept used by artists to describe the posture of stationary figures, actors and dancers (Shrigley, Koballa, & Simpson, 1988). After advancements in social sciences research, the psychological meaning surpassed the physical posture connotation. Darwin first used attitude as a mental concept and as having an evaluative quality to describe the emotional readiness of animals in crisis. Until the middle of the 19th century attitude research had focused on measurement, but then psychology emphasized attitude as a mental concept. In the next few decades attitude's effects on behaviour became the focal point of research and theory, and history's transformation of attitude from a physical to an evaluative concept progressed (Shrigley, Koballa, & Simpson, 1988).

According to Dillard (1993), there are several varying conceptualizations of attitudes in social science research. At different points in its history, the concept of attitude has been linked to emotional, behavioral and cognitive processes. Therefore, the definition of attitude should consist of cognitive, affective, and conative components (Ajzen, 2005, p.20).

One of the first definitions of attitude was given by Thurstone as “an affect for or against a psychological object” (Ajzen, 2005, p.29). Fishbein and Ajzen (1975, p.6) defined attitude as, “a learned predisposition to respond in a consistently favourable or unfavourable manner with respect to a given object”. Petty and Cacioppo (1981, p.7) stated that, “attitude is a general and enduring positive or negative feeling about some person, object, or issue”. Eagly and Chaiken (2007) offered a more comprehensive definition by taking into account three major components of attitude-namely, tendency, entity (or attitude object), and evaluation. They defined attitude as "a psychological tendency that is expressed by evaluating a particular entity with some degree of favour or disfavour". Similar revisions to these definitions by other scholars continued to emerge in attitude literature, but emotion, behaviour and cognition remained central to each definition.

Attitude is the opinion and feeling that you usually have about something (Della, 2008). Gagne (1979) cited by Fasakin (2011) recognized attitude as a major factor in a subject choice, also considered attitude as a mental and natural state of readiness, organized through experiences exerting a directive influence upon the individual’s responses to all objects and situation with which it is related.

Erdemir and Bakirci (2009) described attitude as tendency for individuals who organize thought, emotions, and behaviours towards psychological object. Human beings are not born with attitudes they learn afterwards. Some attitudes are based on the peoples own experience, knowledge and skills and some are gained from other sources. However, the attitude does not stay the same. It changes in the couple of time and gradually.

The attitude of students towards a particular subject matter plays a significant role in determining how such students will perform in that subject matter. If the attitude of the child is favourable, the child learns better but the reverse is the case if the attitude is negative. Therefore, teaching methods that will stimulate students interesting thereby enhancing the development of the appropriate attitude should be adopted in the learning process. Multimedia instruction will no doubt stimulate students' interest in a given subject matter in the sense that students have the opportunity to learn by words and pictures. Multimedia instruction appeal to more than one sense organ of learners and this stimulate students' interest.

Empirical Studies on the Effect of Self-Regulated learning on Students' Achievement in Chemistry

Ejelue (2017) investigated the relationship between students' self-regulated learning skills and academic achievement scores in biology in Onitsha Education Zone. The study was necessitated by the fact that teachers often adopt teacher centered approach to teaching and learning which affords the students little or no responsibility for their learning. The need arose therefore to investigate how the students' self-regulated learning skills correlated with their academic achievement in biology. Eight research questions and six hypotheses tested at 0.05 level of significance guided the study. The correlational survey design was used. The population of the study was made up of 4,526 senior secondary school year two (SS2) students in Onitsha Education Zone of Anambra state. A sample of 400 SS2 biology students obtained using a multi-stage sampling was involved in the study. The instruments for data collection were Biology Achievement Test (BAT) and Self-Regulated Learning Scale (SRLS). The instruments were validated by two lecturers; one in Science Education Department, Nnamdi Azikiwe University

Awka and one Measurement and Evaluation, Departmentand Delta State University, Abraka and one experienced biology teacher. The reliability of the instruments were established using Kudder-Richardson Formula 20 for the BAT with a reliability coefficient of 0.88 and Cronbach Alpha technique for the SRLS with a reliability index of 0.95. The data collection method was by administering the instruments to the students with the aid of research assistants. The data obtained were analyzed using Pearson correlation coefficient. The results revealed that the self-regulated learning skills of peer learning and help seeking correlated positively with achievement in biology. There was no significant relationship between self-regulated learning skills scores of students and achievement in biology. There were low positive relationships between male and female SRL skills and their achievement in biology. Since the study revealed that help seeking skills significantly correlated achievement, teachers should adopt teaching and learning approaches that enhance interaction among students and students with teachers.

Nwafor, Obodo and Okafor (2015) investigated the effect of self-regulated learning approach on junior secondary school students' achievement in basic science. The purpose of the study was to determine the effect of self-regulated learning approach on junior secondary school students' achievement in basic science. Quasi-experimental design was used for the study. Two co-educational schools were drawn for the study through simple random sampling technique. One school was assigned to the treatment group while the other was assigned to the control group through a simple toss of the coin. Basic Science Achievement Test (BSAT) was the instruments used to collect data. Three research questions and three null hypotheses guided the study. The data for the research questions were answered descriptively using mean and standard deviation, while the

hypotheses were tested using the analysis of Covariance (ANCOVA) at an alpha level of 0.05. The findings of the study reveal that self regulated learning strategy enhanced higher students' achievement in basic science than the conventional method.

Oruc and Arslan (2016) investigated the impact of self-regulated learning on reading comprehension and attitude towards Turkish course and metacognitive thinking. The purpose of this study was to examine the impact of self-regulated learning on students' reading comprehension and attitude towards Turkish course and metacognitive thinking skills. For this purpose, the study was carried out with the 5th graders in Zonguldak Province. In this study, one of the classes was designated as the experimental group and the other class as the control group. While self-regulated learning was applied to the experimental group, a traditional method was applied to the control group. The study lasted for 8 weeks totally. In the study, non-equivalent control group's pre-test posttest design was used. The data were obtained with the help of a reading comprehension test, an attitude scale, a metacognitive thinking skills scale and an interview. At the end of the study, depending on the quantitative data, it was found that self-regulated learning significantly increased the reading comprehension and metacognitive thinking skills of the students in the experimental group. The study further revealed that there was no significant difference between the mean attitude scores of students' in experimental and control groups.

Yigzaw and Fentle (2013) investigated the impact of students' self-regulated language learning on their reading achievement in Ethiopian high schools: Grade 9 in focus. The purpose of this study is to determine whether or not motivational beliefs and self-regulated learning strategies are significant predictors of high school students'

reading performance. The subscales used for the motivation scale were intrinsic goal orientation, extrinsic goal orientation, task value, and self-efficacy for learning and performance; while the sub-scales for the cognitive learning strategies were cognitive strategies (rehearsal, elaboration, organization, critical thinking) and metacognitive self-regulation (planning, monitoring, and evaluating). The study group comprised 107 grade 9 students at Bahir Dar. The instruments employed were questionnaire, interview and tests; therefore, both qualitative and quantitative methods were applied to analyze the data. The results showed that self-regulated learning significantly impact high school students' reading performance.

Olakanmi and Gumbo (2017) investigated the effects of self-regulated learning training on students' metacognition and achievement in chemistry. This study reported on an empirical investigation of the effectiveness of self-regulatory training on secondary school students' metacognition and achievement in chemistry. A total of 60 students aged 14-15 were randomly assigned into either the experimental group or the control group. Participants in the experimental group completed four self-regulated learning (SRL) exercises based on Zimmerman's (2002) cyclical model. Data were collected using pre- and post-self-regulated learning questionnaire (SRLQ), and pre- and post reaction rates knowledge tests (RRKT) test. Additional qualitative data were collected through classroom observation and interviews. Quantitative data were analysed using SPSS while thematic analysis was used for the qualitative data. The results revealed that there were significant differences between the two groups in terms of SRL skills, i.e. students in the experimental group scored higher on post-SRLQ. Regarding students' achievement in chemistry, a slightly greater improvement was found for the students with SRL training

which was insignificant. The findings suggested that training in SRL improves students' achievement in chemistry and therefore should be included in secondary science classrooms.

Empirical Studies on the Effect of Self-Regulated Learning on students' Attitude in Chemistry

As reviewed above, Oruc and Arslan (2016) investigated the impact of self-regulated learning on reading comprehension and attitude towards Turkish course and metacognitive thinking. The purpose of this study was to examine the impact of self-regulated learning on students' reading comprehension and attitude towards Turkish course and metacognitive thinking skills. For this purpose, the study was carried out with the 5th graders in Zonguldak Province. In this study, one of the classes was designated as the experimental group and the other class as the control group. While self-regulated learning was applied to the experimental group, a traditional method was applied to the control group. The study lasted for 8 weeks totally. In the study, non-equivalent control group's pre-test posttest design was used. The data were obtained with the help of a reading comprehension test, an attitude scale, a metacognitive thinking skills scale and an interview. At the end of the study, depending on the quantitative data, it was found that self-regulated learning significantly increased the reading comprehension and metacognitive thinking skills of the students in the experimental group. The study further revealed that there was no significant difference between the mean attitude scores of students' in experimental and control groups.

Schroeder (2007) investigated abstract for look at attitude and achievement as a result of self-regulated learning in the Algebra I classroom. The study involved an intervention in a Mid-South urban high school at the 9th grade level. All students who

participated were enrolled in the middle track at the school, thus taking an Algebra I course. The intervention took place with four teachers in seven separate classes. Students were given the opportunity to regulate their own learning based on objectives for district and state requirements. In this pre/post design, students were surveyed for their mathematics attitude and achievement using the Attitude Toward Mathematics Inventory and a polynomial survey designed by the researcher. Teachers were surveyed and interviewed prior to the study to develop a sense of their teaching preferences. During the experiment classroom observations were conducted to assist in developing themes in the intervention. Following the study, extensive interviews took place with each participating teacher. Data analyses revealed no statistically significant difference between the control and experimental group in regards to mathematics attitude and achievement. Qualitative analysis using constant comparative strategies revealed many teacher barriers and misconceptions. Teachers felt uncomfortable with the technique and were unable to allow the students to fully regulate their learning. The teachers imposed a timeline, quizzes, written tests, and direct instruction techniques on the students during the study. All of these created barriers to the students fully regulating their learning. Also, teachers' perceptions of learning and attitude were not valid. Teachers believed the students achieved at a lower level than with a traditional approach and viewed their attitudes as worse than normal. This was in direct contrast to the quantitative results.

Ozdemir and Arslan (2016) explored the effect of self-regulated jigsaw IV on university students' academic achievement and attitudes towards english course. This study determined the effect of self-regulated jigsaw IV upon university students' learning a new grammar structure within EFL learning process and also their attitudes towards the

English course. The research was carried out with 40 students studying in two different prep classes at Bulent Ecevit University Foreign Languages College in the spring term of 2011-2012 academic year. During the courses, while self-regulated jigsaw IV was carried out with the experimental group, a traditional method was performed in the control group. As quantitative data suggest; self-regulated jigsaw IV has significantly increased students' academic achievement compared to traditional method; however, it is slightly effective on their attitudes towards English. As qualitative data suggest; the students in the experimental group feel self-satisfied with their learning and they can use self-regulation skills in their autonomous studies.

Arsal (2009) investigated the impact of self-regulation instruction on mathematics achievements and attitudes of elementary school students. The purpose of this study is to find out the impact of self-regulation instruction on fractions and decimal numbers on academic achievement and attitude towards mathematics in elementary school program in Turkey. The subjects of the study were fourth year elementary school students (N=60). Self-regulated learning instruction was implemented in the experimental group. The results in the study suggested that the students in the experimental group had higher academic achievement on fraction and decimal numbers, and attitude scores in mathematics than the control group

Empirical Studies on Sex Differences in the Effects Self-Regulated Learning on Achievement in Chemistry

Sardareh, Saad and Boroomand (2012) explored self-regulated learning strategies (SRLS) and academic achievement in pre-university EFL learners. The study investigated the relationship between the two variables of the research that is, the use of SRL strategies and students' academic achievement. The subjects under study were a group of

male (40) and female (42) preuniversity students randomly selected from two schools in Tehran, Iran. The instruments used to gather data were a translated version of the Motivated Strategies for Learning Questionnaire (MSLQ) and an academic achievement test. In order to describe data collected from administering the above- mentioned instruments statistical procedures such as mean, standard deviation, correlation coefficient, as well as an independent t-test were used. The findings of the present study revealed that there is a strong relationship (r = .80) between the use of SRL strategies and students' academic achievement which is consistent with the findings of studies conducted before. However, considering the difference between male and females concerning the use of different components of SRL strategies, the findings of this study showed that there is a difference between male and females as to the use of SRL strategies. Females outperformed males in both academic achievement and the use of SRL strategies.

Banarjee and Kumar (2014) carried out a study on self-regulated learning and academic achievement among the science graduate students. The study attempted to find out the relation of SRL and academic achievement of male and female science graduate students. 300 college students from Varanasi District were selected as the sample. Results reveal that SRL is moderately positive correlated with academic achievement. At different dimensions of the SRL, male and female science graduate students do not differ significantly but at environment they differ significantly.

Weis, Heikamp and Trommsdorff (2013) investigated gender differences in school achievement: the role of self-regulation. The study examined whether different aspects of self-regulation (i.e., emotion and behavior regulation) account for gender

differences in German and mathematics achievement. Specifically, they investigated whether higher school achievement by girls in comparison to boys can be explained by self-regulation. German and mathematics achievement were assessed in a sample of 53 German fifth graders (19 boys, 34 girls) using formal academic performance tests (i.e., reading, writing, mathematics) and teachers' ratings (i.e., grades in German and mathematics). Moreover, teachers rated children's behavior regulation using the Self-Control Scale (SCS-K-D). Children's self-reported strategies of emotion regulation were assessed with the Questionnaire for the Measurement of Stress and Coping in Children and Adolescents (SSKJ 3-8). Age and intelligence (CFT 20-R) were included as control variables. Analyses of mean differences showed that girls outperformed boys in German achievement and behavior regulation. Regression analyses, using a bootstrapping method, revealed that relations between gender and German achievement were mediated by behavior regulation. Furthermore, we found a suppression effect of behavior regulation on the relation between gender and mathematics achievement: boys' mathematics achievement was under-estimated when the analyses did not control for behavior regulation. They discussed these results from a developmental perspective and within the theoretical framework of self-regulation and achievement.

Velayutham, Aldridge and Fraser (2012) investigated gender differences in students motivation and self-regulation in science learning: A multi-group structural equation modeling analysis. The purpose of the study was to investigate the influence of students' motivational beliefs (learning goal orientation, task value and self-efficacy) in science learning on students' self-regulation in the science classroom. The study also examines the moderating effect of gender on the proposed relationships. Data were

collected from 719 boys and 641 girls across grades 8, 9 and 10 in 5 public schools in Perth, Western Australia. Results from structural equation modeling analysis indicated that all 3 motivational constructs were strong predictors of students' self-regulation in science learning. The multi-group analysis to examine gender differences revealed that the influence of task value on self-regulation was statistically significant for boys only. The findings present possible opportunities for educators to plan, and to put into practice, effective intervention strategies aimed at increasing students' self-regulation in science learning. The core feature would be to target and develop students' motivational beliefs of learning goal orientation and self-efficacy in science learning. Additionally, for boys, the intervention strategies would be to elevate boys' perspectives of science task value.

Yukselturk and Bulut (2009) investigated gender differences in self-regulated online learning environment. This study analyzed gender differences in self-regulated learning components, motivational beliefs and achievement in self-regulated online learning environment. Sample of the study consisted of 145 participants from an online programming course which is based on synchronous and asynchronous communication methods over the Internet. Motivated Strategies for Learning Questionnaire (MSLQ) was used to assess students' motivation and use of learning strategies. Linear stepwise regression method and multivariate analysis of variance were used to analyze the data. The results of the study indicated that test anxiety explained a significant amount of variance in female students' achievement and two variables (self-efficacy for learning and performance, and task value) explained a significant amount of variance in male students' achievement. It was also found that there were not statistically significant mean

differences among motivational beliefs, self-regulated learning variables and achievement in programming with respect to gender.

Anyichie and Onyedike (2012) explored the effects of self-instructional learning strategy on secondary schools students' academic achievement in solving mathematical word problems in Nigeria. The study investigated the effects of self-instructional learning strategy on students‟ achievement in solving Mathematical word problems. The research determined whether self-instructional learning strategy has significant effects on the learning achievement of senior secondary school students. Three research questions and two null hypotheses guided the study. The study utilized the non-randomized control group pre-test post-test experimental design. The sample consisted of 131 subjects with mean age of 16.02 years from four schools chosen through simple sampling techniques. Students of the experimental group were instructed in four units of Mathematics syllabus using self-instructional method. On the other hand, the control group was taught the same topics in Mathematics using the conventional teaching method. Mathematics Achievement Test instrument developed and duly validated by experts was used to collect data. Data collected were analysed using mean for the research questions and Two-way Analysis of co-variance was used to test the hypotheses at 0.05 level of significance. Major findings of the study indicate that there was significant main effect of treatment (self-instructional learning strategy) on the student's mathematical word problem achievement. The effect of gender on mathematical word problem achievement was found insignificant. However, a significant interaction effect was observed between gender and learning strategy. Thus, males in the experimental group significantly

performed better than their female counterparts. Based on these findings, educational implications of the study were raised.

Empirical Studies on Sex Differences in the Effects Self-Regulated Learning on Attitude in Chemistry

Kanmani and Annaraja (2009) conducted a study on metacognition and attitude in computer science degree students. In that study metacognition was took up as one of the psychological factors, which affects the program writing skill of the students. The result of the study revealed that among the sample, there was a low negative correlation between the metacognition and attitude in computer science degree students. Further, the result of the study revealed that there was a significant difference between the effects of metacognition on the attitude of male and female students in favour of female.

Rahman (2011) conducted a study on the impact of some students' related factors on their metacognitive awareness. Results of the study revealed that metacognitive awareness was significantly correlated with attitude towards library and internet. Further, the study revealed that children of highly educated parents were highly metacognitive aware than the children of less educated parents. Results further indicated that there was no significant difference in the effect of metacognitive awareness on the attitude of male and female students' library.

Garmabi and Zareian (2016) explored EFL teachers' attitudes towards the effectiveness of metacognitive strategies used by high school students. The study examined the teachers' attitude towards the effectiveness of metacognitive strategies used by high school students. To achieve the study goals, 100 teachers who taught English at different high schools of three Cities of Iran were asked to complete 34 item thesis questionnaire which investigated the teachers' attitude toward the effectiveness of

metacognitive strategy use while reading a text. The results of statistical analysis indicated that while male and female teachers have the same attitude about reading and post-reading metacognitive strategies, they have significantly different attitudes about pre-reading metacognitive strategies. The results offer implications and suggestions for the pedagogical considerations within the school and even at university contexts.

Appraisal of the Reviewed Literature

Finding solution to students' underachievement and poor attitude towards chemistry at the senior secondary school level has been the focus of science education researchers. Reviewed works attributed Chemistry students' poor academic achievement to various factors including poor teaching methods among others. Researchers argued that the lecture method commonly used in Nigerian schools is responsible for students' poor performance in Chemistry as a result of students' passive involvement in the teaching and learning process. Succinctly put, the lecture method has not produced the expected results with respect to students' Chemistry performance in external examination such as SSCE.

Self-regulated learning on the other hand is a teaching strategy that enhances students' ability to understand and control their learning. It is an act of learning that is guided by meta-cognition (thinking about one's thought), strategic action (planning, monitoring and evaluating personal progress against standards) and motivation to learn taking the process of control and evaluating one's own learning and behaviour. The evidences from the literature reviewed are not conclusive about the effects of self-regulated learning on students' achievement and attitude. Most of the studies however found significant effect of self-regulated learning on students' achievement and attitude.

There are also little or no studies on the effects of self-regulated learning strategy in the subject area of Chemistry in senior secondary schools. Most of the studies in self-regulatory learning were conducted using higher institutions and in other subject areas. This underlined the need to examine if self-regulated learning can improve students' achievement and attitude in Chemistry in Delta North Senatorial District.

Furthermore, evidences from the reviewed literature on self-regulated learning and sex differences are contradictory. Therefore, it is imperative to carry out further studies to provide more empirical evidence on sex differences in the effects of Self-Regulated learning on students' achievement and attitude towards Chemistry. It is this gap this study filled.

CHAPTER THREE

RESEARCH METHOD AND PROCEDURE

This chapter presents a description of the method and procedure that was used in the study. The chapter was organized under the following sub-headings: Research Design, Population of the Study, Sample and Sampling Techniques, Research Instrument, Validity of the Instrument, Reliability of the Instrument, Treatment Procedure and Method of Data Analysis.

Research Design

The study adopted quasi-experimental design. Specifically, the non-equivalent pre-test posttest control group design was used. In this design, random assignment of subjects to experimental and control groups were not possible rather intact classes were used in order not to disrupt classroom teaching. In support of this design, Wiseman (1999), Campbell and Stanley (1963) stated that quasi-experimental design is an appropriate research design when randomization is impossible. According to Ali (2006), quasi-experimental research design can only be used when the researcher cannot randomly sample and assign subjects to groups. This design was adopted to determine the effects of Self-Regulated learning strategy on students' achievement and attitude. In this design, both the experimental and control groups were exposed to the same Chemistry contents. The only difference between the two groups was their instructional approaches. The experimental groups learned with Self-Regulated learning strategy formats while the control group learnt with lecture method format. The effects of the two methods were then compared.

The design is presented in the table below:

Table 1: Design Matrix

Group	Pre-test	Treatment	Post-test
Self-regulated learning	O_1	X_1	O_2
Lecture method (control)	O_3	X_2	O_4

Where,

O_1 = pre-test of self-regulated learning group

O_2 = posttest of self-regulated learning group

O_3 = pre-test of lecture method group

O_4 = post-test of lecture method group

X_1 = treatment using Self-Regulated learning strategy

X_2 = treatment using lecture method

Population of the Study

The population of this study comprised all public senior secondary school Chemistry students in Delta North Senatorial District. Specifically, population of SSII Chemistry in public secondary schools in Delta North Senatorial District was used for this study. The total population of SSII Chemistry students is five thousand eight hundred and thirteen comprising two thousand nine hundred and fifty six males and two thousand eight hundred and fifty seven females from one hundred and forty-six public secondary schools in the Senatorial District (See Appendix H). The senior secondary two (SS11) students were used for the study because they were available to be used at any point in time, since they were not preparing for any external examination, they had already been selected into specific discipline and the selected content were found in SSII Chemistry

Scheme of Work. A detailed description of the population of SSII Chemistry students is shown in Table 2.

Table 2: Population of Senior Secondary School Two (SSll) Students offering Chemistry in Delta North Senatorial District (Summary)

S/N	Local Government Area	Number of Public Secondary Schools	Number of Male Students	Number of Female Students	Total
1	Aniocha North	16	165	189	354
2	Aniocha South	18	234	212	446
3	Ika NorthEast	16	334	339	673
4	Ika South	18	413	346	759
5	Ndokwa East	25	335	297	632
6	Ndokwa West	20	359	376	735
7	Oshimili North	11	263	249	512
8	Oshimili South	10	477	470	947
9	Ukwuani	12	376	379	755
	Total	**146**	**2956**	**2857**	**5813**

Source: Ministry of Education, Exams and Standard, Asaba, Delta State 2016/2017 academic record.

Sample and Sampling Techniques

Sample size of the study comprised 252 SSII Chemistry students selected from four public mixed secondary school students in Delta North Senatorial District.

The selected schools for the study were selected using simple purposive sampling technique based on the following parameters; presence of well equipped Chemistry laboratory, trained and experienced Chemistry teachers and school must be mixed. To this end, all the single sex schools and schools without laboratories were eliminated from the study.

The summary of sample size in each selected schools is shown in Table 3.

Table 3: Sample size for the Study

Name of Schools	No of students		Total
	Male	Female	
Ogbemudein Sec. Sch., Agbor	29	33	62
Asagba Mixed Gram. Sch., Asaba	39	27	66
Community Sec. Sch, Ogbole-Ogume	19	38	57
Obiaruku Gram. Sch., Obiaruku	31	36	67
Total	**118**	**134**	**252**

Research Instrument

Two instruments were used for data collection and they are: (i) Chemistry Achievement Test (CAT) drawn from a six weeks instructional unit in Chemistry on (1) hydrocarbon; (2) alkanes; (3) alkenes; (4) alkynes; (5) benzene and (6) alkanols (See Appendix A & B); and Chemistry Attitude Questionnaire (CAQ).

The chemistry achievement test (CAT) consisted of 50 multiple choice test items constructed from the six weeks instructional units (See Appendix C).

The Chemistry Attitude Questionnaire (CAQ) consists of twenty (20) items seeking respondents' (students) opinion on the effects of Self-Regulated learning on students' attitude towards Chemistry (see Appendix E). The responses to the Chemistry Attitude questionnaire were framed on a 4-point-likert scale of Strongly Agree (SA, 4), Agree (A, 3), Disagree (D, 2) and Strongly Disagree (SD, 1).

Validity of the Instrument

The face validities of the Chemistry Achievement Test (CAT) and Chemistry Attitude Questionnaire (CAQ) were carried out by a panel of three experts made up of

one experienced Chemistry teacher drawn from Abraka Grammar school in Ethiope East Local Government Area of Delta State, one Chemistry Educator from Delta State University and an expert in Measurement and Evaluation from Delta State University Abraka. They determined the face validities of the instruments by critically examining the clarity and appropriateness of the items in the instruments. Their corrections included: that question 11 should be reconstructed, item 22 should be reframed. The panel finally concluded that the items in Chemistry Achievement Test (CAT) be expanded from 40 to 50. For CAQ, The panel recommended that item 5 should be split in two separate items, item 21 should be deleted. Thereafter, their corrections and suggestions were effected in the instruments.

The content validity of the CAT was done using a table of specification which covers all contents in the six weeks instructional units as shown in Table 4.

Table 4: Table of specification on Chemistry Achievement Test (CAT)

Content Area	Sub units	Mental Skills: Lower Order: Knowledge (26%)	Comprehension (20%)	Higher Order: Application (14%)	Analysis (14%)	Synthesis (10%)	Evaluation (16%)	Total (100%)
Organic Chemistry	Hydrocarbons (10%)	2	1	1			1	5
	Alkanes (22%)	3	1	2	2	2	1	11
	Alkenes (18%)	2	2	1	1		3	9
	Alkynes (16%)	2	2	1	1	1	1	8
	Benzene (12%)	1	1	1	1	1	1	6
	Alkanols (22%)	3	3	1	2	1	1	11
Total		13	10	7	7	5	8	50

Reliability of the Instrument

The reliability of the CAT was established using the Kuder-Richardson formula 21 approach. The rationale behind the use of this method is that it is appropriate for multiple options objective test items. The instrument was administered to 40 Chemistry students in a school in Ethiope East Government Area of Delta State who were outside the area of coverage of the study and the obtained data were subjected to Kuder-

Richardson 21 formula. On analysis, a reliability coefficient value of 0.79 was obtained (See Appendix F). There is a standard that specifies that any instrument with a reliability coefficient value of 0.70 and above is reliable (Johnson & Christensen, 2000).

The reliability of the CAQ was established using the Cronbach-alpha technique. The instrument (CAQ) was administered to 40 Chemistry students in a school in Ethiope East Local Government Area of Delta State which were outside the area of coverage for the study. The responses of the 40 students were scored and the obtained scores were subjected to the Cronbach alpha formula. On analysis using the Cronbach alpha through SPSS, a reliability coefficient of 0.88 was obtained (See Appendix G). The instrument was adjudged reliable because it met a standard that any instrument with a reliability index of 0.70 and above is reliable (Johnson & Christensen, 2000).

Treatment Procedure

The first step in the treatment procedure was the assignment of students into Self-Regulated learning group (experimental group) and lecture method group (control). Two intact SSII classes from the four schools selected for the study were randomly selected to make up the experimental group (Self-Regulated learning group). The two remaining intact SSII classes from the schools left served as lecture method group (control group). Both the experimental and control groups were exposed to the same Chemistry subject matter and learning environment. The experimental group learnt using Self-Regulated learning strategy while the control group was taught with the lecture method.

The four teachers in the four selected schools were used as research assistants. They were trained on the skills of using the Self-Regulated learning strategy and lecture method.

Training of Research Assistants for Both Experimental and Control Group

Two teachers out of the four in the selected schools were trained on the skills of using self-regulated learning strategy. This lasted for five days. In the first day, the researcher sought the approval of the school heads (principals) in order to use the teachers and students in the school for the study. On the second day, the researcher with the help of two expert instructors exposed the two teachers to the theories, origin and features of self-regulated learning strategy. On the third day, the teachers were trained using the training manuals developed by the researcher on self-regulated learning strategy of teaching (See Appendix A). The third and fourth days were spent on practice and generation of ideas on how to apply self-regulated learning strategy in the teaching of the selected Chemistry concepts. On the final day of the training, the researcher and the two other expert instructors constructively evaluated the trained Chemistry teachers and when they are convinced that the Chemistry teachers could accurately apply self-regulated learning strategy in teaching the selected Chemistry contents, the training came to a close.

The two lecture method research assistants were not trained since they were used to the lecture method of teaching. The researcher only provided the two lecture method teachers with a lesson plans on the instructional units to use during treatment to avoid discrepancy in the lecture method group.

Step by step treatment procedure

The treatment groups consisted of:

a) Experimental group (Self-Regulated learning strategy); and

b) Control group (lecture method group)

The treatment lasted for a period of six weeks. A week before the start of treatment, the researcher distributed the instructional units for both experimental and control groups to the four research assistants. The instructional units contained Chemistry contents which include; (i) alkanes, (ii) alkenes (iii) alkynes and (iv) alkanoic acid drawn from New School Chemistry by Osei Yaw Ababio. The distribution of instructional units was done for two reasons; (i) to familiarize the teachers to the subject matter contents and (ii) to ensure that all the instructional presentation followed the recommended format for the designated classes.

Two days before the commencement of treatment, both the experimental and control groups were pre-tested with the 50 items Chemistry Achievement Test (CAT) and Chemistry Attitude Questionnaire (CAQ). This was done to determine the equivalence of the groups before treatment and be sure that any noticed change later was due to the treatment. On treatment, for the control group, each and all the contents in the six week instructional unit were presented to the students using lecture method. The two teachers who taught the control groups equally presented the content materials to the students in their final forms. In the experimental classrooms self-regulated learning strategy was applied, the following activities were performed.

Self-Regulated Learning: The teachers in the self-regulated learning group incorporated the four sequence phases; task perception, goal setting and planning, enacting and adaptation phase.

Task perception: Teacher guides the learner, identifies problem and assembles information about the task at hand and take the responsibility.

Goal setting: Goal setting and planning stage is the stage where learners focus on about how to succeed the task. This involves stating goals out of the task perceived. The goals stated guide the student to make plans to actualize the stated goals by utilizing study skills and other tactics in learning strategies.

Enacting phase: Enacting phase is the processing stage of self regulation where all the planning is carried out in focus to already set goals. It is the stage of rigorous activities, action and reaction for the purpose of achieving the stated goals.

Adaptation phase: Adaptation stage which is the last phase is the evaluation of performance and observing the loopholes to modify so as to have greater performance in future. The stages are followed step-by-step intensively by students which lead to sure success in academics.

Two days to the end of the treatment, students in both experimental and control group were posttested with the CAQ and 50 items chemistry achievement test (CAT) after re-shuffling the items in the CAT and scored.

Method of Data Analysis

All the research questions were answered using mean and standard deviation. Hypotheses 1, 3 and 4 were tested for significant difference using analysis of variance (ANOVA) since there was no significant difference in the pre-test scores of students in the compared groups. Hypotheses 2, 5 and 6 was tested using analysis of covariance (ANCOVA) to accommodate the significant difference in the pretest scores of he compared groups. Hypotheses testing were done at 0.05 level of significance.

CHAPTER FOUR

PRESENTATION OF RESULTS AND DISCUSSION

This chapter presents the analysis of the data gathered from students through Chemistry Achievement Test (CAT) and Chemistry Attitude Questionnaire (CAQ).

Presentation of Results

The analysis of results is presented in tables with interpretation of the results after the tables. The results of the data analysis are presented in accordance with the research questions and corresponding hypotheses raised to guide the study.

Research Question 1

Is there any difference between the mean achievement scores of students taught Chemistry using self-regulated learning strategy and those taught using lecture method?

Table 5: Mean and standard deviation of pre-test and posttest achievement scores between students taught chemistry using self-regulated learning strategy and lecture method

Group	N	Pretest		Posttest		Mean Gain
		Mean	SD	Mean	SD	
Self-Regulated Learning	128	29.47	6.44	59.69	12.64	30.22
Lecture	124	29.79	7.79	48.94	10.86	19.15

Table 5 shows a mean achievement pretest score of 29.47, with a standard deviation of 6.44, for students taught Chemistry using self-regulated learning strategy, and a mean achievement pretest score of 29.79, with a standard deviation of 7.79, for students taught Chemistry using the lecture method. Mere comparison of the mean scores shows that the students in both groups are equivalent on the knowledge of the Chemistry concepts taught before treatment. As for the posttest scores, Table 5 indicates a mean

achievement score of 59.69, with a standard deviation of 12.64, for students taught Chemistry using self-regulated learning strategy, while their counterparts taught using the lecture method had a mean score of 48.94, with a standard deviation of 10.86. The students in the self-regulated learning group had a higher mean gain of 30.22, compared to their counterparts in the lecture group which had a mean gain of 19.15.

Hypothesis 1 (Ho_1)

There is no significant difference between the mean achievement scores of students taught Chemistry using self-regulated learning strategy and those taught using the lecture method.

Table 6: ANOVA summary of pretest achievement scores of students taught chemistry using self-regulated learning strategy and lecture method

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	6.513	1	6.513	.128	.721
Within Groups	12730.423	250	50.922		
Total	12736.937	251			

Table 6 indicates a non-significant difference between the mean achievement pretest scores of students taught Chemistry using self-regulated learning strategy and those taught using lecture method, $F(1, 250) = 0.128$, $P(0.721) > 0.05$. With this result, Ho_1 was tested using t-test.

Table 7: t-test summary of posttest achievement scores of students taught chemistry using self-regulated learning strategy and lecture method

Sex	N	$\bar{x}$	SD	df	t-cal.	Sig. (2-tailed)	Decision
Male	128	59.69	12.64				
				250	7.233	0.000	Ho_1 is rejected
Female	124	48.94	10.86				

Table 7 shows that there is a significant difference between the mean achievement posttest scores of students taught Chemistry using self-regulated learning strategy and those taught using lecture method, t = 7.233, P(0.000) < 0.05. Thus, Ho_1 is rejected. Therefore, there is a significant difference between the mean achievement scores of students taught Chemistry using self-regulated learning strategy and those taught using lecture method, in favour of students taught using self-regulated learning strategy.

Research Question 2

Is there any difference between the mean achievement scores of male and female students taught Chemistry using self-regulated learning strategy?

Table 8: Mean and standard deviation of pretest and posttest achievement scores of male and female students taught chemistry using self-regulated learning strategy

Sex	N	Pretest		Posttest		Mean Gain
		Mean	SD	Mean	SD	
Male	68	28.32	6.94	59.76	12.76	31.44
Female	60	30.77	5.60	59.60	12.61	28.83

Table 8 shows a mean achievement pretest score of 28.32, with a standard deviation of 6.94, for male students taught Chemistry using self-regulated learning strategy, and a mean achievement pretest score of 30.77, with a standard deviation of 5.60, for female students taught Chemistry using self-regulated learning strategy. The female students had a greater knowledge of the Chemistry contents taught before treatment by mere comparison of the mean achievement scores. In other words, both the male and female students are not equivalent on the knowledge of the Chemistry concepts taught before treatment. For the posttest, Table 8 indicates a mean achievement score of

59.76, with a standard deviation of 12.76, for male students taught Chemistry using self-regulated learning strategy, while their female counterparts had a mean achievement score of 59.60, with a standard deviation of 12.61. The male students in the self-regulated learning group had a higher mean achievement gain of 31.44, compared to their female counterparts which had a mean achievement gain of 28.83.

Hypothesis 2 (Ho_2)

There is no significant difference between the mean achievement scores of male and female students taught Chemistry using self-regulated learning strategy.

Table 9: ANOVA summary of pretest achievement scores of male and female students taught chemistry using self-regulated learning strategy

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	190.259	1	190.259	4.721	.032
Within Groups	5077.616	126	40.299		
Total	5267.875	127			

Table 9 indicates a significant difference between the mean achievement pretest scores of male and female students taught Chemistry using self-regulated learning strategy, $F(1, 126) = 4.721$, $P(0.032) < 0.05$. Thus, Ho_1 was tested using ANCOVA.

Table 10: ANCOVA summary of posttest achievement scores of male and female students taught chemistry using self-regulated learning strategy

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	68.131[a]	2	34.065	.211	.810
Intercept	22137.972	1	22137.972	136.834	.000
Pre	67.266	1	67.266	.416	.520
Sex	.417	1	.417	.003	.960
Error	20223.369	125	161.787		
Total	476304.000	128			
Corrected Total	20291.500	127			

A non-significant difference was found between the mean achievement posttest scores of male and female students taught Chemistry using self-regulated learning strategy, as shown in Table 10, $F(1, 125) = 0.003$, $P(0.960) > 0.05$. Thus, Ho_2 is retained. Therefore, there is no significant difference between the mean achievement scores of male and female students taught Chemistry using self-regulated learning strategy.

Research Question 3

Is there any difference between the mean attitude scores of students taught Chemistry using self-regulated learning strategy and those taught using lecture method?

Table 11: Mean and standard deviation of pre-test and posttest attitude scores between students taught chemistry using self-regulated learning strategy and lecture method

Group	N	Pretest		Posttest		Mean Gain
		Mean	SD	Mean	SD	
Self-Regulated Learning	128	23.30	9.34	57.42	7.22	34.12
Lecture	124	22.50	9.72	55.11	9.93	32.61

Table 11 shows a mean attitude pretest score of 23.30, with a standard deviation of 9.34, for students taught Chemistry using Self-Regulated learning strategy, and a mean attitude pretest score of 22.50, with a standard deviation of 9.72, for students taught Chemistry using lecture method. Mere comparison of the mean scores implies that the students in both groups are equivalent in terms of attitude towards Chemistry before treatment. For the posttest scores, Table 11 indicates a mean attitude score of 57.42, with a standard deviation of 7.22, for students taught Chemistry using Self-Regulated learning strategy, while their counterparts taught using lecture method had a mean score of 55.11, with a standard deviation of 9.93. The students in the Self-Regulated learning group had a

higher mean attitude gain of 34.12, compared to their counterparts in the lecture group which had a mean attitude gain of 32.61.

Hypothesis 3 (Ho_3)

There is no significant difference between the mean attitude scores of students taught Chemistry using Self-Regulated learning strategy and those taught using lecture method.

Table 12: ANOVA summary of pretest attitude scores of students taught chemistry using self-regulated learning strategy and lecture method

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	39.996	1	39.996	.440	.508
Within Groups	22705.719	250	90.823		
Total	22745.714	251			

Table 12 indicates a non-significant difference between the mean attitude pretest scores of students taught Chemistry using self-regulated learning strategy and those taught using lecture method, F(1, 250) = 0.440, P(0.508) > 0.05. With this result, Ho_3 was tested, using t-test.

Table 13: t-test summary of posttest attitude scores of students taught chemistry using self-regulated learning strategy and lecture method

Sex	N	$\bar{x}$	SD	df	t-cal.	Sig. (2-tailed)	Decision
Male	128	57.42	7.22				
				250	2.117	0.035	Ho_3 is rejected
Female	124	55.11	9.93				

Table 13 shows that there is a significant difference between the mean attitude posttest scores of students taught Chemistry using self-regulated learning strategy and those taught using lecture method, t = 2.117, P(0.035) < 0.05. Thus, Ho_3 is rejected. Therefore, there is a significant difference between the mean attitude scores of students

taught Chemistry using self-regulated learning strategy and those taught using lecture method, in favour of students taught using self-regulated learning strategy.

Research Question 4

Is there any difference between the mean attitude scores of male and female students taught Chemistry using self-regulated learning strategy?

Table 14: Mean and standard deviation of pretest and posttest attitude scores of male and female students taught chemistry using self-regulated learning strategy

Sex	N	Pretest		Posttest		Mean Gain
		Mean	SD	Mean	SD	
Male	68	22.24	10.11	57.29	7.32	35.05
Female	60	23.30	8.31	57.57	7.16	34.27

Table 14 shows a mean attitude pretest score of 22.24, with a standard deviation of 10.11, for male students taught Chemistry using self-regulated learning strategy and a mean attitude pretest score of 23.30, with a standard deviation of 8.31, for female students taught Chemistry using self-regulated learning strategy. The male and female students were almost equivalent with respect to their attitude towards Chemistry by mere comparison of the mean scores. For the posttest, Table 14 indicates a mean attitude score of 57.29, with a standard deviation of 7.32, for male students taught Chemistry using self-regulated learning strategy, while their female counterparts had a mean attitude score of 57.57, with a standard deviation of 7.16. The male students in the self-regulated learning group had a slightly higher mean attitude gain of 35.05, compared to their female counterparts who had a mean attitude gain of 34.27.

Hypothesis 4 (Ho_4)

There is no significant difference between the mean attitude scores of male and female students taught Chemistry using self-regulated learning strategy.

Table 15: ANOVA summary of pretest attitude scores of male and female students taught chemistry using self-regulated learning strategy

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	163.483	1	163.483	1.886	.172
Within Groups	10921.235	126	86.676		
Total	11084.719	127			

Table 15 indicates a non-significant difference between the mean attitude pretest scores of male and female students taught Chemistry using self-regulated learning strategy, F(1, 126) = 1.886, P(0.172) > 0.05. Thus, Ho_4 was tested, using t-test.

Table 16: t-test comparison of posttest attitude scores of male and female students taught chemistry using self-regulated learning strategy

Sex	N	$\bar{x}$	SD	df	t-cal.	Sig. (2-tailed)	Decision
Male	68	57.29	7.32				
				126	0.212	0.832	Ho_1 is retained
Female	60	57.57	7.16				

Table 16 indicates a non-significant difference between the mean attitude posttest scores of male and female students taught Chemistry using self-regulated learning strategy, F(1, 126) = 0.045, P(0.832) > 0.05. Thus, Ho_4 is retained. Therefore, there is no significant difference between the mean attitude scores of male and female students taught Chemistry using self-regulated learning strategy.

Research Question 5

Is there any effect of interaction between sex and teaching method on students' achievement in Chemistry?

Table 17: Mean and standard deviation on effect of interaction between sex and teaching method on students' achievement in chemistry

Methods		**Self-Regulated Learning**			**Lecture**	
	N	**Mean**	**SD**	**N**	**Mean**	**SD**
Pretest						
Male	68	28.32	6.94	50	28.40	7.07
Female	60	30.77	5.60	74	30.73	8.15
Differences		**-2.45**	**1.34**		**-2.33**	**-1.08**
Posttest						
Male	68	59.76	12.76	50	49.92	8.43
Female	60	59.60	12.61	74	48.27	12.25
Differences		**0.16**	**0.15**		**1.65**	**-3.82**

Table 17 shows a mean achievement score of 59.76 for male students who were taught using self-regulated learning strategy (experimental group), while their female counterparts had a mean achievement scores of 59.60. Male students who were taught with lecture method (control) had a mean achievement score of 49.92, while their female counterparts had a mean achievement score of 48.27. The results do not suggest effect of interaction between teaching method and sex on students' achievement in chemistry. This was because for both sexes, the mean achievement scores were higher for students in the experimental group.

Hypothesis 5 (Ho_5)

There is no significant effect of interaction between sex and teaching method on students' achievement in Chemistry.

Table 18: ANCOVA summary of effect interaction between sex and teaching method on students' achievement in chemistry

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	7380.311[a]	4	1845.078	13.134	.000
Intercept	41249.263	1	41249.263	293.619	.000
Pretest	16.903	1	16.903	.120	.729
Methods	6908.941	1	6908.941	49.179	.000
Sex	40.213	1	40.213	.286	.593
Methods * Sex	34.179	1	34.179	.243	.622
Error	34700.007	247	140.486		
Total	787752.000	252			
Corrected Total	42080.317	251			

Table 18 shows that there is no significant effect of interaction between sex and teaching method, as measured by the students' mean achievement scores in Chemistry, $F(1, 247) = 0.243$, $P(0.622) > 0.05$. Therefore, Ho_5 is retained. Thus, there is no significant effect of interaction between sex and teaching method on students' achievement in Chemistry. This implies that the students' achievement in Chemistry relative to the teaching method is not influenced by sex.

Research Question 6

Is there any effect of interaction between sex and teaching method on students' attitude towards Chemistry?

Table 19: Mean and standard deviation on effect of interaction between sex and teaching method on students' attitude in chemistry

Methods		**Self-Regulated Learning**			**Lecture**	
	N	**Mean**	**SD**	**N**	**Mean**	**SD**
Pretest						
Male	68	22.24	10.11	50	24.32	8.15
Female	60	24.50	8.31	74	21.27	10.53
Differences		**-2.26**	**1.80**		**3.05**	**-2.38**
Posttest						
Male	68	57.29	7.32	50	54.64	8.94
Female	60	57.57	7.16	74	55.43	8.56
Differences		**-0.28**	**0.16**		**-0.79**	**0.38**

Table 19 shows a mean attitude score of 57.29 for male students who were taught using Self-Regulated learning strategy (experimental group), while their female counterparts had a mean attitude score of 57.57. Male students who were taught with lecture method (control) had a mean attitude score of 54.64, while their female counterparts had a mean attitude score of 55.43. The results do not suggest effect of interaction between teaching method and sex on students' attitude towards chemistry. This was because for both sexes, the mean achievement scores were higher for students in the experimental group.

Hypothesis 6 (Ho_6)

There is no significant effect of interaction between sex and teaching method on students' attitude towards Chemistry.

Table 20: ANCOVA summary of effect interaction between sex and teaching method on students' attitude in chemistry

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	359.384[a]	4	89.846	1.186	.318
Intercept	112023.444	1	112023.444	1478.400	.000
Pretest	2.489	1	2.489	.033	.856
Methods	351.259	1	351.259	4.636	.032
Sex	17.746	1	17.746	.234	.629
Methods * Sex	5.016	1	5.016	.066	.797
Error	18716.044	247	75.773		
Total	817432.000	252			
Corrected Total	19075.429	251			

Table 20 shows that there is no significant effect of interaction between sex and teaching method, as measured by the students' mean attitude scores in Chemistry, F(1, 247) = 0.066, P(0.797) > 0.05. Therefore, Ho_6 is retained. Thus, there is no significant effect of interaction between sex and teaching method on students' attitude towards Chemistry. This implies that teaching methods do not combine with sex to influence students' attitude towards Chemistry.

Discussion of Results

The results of this study are discussed under the following sub-headings.

Self-Regulated Learning Strategy and Achievement in Chemistry

The first finding of the study revealed that there is a significant difference between the mean achievement scores of students taught Chemistry using self-regulated learning strategy and those taught using lecture method, in favour of students taught using self-regulated learning strategy. One possible explanation for this observation is Self-Regulated learning strategy has the capacity to arouse and sustain students' motivation and interest as well as helping students to develop learning skills. Self-

regulated learning strategy gave students the opportunity to apply self-regulatory skills in the quest of resolving a giving problem. The lecture method on the other hand does not stimulate and capture students' interest and motivation as a result of students' passive involvement in the teaching and learning process. This may have accounted for the observed low achievement scores of students in the lecture group. This finding agrees with the views of Nwafor, Obodo and Okafor (2015), who reported that self regulated learning strategy enhanced higher students' achievement in Basic Science than the lecture method. This finding also gives credence to that of Oruc and Arslan (2016) and Yigzaw and Fentle (2013) who reported that Self-Regulated learning strategy significantly increased the reading comprehension and metacognitive thinking skills of students. The finding further corroborates with that of Olakanmi and Gumbo (2017), who reported that self-regulated learning significantly improved students' achievement in Chemistry.

Self-Regulated Learning Strategy, Sex and Achievement in Chemistry

The second finding of this study revealed that there is no significant difference between the mean achievement scores of male and female students taught Chemistry using self-regulated learning strategy. This finding confirms that of Yukselturk and Bulut (2009) who reported that there were not statistically significant mean differences among motivational beliefs, self-regulated learning variables and achievement in programming with respect to gender. This finding disagrees with the views of Sardareh, Saad and Boromand (2012) who found a significant difference in the mean achievement scores of learners exposed to self-regulated learning strategy, based on sex. Specifically, Sardareh, Saad and Boromand (2012) reported that females outperformed males in both academic achievement and the use of self-regulated learning (SRL) strategies. This finding also

contradicts the views of Anyichie and Onyedike (2012) who reported that males in the experimental group (Self-Regulated Learning) significantly performed better than their female counterparts in Mathematics.

Self-Regulated Learning Strategy and Attitude Towards Chemistry

The third finding of this study revealed that there is a significant difference between the mean attitude scores of students taught Chemistry using self-regulated learning strategy and those taught using lecture method, in favour of students taught using self-regulated learning strategy. This finding concurs with that of Arsal (2009) who reported that self-regulated learning significantly improved the attitude scores of students in Mathematics. This finding further gives credence to that of Ozdemir and Arslan (2016) who observed that self-regulated Jigsaw IV significantly enhanced students' attitude towards English Language, compared to the lecture method. However, this finding contradicts that of Oruc and Arslan (2016) who reported that there was no significant difference between the mean attitude scores of students' taught using self-regulated learning strategy and lecture method.

Self-Regulated Learning Strategy, Sex and Attitude Towards Chemistry

The fourth finding of this study revealed a non-significant difference between the mean achievement scores of male and female students taught Chemistry using self-regulated learning strategy. This finding is consistence with that of Rahman (2011); Garmabi and Zarein (2016) who reported a non-significant difference in the attitude scores of male and female students exposed to self-regulated learning strategy. However, this finding contradicts the views of Kanmani and Annaraja (2009) who reported a

significant difference between the effects of self-regulated learning strategy on the attitude of male and female students, in favour of female.

Effect of Interaction Between Sex and Teaching Method on Chemistry Achievement

The study further revealed a non-significant effect of interaction between sex and teaching method on students' achievement in Chemistry. This finding confirms the views of Banarjee and Kumar (2014) who reported a non-significant effect of interaction between sex and teaching method on students' achievement in science. However, this finding disagrees with that of Anyichie and Onyedike (2012) who reported a significant interaction effect between gender and self-regulated learning strategy on students' achievement in Mathematics.

Effect of Interaction Between Sex and Teaching Method on Attitude Towards Chemistry

The study finally revealed that there is no significant effect of interaction between sex and teaching method on students' attitude towards Chemistry. This finding is in agreement with that of Oruc and Arslan (2016), who found a non-significant effect of interaction between sex and teaching method on students' attitude towards reading comprehension. This finding also gives credence to that of Ozdemir and Arslan (2016) who observed that there was no significant effect of interaction between sex and teaching method on students' attitude towards English.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMNDATIONS

This chapter is organized under the following sub-headings: summary of the research, conclusions, recommendations, contributions to knowledge and suggestions for further research.

Summary of the Research

The study investigated the effects of self-regulated learning strategy on Chemistry students' achievement and attitude in Senior Secondary Schools in Delta North Senatorial District. Six research questions and six hypotheses were raised to guide the study. The design of the study was quasi-experimental design, specifically the non-equivalent pre-test, posttest, control group design. Population of the study was senior secondary two (SS II) Chemistry students. There are 5, 813 SS II Chemistry students in the 146 public secondary schools in Delta North Senatorial District. A sample size of 252 SS II Chemistry students, randomly selected from six secondary schools in Delta North Senatorial District was used for this study. The instruments used for data collection in the study were a Chemistry Achievement Test (CAT) and Chemistry Attitude Questionnaire (CAQ) constructed by the researcher and which was validated by two lecturers, one Science Educator in Chemistry and an expert in Measurement and Evaluation in Delta State University Abraka and one experienced Chemistry teacher drawn from Abraka Grammar School in Ethiope East Local Government Area of Delta State. The reliability of the Chemistry Achievement Test (CAT) was established, using the Kuder-Richardson Formula 21. This was done by administering the CAT to 40 Chemistry students outside the area of the study and computing the reliability index. The reliability coefficient of

CAT was 0.79. As for the Chemistry Attitude Questionnaire, the Reliability of the CAQ was established, using the Cronbach-Alpha technique. The instrument (CAQ) was administered to 40 Chemistry students in a school in Ethiope East Local Government Area of Delta state which was outside the area of coverage for the study. The responses of the 40 students were scored and the obtained scores were subjected to the Cronbach Alpha formula. On analysis using the Cronbach alpha through SPSS, a Reliability Coefficient of 0.88 was obtained

The treatment involved exposing the students in the experimental group to the Chemistry concepts "alkanes, alkenes, alkynes and alkanoic acid", with the use of Self-Regulated learning strategy and the control group with lecture method. Pre-test was administered before the treatment and posttest after the treatment. The scores obtained were collated and analyzed using descriptive statistics, analysis of variance (ANOVA) and analysis of covariance (ANCOVA).

Major Findings of the Study

The major findings of the study are as follows:

1. There was a significant difference between the mean achievement scores of students taught Chemistry using Self-Regulated learning strategy and those taught using lecture method, in favour of students taught using Self-Regulated learning strategy.
2. There was no significant difference between the mean achievement scores of male and female students taught Chemistry using Self-Regulated learning strategy.
3. There was a significant difference between the mean attitude scores of students taught Chemistry using Self-Regulated learning strategy and those taught using

lecture method, in favour of students taught using Self-Regulated learning strategy.

4. There was no significant difference between the mean attitude scores of male students taught Chemistry using Self-Regulated learning strategy.
5. There was no significant effect of interaction between sex and teaching method as measured by the students' mean achievement scores in Chemistry Achievement Test (CAT).
6. There was no significant effect of interaction between sex and teaching method as measured by the students' mean attitude scores in Chemistry Attitude Questionnaire (CAQ).

Conclusion

The study concluded that self-regulated learning significant improves students' achievement and attitude in Chemistry more than the lecture method. Self-regulated learning strategy did not significantly differentiate between sexes relative to achievement and attitude in Chemistry. Finally, the study concluded that self-regulated learning strategy did not combine with sex to influence students' achievement and attitude in Chemistry.

Recommendations

The following are recommended, based on the major findings of the study:

1. Chemistry teachers should adopt the use of self-regulated learning strategy in teaching Chemistry at the secondary school level. The use of self-regulated learning strategy will enhance students' ability to understand and control their learning.

2. Government should train Chemistry teachers to acquaint them on importance of students' self-regulating learning. This will aid Chemistry and other science teachers in guiding students through the various stages of Self-Regulated learning strategy.
3. Chemistry teachers should be trained by government on how to construct lesson plans on Self-Regulated learning strategy and other innovative teaching strategies. The construction of adequate lesson plans on these innovative teaching strategies is one of the major obstacles militating against teachers' adoption of these methods in classroom teaching.

Contributions to Knowledge

The study has contributed the following to knowledge.

1. The study re-affirmed that Self-Regulated learning strategy significantly improves students' achievement and attitude in Chemistry more, compared to lecture method.
2. The study also established that there was no significant effect of interaction between self-regulated learning strategy and sex on students' achievement and attitude in Chemistry.

Suggestions for Further Research

The following suggestions are made for further research:

1. A research should be carried out on the effects of self-regulated learning strategy on students' achievement and attitude in other disciplines.
2. A research should be carried out on the effects of self-regulated learning strategy on students' retention and interest in Chemistry.

REFERENCES

Adegoke, B. A. (2011). Effect of multimedia instruction on senior secondary school students' achievement in Physics. *European Journal of Educational Studies, 3(3),* 537-541.

Ajaja, O. P. (2009). *Teaching methods across disciplines*. Ibadan: Bomn Prints.

Ali, A. (2006). *Conducting research in education and social sciences.* Enugu: Tashiwo Net Wones Ltd.

Anene, G. U. (2005). Home economics and the academic performance of a child. *Journals of Home Economics Research*, *6(1),* 99-103.

Anyichie, A. C., & Onyedike, C. C. (2012). Effects of self-instructional learning strategy on secondary schools students' academic achievement in solving mathematical world problems in Nigeria. *An International Multidisciplinary Journal, Ethiopia, 6(4),* 302-323. doi:http://dx.doi.org/10.4314/afrev.v6i4.21

Ajzen, I. (2005). *Attitudes, personality and behaviour*. New York: Open University Press.

Arsal, Z. (2009). *The impact of self-regulation instruction on mathematics achievements and attitudes of elementary school students*. *Egitim ve Bilim,* 34(3-14).

Bandura, A. (1991). Social cognitive theory of self-regulation. *Organizational Behavior and Human Decision Processes, 50(2)*, 248-287. doi:10.1016/0749-5978(91)90022L

Barbara, S.F., & Cirila, P. (2009). Self-regulated processes as correlate of students'achievement in music theory in slovenian elementarymusic schools. *Psihološka obzorja / Horizons of Psychology, 18(4),* 5-18.

Banarjee, P., & Humar, K. (2014). A study on self-regulated learning and academic achievement among the science graduate students. *International Journal of Multidisciplinary Approach and Studies, 1(6),* 329.

Breckler, J. S., & Wiggins, E. C. (1989). On defining attitude and attitude theory: Once more with feeling. In A. Pratkanis, J. Breckler, A. Greenwald (eds.), *Attitude structure and function* (pp. 407- 425). New Jersey: Lawrence Erlbaum Associates, Inc.

Brown, H. C. (1931). *Animal drive and the learning process: An essay toward radical empiricism.* New York: H. Holt and Co.

Bruner, J. S. (1997). Celebrating divergence: Piaget and Vygotsky. *Human Development, 40,* 63-73.

Butler, R. (1998). Determinants of help seeking: Relations between perceived reasons for classroom help-avoidance and help-seeking behaviors in an experimental context. *Journal of Educational Psychology*, *90,* 630-643.

Butler, D. L., & Winne, P. H. (1995). Feedback and self-regulated learning: A theoretical synthesis. *Review of Educational Research*, *65,* 245-281.

Callan, G. L. (2014). *Self-regulated learning (SRL) microanalysis for mathematical problem solving: A comparison of a SRL event measure, questionnaires, and a teacher rating scale.* Theses and Dissertations, Paper 557, University of Wisconsin-Milwaukee.

Campbell, D. T., & Stanley, J. C. (1963). Experimental and quasi-experimental designs for research on teaching. In N. L. Gagne (ed), *Handbook of research on teaching* (231-234). Chicago: Rand McNally.

Carver, C. S., & Scheier, M. F. (1990). Origins and functions of positive and negative affect: A control-process view. *Psychological Review*, *97*, 19-35.

Corno, L. (1993). The Best-laid plans: Modern conceptions of volition and educational research. *Educational Researcher, 22*, 14-22.

Dani, D. (2009). Scientific literacy and purposes for teaching science: A case study of Lebanese private school teachers. *International Journal of Environmental and Science education, 4(3),* 289-299.

David, G. M. (2007). *Psychology* (8th ed.). UK: Worth Publishers.

Della, S. (2008). *Longman dictionary of contemporary english*. Edinburgh Gate Harlow Essex, England: Pearson Education Limited.

Dillard, J. P. (1993). Persuasion past and present: Attitudes aren't what they used to be. *Communication Monographs*, *60*, 90-97.

Eagly, A. H., & Chaiken, S. (2007). The advantages of an inclusive definition of attitude. *Social Cognition , 25(5)*, 582-602.

Ejelue, V. I. (2017). Relationship between secondary school students' self-regulated learning skills and academic achievement scores in biology in Onitsha education

zone. Unpublished M.Ed Thesis Submitted to the Department of Science Education, Faculty of Education, Nnamdi Azikwe University, Awka.

Erdemir, N., & Barkirci, B. (2009). The change and development of attitude of science teacher candidates towards branches. *Kastamonu Education Journal*, *17(1),*161-170.

Fasakin, P. J.(2011). Effects of everyday phenomena on students' achievement, attitude and practical skills in physics. A Masters Dissertation Submitted to the Department of Teacher Education, University of Ibadan, Ibadan, Nigeria.

Federal Ministry of Education. (1985). *National curriculum for senior secondary school, volume 3 science.* Lagos: Federal Ministry of Education.

Federal Republic of Nigeria (FRN), (2004). *National policy on education*. Lagos: NERDC Press.

Fishbein, M., & Ajzen, I. (1975). *Belief, attitude, intention, and behavior: An introduction to theory and research.* Reading, MA: Addison-Wesley.

Garmabi, H., & Zarein, G. (2016). EFL teachers' attitudes towards the effectiveness of metacognitive strategies used by high school students. *International Journal of Learning and Development, 6(1),* 61-75.

Gerard, E., Annemaree, C., & Nan, B. (2013). Self-Regulated learning: key skills and their sources in a sample of adolescent males.*Australian Journal of Educational & Developmental Psychology, 13(1),* 58-74.

Good, T., & Brophy, J. (1995). *Continued educational psychology*. USA: Longman.

Hamid, R. R., Zahra, V., Seyed, H. (2015). Studying the relationship between self-regulation and high school students' academic motivation of the second course in county of Larestan. *Indian Journal of Fundamental and Applied Life Science*, *5 (51),* 455-467.

Harnishferger, K. K. (1995). The development of cognitive inhibition: Theories, definitions, research. In F. N. Dempster & C. J. Brainerd (Eds.), *Interference and Inhibition in Cognition* (pp. 176-206). San Diego: Academic Press.

Hattie, J. (2009). *Visible learning.* Hattie rankings: 195 influences and effects sizes related to student achievement, University of South Australia, ACER.

Igwe, I. O. (2015). Secondary education chemistry curriculum implementation in Nigeria: Contending issues and innovation approaches for the future. *IJSAR Journal of Life and Applied Sciences, 3(1),* 24-33.

Jimoh, A. T. (2007). Influence of gender difference on students' achievement in chemistry. *Nigeria Journal of Educational Studies and Research, 2(1),* 88-94.

Kadivar, P., Manzari, T. V., & Sarami, T. (2012). *Relationship between self-regulated learning skills with academic achievement: A meta-analysis*. Retrieved From http//:www.google.com/recent-advances-on-educational-technologies/123-06.

Kanmani, M., & Annaraja, P. (2009). Metacognition and achievement in computer science degree students. *The Indian Educational Researcher*, *3(1),* 51-59.

Kistner, S., Rakoczy, K., & Otto, B. (2010). Promotion of self-regulated learning in classrooms: Investigating frequency, quality, and consequences for student performance. *Metacognition and Learning*, *5(2),* 157-171.

Kuhl, J. (1985) Volitional mediators of cognition–behavior consistency: self-regulatory processes and action versus state orientation. In J. Kuhl and J. Beckman (Eds), *Action control: From cognition to behavior* (pp. 101-128). New York: Springer.

Ledbetter, A. M. (2009). Measuring online communication attitude: Instrument development and validation. *Communication Monographs, 76(4),* 463-486.

Ledbetter, A. M., & Kuznekoff, J. H. (2011). More than a game: Friendship relational maintenance and attitudes toward Xbox LIVE communication. *Communication Research Journal, 39(2),* 269-290.

Maduabum, M.A. (2006). Sex differences in attitude Towards science and achievements in science in Nigeria: An analysis of 12 years of research. *Journal of Technicaland Science Education, 2* (*1&2*), 63-71.

Magnuson, K. (2007). Maternal education and children's academic achievement during middle childhood. *Developmental Psychology, 43*(*1*), 1497–1512. doi:10.1037/0012-1649.43.6.1497.

Nwagbo, C. R. (2009). *Science technology and mathematics (STM) curriculum development: Focus on problems and prospects of biology curriculum delivery*. 49th Annual conference proceeding of science teachers' Association of Nigeria, 77-81.

Nwafor, C. E., Obodo, A. C., & Okafor, G. (2015). Effect of self regulated learning approach on junior secondary school students' achievement in basic science. *Journal of Education and practice, 6(5),* 78-92.

Nwanze, A. C. (2016). Effect of multimedia synchronized instructional strategy on students' achievement and retention in secondary school chemistry in Onitsha education zone. Unpublished M. Ed Dissertation Submitted to Department of Science Education, Nnamdi Azikiwe University, Awka.

Mezie, G. (2008). Motivation and self-regulated learning: A case study of a pre-intermediate and upper-intermediate adult education students. *WolPap, 2(1),* 79-104.

Mulemwa, J. N. (2002). *A triangular framework for improving girls' participation in SMTE at the school level in Afriac.* An Invited Discussion Paper to the FEMSA/AFCLIST Workshop on Developing a Systematic Framework for Gender Interventions within the Education System in Africa. Kenya: Nairobi.

Olakanmi, E. E., & Gumbo, M. T. (2017). The effects of self-regulated learning training on students' metacognition and achievement in chemistry. *Open Journal Systems, 25(2),* 161-170.

Oruc, A., & Arslan, A. (2016). The impact of self-regulated learning on reading comprehension and attitude towards Turkish course and metacognitive thinking. *Educational Research and Reviews, 11(8),* 523-529.doi:10.5897/ERR2016.2692.

Oxford English Dictionary. (1984). *Definition of attitude*. London: Oxford Publishers.

Ozdemir, E., & Arslan, A. (2016). The effect of self-regulated jigsaw iv on university students' academic achievements and attitudes towards english course. *Journal of Education and Training Studies, 4(5).*doi:10.11114/jets.v4i5.1453.

Paris, S. G., & Paris, A. H. (2001). Classroom applications of research on self-regulated learning. *Educational Psychologist*, *36,* 89-91.

Petty, R. E., & Cacioppo, J. T. (1981). *Attitudes and persuasion: Classic and contemporary approaches*. Dubuque, IA: Wm. C. Brown.

Pintrich, P.R. (2000). The role of goal orientation in self- regulated learning. In M. Boekaerts, P.R. Pintrich & M. Zeidner (Eds.), *Hand book of self-regulation* (pp. 453-458). San Diageo, California: Academic press.

Pintrich, P. R. (2004). A conceptual framework for assessing motivation and self-regulated learning in college students. *Educational Psychology Review*, *16*(*4*), 385-407. doi:10.1007/s10648-004-0006-x

Pressley, M., & Woloshyn, V. (1995). *Cognitive strategy instruction that really improves children's academic performance* (2nd ed.). Cambridge, MA: Brookline.

Rahman, F. (2011). Effects of some students related factors on their metacognitive awareness. *Language of India*, *11(4),* 76-85.

Roediger, H. L., & Marsh, E. J. (2005). The positive and negative consequences of multiple-choice testing. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *31*, 1155–1159.

Ryan, A. M., Pintrich, P. R., & Midgley, C. (2001). Avoding seeking help in the classroom: Who and why? *Educational Psychology Review*, *13*, 93-114.

Sardareh, S. A., Saad, M. R. M., & Boroomand, R. (2012). Self-regulated learningn strategies (SRLS) and academic achievement in pre-university EFL learners. *California Linguistic Notes, 37(1),* 115-123.

Schraw, G., & Moshman, D. (1995). Metacognitive theories. *Educational Psychology Review*, *7*, 351-371.

Schroeder, D. C. (2007). *Abstract for a look at attitude and achievement as a result of self-regulated learning in algebra I classroom*. University of Kentucky Doctoral Dissertations, 541. Retrieved from http://uknowledge.uky.edu/gradschool_diss/541

Schunk, D. H. (2001). Social cognitive theory and self-regulated learning. In B. J. Zimmerman & Schunk, D. H. (eds.), *Self-regulated learning and academic achievement: Theoretical perspectives* (pp. 236-254). Mahwah, NJ. Lawrence Erlbaum Associates.

Shrigley, R., Koballa, T., & Simpson, R. (1988). Defining attitude for science educators. *Journal of Research in Science Teaching, 25(8)*, 659-678.

Tang, E. L. (2012). Correlating pre-university international students' math performance by learning skills and math anxiety in Malaysia. *Journal of Educational and SocialResearch*, *2*(*2*), 73-83.

Velayutham, S., Aldridge, J. M., & Fraser, B. (2012). Gender differences in students motivation and self-regulation in science learning: A multi-group structural equation modelling analysis. *International Journal of Science and Methematics Education, 10(6),* 1347-1368.

Van den Broek, P., Lorch, R., Linderholm, T., & Gustafson, M. (2001). The effects of readers' goals on inference generation and memory for texts. *Memory & Cognition*, *29*, 1081-1087.

Weis, M., Heikamp, T., & Trommsdorff, G. (2013). Gender differences in school achievement: The role of self-regulation. *Front Psychol, 4*, 442.

Winne, P. H. (1995). Inherent details in self-regulated learning. *Educational Psychologist*, *30*, 173-188.

Winnie, P. H., & Hadwin, A. F. (1998). Studying as self-regulated learning. In D. J. Hacker & J. Dunlosky (eds*.), Metacognition in educational theory and practice: The educational psychology series*. Mahwah, NJ: Erlbaum.

Wiseman, D.C. (1999). *Research strategies for education.* New York: Wadsworth Publishing Company.

Wolters, C. A. (2003). Regulation of motivation: Evaluating an underemphasized aspect of self-regulated learning. *Educational Psychologist, 38*, 189-205.

Yigzaw, A., & Fentle, A. (2013). The impact of students' self-regulated language learning on their reading achievement in Ethiopian high schools: Grade 9 in focus. *Journal of Media and Communication Studies, 5(5),* 44-51.doi:10.5897/JMCS2013.0345.

Yukselturk, E., & Bulut, S. (2009). Gender differences in self-regulated online learning environment. *Educational Technology and Society, 12(3),* 12-22.

Zimmerman, B. J. (2000). Attaining self-regulation: A social cognitive perspective. In M. Boekaerts, P. R. Pintrich, M. Zeidner, M. Boekaerts, P. R. Pintrich, M. Zeidner (Eds.), *Handbook of self-regulation* (pp. 13-39). San Diego, CA US: Academic Press.

Zimmerman, B. J. (2004). Sociocultural influence and students' development of academic self-regulation: A social-cognitive perspective. In D. M. McInerney & S. Van Etten (Eds.), *Big theories revisted* (pp.139-164). Greenwhich, CT: Information Age.

Zimmerman, B. J. (2008). Investigating self-regulation and motivation: Historical background, methodological developments, and future prospects. *American Educational Research Journal*, 45(1), 166-183.

Zimmerman, B., & Risemberg, R. (1997). Becoming a self-regulated writer: A social cognitive perspective. *Contemporary Educational Psychology*, 22, 73-101.

APPENDICES

Appendix A: Lesson Plan on Self-Regulated Learning

Week:	1
Subject:	Chemistry
Class:	SS II
Topic:	Basic concepts of organic Chemistry (Hydrocarbon)
Time:	90 minutes
Age:	15^{+}
Mental Ability:	mixed.

Specific objectives – at the end of the lesson, the students should be able to;

1. Define organic chemistry
2. list at least 5 organic concepts
3. Explain at least 5 of the organic concept with examples
4. Explain the sources, classifications and types of hydrocarbons giving examples.

Instructional Materials: Chalk board, Charts, Atomic Models of organic molecules and so on.

Entry Behaviour – The teacher asks the students the following questions

1. What group of element does carbon belong in the periodic table
2. What is the valency of carbon
3. Why is carbon always described as a unique and important element?

Instructional procedure

STEPS	TEACHERS ACTIVITIES	STUDENTS ACTIVITIES	STRATEGIES
Step 1	The teacher introduces the lesson by explaining to the students the group carbon belongs in the periodic table, the oxidation number or valency and as well as the reason why carbon is said to be a unique and important element whereby the students are unable to answer those questions posed that he takes time to explain thoroughly	The students attempts to observe and follow the teacher guide with full attention, asking and answering questions.	**Task perception, goal setting & planning phase** Meticulously the teacher guide students to: Identify challenges, Goal setting and planning, organization of learning and environmental structuring, record keeping and monitoring, seeking information and help.
Step 2	Organic concepts such As Hydrocarbons, Homologous, Series, Isomerism, Cracking Polymerisation General Molecular formula and so on using a prepared chart like flow – chart and discusses each of the concepts	The students follows the precepts and write into their note books the important points as the teacher explains and guide	**Enacting phase** Reviewing responses and consequences, zealously giving attention to learning.

Step 3	The teacher teaches the sources of hydrocarbons, classification and types. How many ways are hydrocarbons classified: aliphatic and aromatic. The teacher explains the differences between them. That the major chief source of hydrocarbon is petroleum.	The students write the two classes of hydrocarbon. And the aliphatic hydrocarbon is divided into 3 Alkane, Alkene, and Alkyne and copy notes.	**Enacting phase** Re-organizing and transforming, seeking and receiving of assistance, process of elimination, planning appropriate responses, record keeping.
Step 4	**Evaluation** The teacher evaluates the students by asking the questions thus: 1. Define organic chemistry 2. List out from your experience 5 organic concepts	Student answer questions, review the learning and take note if there is more challenge	**Adaptation phase** Self evaluation, review of records, rehearsing and memorizing, rating of self, identify challenge

Assignment: Write out the general molecular formular of the 3 groups of the hydrocarbons and other sources of hydrocarbons.

References:

Ababio, S.Y. (2001), New School Chemistry, Onitsha: FEP

Holderness, A., &Lambert, J. (1996). *A new certificate Chemistry*. Ibadan: Heinemann.

Fassan, M.A. et al (1999). *Chemistry for senior secondary schools*. Ibadan: Heinemann

Week: 2

Subject: Chemistry

Class: SS II

Topic: Alkanes - Preparation, Properties and Uses

Time: 90mins

Age: 15 +

Mental Ability: Mixed

Specific Objectives - At the end of the lesson, the students should be able to:

1. Write the general molecular formula for alkanes
2. List at least 9 characteristics of the alkanes
3. Explain how alkanes can be prepared in the laboratory
4. State their physical and chemical properties
5. Explain the uses of alkanes accurately.

Instruction Materials — Chalkboard, diagram, reagents such as sodium hydroxide, alkanoic acid, organic models etc.

Entry Behaviour: The teacher asks the students some

question relating to what they have been taught previously

Instructional Procedure

STEPS	TEACHERS ACTIVITIES	STUDENTS ACTIVITIES	STRATEGIES
Step 1	The teacher introduces the lesson by stating the General Molecular formula of the Alkanes as C_nH_{2n+2} together with teaching them how to derive first member of the group up to the tenth. The n stands for the number of C and H- atoms for the first member which is	The learners will solve problems leading to the derivation of the 1st members till the students will ask questions where they follow. The students	**Task perception, goal setting and planning phase** Guide students to: Identify challenges, Goal setting and planning, organization of learning and environmental

	methane (CH_4) C_1H_2 x 1+2 = CH_4 for the 2nd member ethane C_2H_6 C_2H_2 x 2 +2 = C_2H_6 (ethane) and so On.	will mention names of alkanes and write them into their notes	structuring, record keeping and monitoring, seeking information and help.
Step 2	The teacher teaches the various characteristics of alkanes as an unsaturated hydrocarbon. he asks the students to come forward to the board to write these characteristics Eg Alkanes contains C to C Single covalent bond, are Sp3 hybridized, have bond angles 109.5 with tetrahedral shape and so on. He also teach them how they can be prepared by the reaction between alkanoic acid and a base such NaoH when heated.	The students listens and answers question posed before them students demonstrates how alkanes can be prepared they write down the characteristics of alkanes.	**Enacting phase** Reviewing responses and consequences, zealously giving attention and keeping records.
Step 3	The teacher asks the students to observe the demonstration of how alkanes undergoes some of its reactions physically and chemical. He explains their substitution reaction	The students observes as directed by their teacher physical and chemical properties of alkanes while the teacher explains them	**Enacting and Adaptation phase** Re-organizing and transforming, seeking and receiving of assistance, process of elimination, planning appropriate responses Observation and note taking

Step 4	**Evaluation** The teacher evaluates the students by asking the following questions, 1. Write the general molecular formula of the alkanes 2. State the characteristics of the alkanes 3. Explain using a diagram the laboratory preparation of the alkanes and so on.		**Adaptation phase** Self evaluation, review of records, rehearsing and memorizing, rating of self, identify challenge

Assignment: Define isomerism and write out 3 isomers of pentane.

References:

Ababio, S.Y. (2001). *New school chemistry*. Onitsha: FEP

Holderness, A., & Lambert J. (1996). *A new certificate Chemistry*. Ibadan: Heinemann.

Week: 3

Subject: Chemistry

Class: SSII

Topic: Alkenes; Preparations, properties and uses

Time: 90 mins

Age 15+

Mental Ability: Mixed

Specific Objectives: At the end of the lesson, the students

should be able to do the following;

1. Write the general molecular formula of the Alkenes.

2. State the characteristics of the alkenes generally

3. Explain how alkenes can be prepared in the laboratory

4. Using ethane as an example state how this group of organic compound can be identified physically and chemically with their properties.

5. Explain the uses of ethane using alkene for illustration.

Instructional Materials: Chalkboard, reagents, like alkanols, organic atomic models and so on.

Entry Behaviour: The teacher asks the students one or two questions in order to alert them up. This questions should be based on, previous knowledge that has a link to the new topic.

Instructional Procedure

STEPS	TEACHERS ACTIVITIES	STUDENTS ACTIVITIES	STRATEGIES
Step 1	The teacher introduces the lesson by stating the General molecular formula of the alkenes as CnH2n. He now uses this to derive the molecular	The students listens and will solve problems leading to the derivation of other members of the group. Students could	___ **Task perception, goal setting and planning phase** Guide students to: Identify challenges, Goal setting and planning, organization

	formula of other members of the group. Eg for the 1st members, C2H22 = C2H4 (Ethene) n here stands for the number of Hydrogen and carbon atoms. = C3H6 Propene) and so on.	ask questions students writes into their notes essential points.	of learning and environmental structuring, record keeping and monitoring, seeking information and help.
Step 2	The teacher teaches the characteristics of the alkenes as know to posses double bonds, bond angle 120° and so on. And he then ask the students to come forward to write these characteristics on the board under his guidance teacher proceeds to teach the preparations of alkenes using concentrated H2804 to dehydrate the alkanol. Eg C2H5OH Cone. H2504 H2O + C2H4(g) _____(Ethai___	_____ _____ The students listens and answers questions posed before them. They demonstrate how alkenes can be prepared. Describe the properties and uses	_____ **Enacting phase** Reviewing responses and consequences, zealously giving attention and keeping records.
Step 3	teacher as the students to observe and even demonstrate how their physical and chemical reactions can be effect. He explains addition reactions, Polymerization of the alkenes to make Polythene. He now teaches the uses of ethane to make tiles, detergents, ethanol and so on	Discussions explanations Encouraging students to ask questions	**Enacting and adaptation phase** Re-organizing and transforming, seeking and receiving of assistance, process of elimination, planning appropriate responses
Step 4	**Evaluation:** This is done to get feed backsfrom the students using the		**Adaptation** Self evaluation,

	stated objectives 1. Write out the characteristics of alkane 2. What are the characteristics of the alkenes 3. Using a suitable diagram describe how ethane can be prepared in the laboratory and so		review of records, rehearsing and memorizing, rating of self, identify challenge

Assignment:

1.What is addition reaction

2. State the mechanism of addition reaction

References:

Ababio, S.Y. (2001). *New school chemistry.* Onitsha: FEP

Holderness, A., & Lambert J. (1996). *A new certificate Chemistry*. Ibadan: Heinemann

Week: 4

Subject: Chemistry

Class: SSII

Topic: Alkynes; preparations, properties and uses.

Time: 90 mins

Age - 15+

Mental Ability – Mixed

Specific objectives — At the end of the lesson, the students

should be able to do the following;

(1)Write out the general molecular formula of the alkynes

(2) State the general characteristics of the akynes

(3) Explain how alkenes can be prepared in the laboratory

(4) State the various properties of the alkynes both physical and chemical properties. The ethyne is to be used as a focus.

(5) Explain the uses of the ethyne correctly.

Instructional Materials — Chalkboard, reagents like calcium carbide, diagrams, organic models and so on.

Entry Behaviour — The teacher tries to link their old knowledge to the new once by asking the students some questions.

Instructional Procedure

STEPS	TEACHERS ACTIVITIES	STUDENTS ACTIVITIES	STRATEGIES
Step 1	The teacher introduces the lesson by stating the general molecular formula of the alkynes as CnH2n- 2 He the uses this, to derive the molecular formula of the other members of the group Eg the 1st member = C2H2	The students solve problems and copy down important points in their notes. Students to derive other members of the group. They will	**Task perception, goal setting and planning phase** Guide students to: Identify challenges, Goal setting and planning, organization of learning and environmental

	(Ethyne) n here stand for the number of C and H — atoms for n = 3, C3H3 C3H4 (Propyne) and so on.	define alkynes as unsaturated hydrocarbons	structuring, record keeping and monitoring, seeking information and help.
Step 2	The teaches students characteristics of the alkyne eg Bond angle 1800, have CsC triple covalent bond and so on. He then teach their preparations using Calcium carbride (CaC2) and water eg to produce ethyne (C2H2) CaC2 + 2H20 C2H2(g) + Ca(OH)2 teacher the	Students will be guided to recall different characteristics of the alkynes. Balance the equations lending to producing ethynes gas	**Enacting phase** Reviewing responses and consequences, zealously giving attention and keeping records. Encourage students to ask questions. Observe and demonstration to be used.
Step 3	He also teaches the properties, physical and chemical properties using ethyne as a case study. The teacher teaches the various uses of ethyne eg for welding metals in form of oxyethyne flame, for making choroethene and other monomers for plastic industry	Students to state the physical and chemical properties. Explain markownikoffs nile of alkynes reacting with a Halogen — halide. The students will mention that alkynes under goes addition reaction	**Enacting phase** Re-organizing and transforming, seeking and receiving of assistance, process of elimination, planning appropriate responses and keeping records.
Step 4	**Evaluation-** The teacher evaluates the students by asking them the following questions 1.Whatisthe general molecular formula of the alkynes		**Adaptation phase** Self evaluation, review of records, rehearsing and memorizing, rating of self, identify

	2. State their characteristics 3. Explain the method of their preparations ethyne gas and so on.		challenge

Assignment:

1: Briefly explain how the ethyne undergoes addition reaction. 2.What do you understand by Halogenation and Hydrogenation of the alkynes

3. Briefly explain Markonikof's rule of the reaction between the propyne and Halogen halide.

References:

Ababio, S.Y. (2001). *New school chemistry*, Onitsha: FEP

Fassan, M.A. et al (1999). *Chemistry for senior secondary schools.* Ibadan: Heinemann

Week: 5

Subject: Chemistry

Class: SSII

Topic: Aromatic Hydrocarbons (Benzene structure and formation)

Time: 90 mins

Age: 15+

Mental Ability: Mixed

Specific Objectives — At the end of the lesson, the students should be able to do the following:

1. Identify that Aromatic Compounds ring structures.

2. Draw the structure of benzene with molecular formula C6H6

3. Explain the resonance structure of benzene as propsed by Kekule in 1865

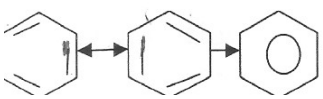
4. State the physical and chemical properties of Benzene

5. Write out the uses of Benzene

Instructional Materials — Chalkboard, diagrams, organic atomic models and so on.

Entry Behaviour - The teacher begin by asking the students what aroma means? As Aromatic compounds have storing Aroma. He give them examples of ring structured compounds like cyclohexane, cyclopropane, and so on.

Instruction procedure

STEPS	TEACHERS ACTIVITIES	STUDENTS ACTIVITIES	STRATEGIES
Step 1	The teacher introduces the lesson by teaching them the structure of benzene, using Kekule's structure up to the modern structure  Showing X — ray	The teacher directs the students on how to draw benzene structure. Each student will draw and x structure formation up	**Task perception, goal setting and planning phase** Guide students to: Identify challenges, Goal setting and planning, organization of learning and environmental structuring, record keeping and

	diffraction confirming benzene to have 6 carbon atoms and 6 hydrogen atoms. Their electrons resonating. The 6 pie electrons are found to delocalize and spread over the entire benzene ring.	to the modern structure. Students take down important points.	monitoring, seeking information and help.
Step 2	The teacher now teaches the physical and chemical properties of Benzene as a liquid with characteristics smell, insoluble in water and so on. He also explains the chemical properties as it undergoes combustion, substitution reaction	Students in their group set up explain the physical and chemical properties of Benzene eg benzene is an oily liquid and has aroma	**Enacting phase** Reviewing responses and consequences, zealously giving attention and keeping records.
Step 3	The teacher explain the uses of benzene and explain that benzene structure is the basis for which other aromatic compounds sprang up. As it is used in their production. 1. Making of paints 2. Plastics 3. Detergents 4. Drugs, 5. Fabrics 6. Phenols and so on	The students ask questions and make their own contribution, The teacher guides them in so doing	**Enacting phase** Re-organizing and transforming, seeking and receiving of assistance, process of elimination, planning appropriate responses Explanations Questioning Discussions Writing notebooks
Step 4	**Evaluation:** The teacher evaluates the students by asking them the following questions 1. Mention the compound which form the basis of other aromatic compound 2. Draw and explain the resonance		**Adaptation phase** Self evaluation, review of records, rehearsing and

	structure of benzene ring. 3. Define the term Aromatic compound 4. State the properties of Benzene 5. List at least 5 uses of Benzene		memorizing, rating of self, identify challenge

Assignment: Explain the term delocalization of electrons in" the benzene ring.

References:

Ababio, S.Y. (2001). *New school chemistry*. Onitsha: FEP

Holderness, A., & Lambert J. (1996). *A new certificate chemistry*. Ibadan: Heinemann.

Fassan, M.A. et al (1999). *Chemistry for senior secondary schools*. Ibadan: Heinemann

Week: 6

Subject: Chemistry

Class: SSII

Topic: Alkanols; classes, properties and uses

Time: 90 mins

Age - 15+

Mental Ability - Mixed

Specific Objectives — At the end of the lesson, the students should be able to do the following;

1. Identify the general molecular formula of the alkanols

2. List the general characteristic of the alkanols

3. Give the IUPAC names of the alkanols

4. Types of alkanols into primary, secondary and tertiary classes.

5. Explain their preparations, properties and uses particularly ethanol

Instructional Material — Chalk board, diagrams, concept maps. Starch granules, yeast and others.

Entry Behaviour — The teacher starts by asking the students to list food substances that contains starch. And that when they are fermented, under certain conditions alkanols can be produced. The idea of extracting ethanol can then be through Distillation

Instructional procedure

STEPS	TEACHERS ACTIVITIES	STUDENTS ACTIVITIES	STRATEGIES
Step 1	He introduces the lesson by giving the students the general molecular formula as C_nH_{2n}+OH or ROH where R = CH_2+1. From here, the derivation of the molecular formula of other members. When n = 1 that is H-atoms is equals to 1 C_1H_{21}+$_1$OH = CH_3OH (Methanol) Eg if n = 2 where CH_2+1OH, C_2H_{2X2}+1OH = C_2H_5OH	Students listens and are directed to derive different members of the alkanol using the general molecular formula. Students	**Task perception, goal setting and planning phase** Guide students to: Identify challenges, Goal setting and planning, organization of learning and environmental structuring, record

	(ethanol). He goes ahead to teach the general characteristic of the alkanols. Eg they have – OH functional group. Are polar compounds. neutral to litmus	have to solve group activity as elicited and are encouraged to ask question. Students copy salient points into the note books.	keeping and monitoring, seeking information and help.
Step 2	The teacher teaches the IUPAC names of the akanols. That the position of the OH group is where emphasis should be laid in numbering and naming eg $CH_3CH_2CH_2OH$ propan -1-ol. He then teaches the classification of alkanols first into monohydric, dihydric and trihydric according to the number of OH group it has. Types of alkanols RCOH = 1°, RCHOH = 2°, R_3COH = 3° primary, secondary and tertiary with structures.	Students derives the IUPAC of other alkanols using the teachers directives the students solves to derive the classifications alkanols	**Enacting phase** Reviewing responses and consequences, zealously giving attention and keeping records.
Step 3	Teacher teaches the preparations properties and uses of alkanols. Eg $C_6H_{12}O_6$ Zyamase glucose $2c_2H_5OH + 2CO_2(g)$ eg is a coloures liquid that has burning sensation. And is dehydrated into ethane using conc. H_2SO_4	Students carry out the laboratory test for 1°, 2° and 3° alkanols and write their structures.	**Enacting phase** Re-organizing and transforming, seeking and receiving of assistance, process of elimination, planning appropriate responses and keeping record.
Step 4	**Evaluation:** The teacher evaluates the students by asking them the following	Students pay attention and are ready to give	**Adaptation phase** Self evaluation,

	questions. 1. Write out the general molecular formula of the alkanols. 2. List the general characteristics of the atlkanols and so on using the specific objectives Project — Get starch foods, ferment for 48 hours, observe and write down your observations.	responses.	review of records, rehearsing and memorizing, rating of self, identify challenge

Assignment: Write out the 3 classes of alcohol with clear structure

References:

Ababio, S.Y. (2001). *New school chemistry*. Onitsha: FEP

Holderness, A., & Lambert, J. (1996). *A new certificate chemistry*. Ibadan: Heinemann

Fassan, M.A. et al (1999). *Chemistry for senior secondary Schools.* Ibadan: Heinemann

Appendix B: Lesson Plan on Lecture Method

Week: 1

Subject: Chemistry

Class: SS II

Topic: Basic concepts of organic chemistry (Hydrocarbon)

Time: 90mins

Age: 15+

Mental Ability: Mixed

Specific Objectives: At the end of the lesson students should be able to;

1. Define organic chemistry
2. Mention at least 5 organic concepts,
3. Explain at least 5 organic concepts with examples
4. Explain the sources, classifications and types of hydrocarbons with examples

Instructional Materials: Chalk board, Charts, Atomic Models of organic molecules, etc.

Entry behaviour: The teacher asks the students question that will relate to the new topic

Instructional Procedure

STEPS	TEACHER ACTIVITIES	STUDENTS ACTIVITIES	STRATEGIES
STEP 1	The teacher introduces the lesson by defining organic chemistry. He explains why carbon is a unique and important element why it can join itself and with other element. Thereafter he goes straight to explaining those basic concepts necessary for understanding organic chemistry Homologues series, general molecular formula, Isomerism etc	The students listen to the teacher and take down notes.	Lecture Method Explanations
Step 2	The teacher writes these concepts on the chalk board and starts to explain them one	The students copy the points made	Explanations Discussions.

	after the other, Eg. Organic concepts such as Isomerism is a phenomenon whereby two Organic compounds or molecules have the same molecular formula but with different structural formula.	by their teacher into their note books	
Step 3	The teacher teaches the sources, classification and types if hydrocarbons,. He can ask the students to mention the two classes of hudrocarbons	The students Questioning	listen and discussion
Step 4	**Evaluation** — The teacher evaluates the lesson by asking •questions thus; 1. Define Organic chemistry 2. List 5 concepts used to understand organic chemistry 3. Explain and 5 of these concepts. 4. Explain the sources classification and types of hydrocarbons with examples. 5. What are aromatic hydrocarbon give example	The students listen	Questioning and discussion

Assignment: Write out the general molecular formular of the 3 groups of the hydrocarbons and other sources of hydrocarbons.

References:

Ababio, S.Y. (2001). *New school chemistry*. Onitsha: FEP

Holderness, A., & Lambert J. (1996). *A new certificate chemistry*. Ibadan: Heinemann.

Fassan, M.A. et al (1999). *Chemistry for senior secondary schools*. Ibadan: Heinemann

Week: 2

Subject: Chemistry

Topic: Alkanes - preparations, properties and uses (Control Group)

Time: 90 mins

Age: 15+

Mental Ability: Mixed

Specific Objectives — At the end of the learning exercise the

students should be able to do the following

1. Write the general molecular formula of the alkanes

2. State at least nine characteristics of the alkanes

3. Explain how alkanes can be prepared in the laboratory.

4. State their physical and chemical properties

5.. Explain their uses correctly

Instructional Materials — Chalkboard diagrams, reagents, sodium hydroxide, alkanoic acid organic models and so on

Entry Behaviour — The teacher asks the students some questions relating to what they were taught previously which however have connects with the present topic.

Instructional Procedure

STEPS	TEACHERS ACTIVITIES	STUDENTS ACTIVITIES	STRATEGIES
Step 1	The teacher introduces the lesson by stating the General molecular formula of the alkanes - CnH2n+2. He then go ahead to show then how this formula can be used to derive the first to the tenth member of the group. He tells them that n is the number of C and H — atoms in the compound eg for 1st member (CH4) methane C1H2x1+2 = CH4 for the	The learners continues to listen and copy notes They may ask questions where they are in doubt	

	2nd. member C2H2x2+2 = C2H6 (ethane) and so on.		
Step 2	The teacher teaches the various characteristics of alkanes as an unsaturated hydrocarbon. He asks the students to come forward to write these characteristics Eg alkanes contains C to C single covalent bond, are Sp3 hybridized, and have bond angles 109.5° preparations can be by organic acid and a base such as NaoH then heat the mixture.	The students listens and copy notes	Lecture Explanations Questioning
Step 3	The teacher demonstrates how alkanes can 1e prepared in the laboratory Explains physical and chemical properties and uses alkanes	Students observes and continue to listen students takes down notes	Discussion
Step 4	Evaluation - The teacher evaluates his students by asking them the following questions 1. Write the gen0eral molecular formula of the alkanes 2. State the characteristics of the alkanes 3. Explain how alkanes how alkanes can be prepared in the laboratory and so on using diagram.		

Assignment: Define Isomerism and write out 3 Isomers of pentane.

References:

Ababio, S.Y. (2001). *New school chemistry*. Onitsha: FEP

Holderness, A., & Lambert, J. (1996). *A new certificate chemistry*. Ibadan: Heinemann.

Week: 3

Subject: Chemistry

Class: SSII

Topic: Alkenes; Preparations, properties and uses.

Time: 90 mins

Age - 15+

Mental Ability – Mixed

Specific Objectives — At the end of the students should be able to do the following thus;

1. Write out the general molecular formula of the alkane hydrocarbons

2. State the characteristics of the alkenes generally.

3. Explain how alkenes can be prepared in the laboratory.

4. State the properties of the alkenes

5. Explain the uses of alkenes using ethane as an example

Instructional Materials — Chalkboard, reagents like alkanol organic atomic models and so on.

Entry Behaviour: The teacher asks the students questions that would connect their previous knowledge to the new topic.

Instruction procedure

STEPS	TEACHERS ACTIVITIES	STUDENTS ACTIVITIES	STRATEGIES
Step 1	The teacher introduces the lesson by stating the general molecular formula of the alkenes as CH2. he now uses this to derive the molecular formula of the other members of the group. Eg for the 1st member, C2H2x2 = C2H4 (Ethene) where n stands for the no.of C and H — atoms CsH23 = C3H6 (Propene)	The students listens and solve problems copy down important problems into their notes	Discussion Explanation Lecturing
Step 2	The teacher teaches	Students	Lecture

	the characteristics of the alkene eg posses bond angles 1200 have double covalent bonds C = C and so on. He then teach the preparations of the alkenes by the dehydration of alkanols using concentrated H2S04 to produce an alkene and water as a product. Eg Con c. C2H5OH LI Cfl r123tJ4 H20 + C2H4 (g) (Ethene)	listens, takes down notes	Explanation Demonstration Discussion
Step 3	The teacher also teaches the properties and uses of alkenes. Eg ethane is used for making polythene and it undergoes polymerization, tiles, detergents, ethanol and so on.	Students listens takes down notes	Explanation Discussion Lecture
Step 4	**Evaluation:** This is done by asking the students questions using already stated objectives, 1. Write out the general molecular formula of the alkenes 2. What are their characteristics 3. Using a suitable diagram describe the laboratory preparation of the alkanes eg Ethane		

Assignment: 1. What is addition reaction?

2. State the mechanism of how addition reaction is effected

References:

Fassan, M.A. et al (1999). *Chemistry for senior secondary schools*. Ibadan: Heinemann

Ababio, S.Y. (2001). *New school chemistry*. Onitsha: FEP

Holderness, A., & Lambert J. (1996). *A new certificate chemistry*. Ibadan: Heinemann

Week: 4

Subject: Chemistry

Class: SS II (Control Group)

Topic: Alkynes; preparations, properties and uses

Time: 90 mins

Age: 15+

Mental Ability: Mixed

Specific Objectives — At the end of the lesson, the students should be able to do the following.

(1)Write out the general molecular formula of the alkynes

(2) State the general characteristics of the alkynes

(3) Explain how alkynes ca be prepared in the laboratory.

(4) State the various properties of the alkynes using ethyne as a focus

(5) Explain the uses of ethyne correctly

Instructional Materials — Chalkboard, reagents such as Calcium carbide and water , Organic models and so on

Entry behavior — The teacher asks the students simple questions that will link them up unto the new topic.

Instruction procedure

STEPS	TEACHERS ACTIVITIES	STUDENTS ACTIVITIES	STRATEGIES
Step 1	The teacher introduces the lesson by stating the general molecular formula of the alkynes as CH2-2. He then uses this, to derive the molecular formula of the other members of	The students merely listens and takes down the points into their note books.	Lecture Illustration with correct formula

	the group. Eg the 1st member the ethyne, C2H22-2 = C2H2. N here stands for the number of C and H — atoms for n = 3. C3H2x3-2 = C3H4 (Propyne) and so on.		
Step 2	The teacher teaches the students characteristics of the alkyne. Eg bond angle is 180°, have C C triple covalent bond arid so on. He the teaches their preparations using Calcium Carbide plus water eg to produce C2H2 (ethyne) CaC2 + H20 ‘C2H2(g) + Ca(OH)2	Students listens •copy into their notes and then ask their questions where it is necessary	Lecture Illustrations
Step 3	He now come to teach the properties; physical and chemical properties using ethyne as an example. He talks about the uses of this very gas. Eg it can be used for welding metals.	The students listens, copy notes and ask their questions where necessary	_____ Lecture Question arid answer Illustration with reaction
Step 4	**Evaluation:** At the end of the lesson, the students should be able to do the following; 1. Write down the general molecular formula of the • alkynes. 2. State the various characteristics of the alkynes 3. State the physical and chemical		

	properties of ethyne gas 4. State the various uses of ethyne Gas		

Assignment:

1: Briefly explain how the ethyne undergoes addition reaction.

2. Briefly explain Markonikof's rule of the reaction between the propye and Halogen halide.

References:

Ababio, S.Y. (2001). *New school chemistry*. Onitsha: FEP

Fassan, M.A. et al (1999). *Chemistry for senior secondary schools.* Ibadan: Heinemann

Week: 5

Subject: Chemistry

Class: SSII

Topic: Aromatic Hydrocarbons (Benzene structure and formation)

Time: 90 mins

Age - 15+

Mental Ability — Mixed

Specific Objectives — At the end of the lesson, the students should be able to do the following:

1. Identify that Aromatic compound have ring structures.

2. Draw the structure of Benzene with molecular formula — C6H6.

3. Explain the resonance structure of Benzene as proposed by Kekule in 1865.

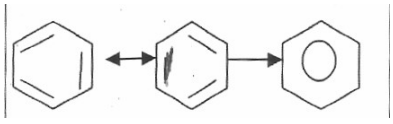
4. State the physical and chemical properties of Benzene

5. Write out the uses of Benzene.

Instructional Materials — Chalkboard, diagrams, organic atomic model's and so on.

Entry Behaviour - The teacher begin by asking the students what the term Aroma means? He give them example of ring structured compounds like cyclohexane, cyclopropane, etc.

Instruction procedure

STEPS	TEACHERS ACTIVITIES	STUDENTS ACTIVITIES	STRATEGIES
Step 1	The teacher introduces the lesson by teaching them the structure of benzene, using Kekule's structure up to the modern structure to  Showing X - ray diffraction confirms that benzene has 6 carbon	The students and asks questions where they are in doubt. They copy the points into their note books	Lecture Discussion Illustration Questions and answers

	atoms. Their electrons resonating the 6 pie — electrons are found to delocalize and spread over the rebepzenerin		
Step 2	The teacher teaches the physical properties of Benzene as a liquid with characteristic smell, insoluble in water and so on. He also explains the chemical properties as it undergoes combustion and substitution reaction	Students listens	Lecture Lecture Note copying by the students
Step 3	The teacher explains the uses of Benzene and its structure as the basis for which other aromatic compounds sprang up. As it Produce following; 1. Paints 2. Plastics 3. Detergents, drugs, fabrics, phenols and so on used to the	The students listen and asks their questions thereafter copy notes.	Lecture Discussion
Step 4	**Evaluation:** The teacher evaluates the students by• asking them the following questions 1. Mention the compound which form the basis of other aromatic hydrocarbons 2. Draw and explain the resonance structure of Benzene ring. 3. Define the term Aromatic Compound 4. State the properties of Benzene 5. List at least 5 uses of Benzene		

Assignment: Explain briefly Nitration reaction in Benzene.

References:

Ababio, S.Y. (2001). *New school chemistry*. Onitsha: FEP

Holderness, A., & Lambert J. (1996) *A new certificate chemistry.* Ibadan: Heinemann.

Fassan, M.A. et al (1999). *Chemistry for senior secondary schools.* Ibadan: Heinemann

Week: 6

Subject: Chemistry

Class: SSII

Topic: Alkanols; classes, properties and uses

Time: 90 mins

Age: 15+

Mental Ability - Mixed

Specific Objectives — At the end of the lesson, the students should be able to do the following;

1. Identify the general molecular formula of the alkanols

2. List the general characteristics of the alkanols

3. Give the IUPAC names of the alkanols

4. State the classifications of the alkanols — according to the number of — OH groups and position

5. Explain the preparations, properties and uses of ethanol

Instructional Materials — chalkboard, diagrams, concept maps, starch granules, yeast and others.

Entry Behaviour — The teacher starts by asking the students to list food substances that contains starch. And then distillation done, alkanols are produced.

Instructional procedure

STEPS	TEACHERS ACTIVITIES	STUDENTS ACTIVITIES	STRATEGIES
Step 1	He introduces the lesson by giving the students the general molecular formula as CH_2+1OH or ROH whre 1? = C_nH_{2n}+1. From here, derivation of other molecules of the group can be got. Egwhenn= 1,that is CandHatom= 1 $C1H_{2x}$1+1OH = CH_3OH (Methanol)	The students listen and copy notes	Lecture explanation

	if n = 2, C_2H_{2x2}+1OH = C_2H_5OH (ethanol) and so on. He also teaches their Functional group — OH		
Step 2	The teacher teaches the IUPAC names of alkanols. That the position and number groups of the —OH attached to the compound makes it easy for classifica-tion and naming eg IUPAC name of a structure like $CH_3CH_2CH_2OH$ is propan-1-ol as naming is given preference which number of C — atom is carrying the - OH group. So we have monohydric, dihydric and trihydric alkanol. We also have 1^0,2^0 and 3° alkanol respectively ie RCOH 10, RCHOH -2° R_3COH-3° ___	The students listen and copy notes	Lecture
Step 3	Teacher teaches the preparations properties and uses of alkanols. Eg CGH12Oo Zyamase glucose 2c2H5OH + 2CO2(g) eg is a coloures liquid that has burning sensation. And is dehydrated into ethane	Students to carry out the laboratory test for 1°, 2° and 3° alkanols	Demonstration Discussion Illustration
Step 4	**Evaluation:** The teacher evaluates the students by asking them the following questions. 1. Write out the general molecular formula of the alkanols. 2. List the general characteristics of the atlkanols and so on using the specific objectives.		

Assignment: Write out the 3 classes of alcohol with clear structure

References:

Ababio, S.Y. (2001). *New school chemistry*. Onitsha: FEP

Fassan, M.A. et al (1999). *Chemistry for senior secondary schools.* Ibadan: Heinemann

Appendix C: Chemistry Achievement Test (CAT)

CHEMISTRY ACHIEVEMENT TEST ITEMS

Name of Student:……..

Sex:……

School:……..

Please answer the following objective questions with option A to D

1. Which of the following reactions is common to all hydrocarbons? A. combustion B. addition C. polymerization D. condensation

2. The separation of petroleum fractions depend on the differences in their A. melting points B. molar masses C. solubility D. boiling points

3. A mixture of kerosene and diesel oil can be separated by A. crystallization B. distillation C. precipitation D. sublimation

4. A hydrocarbon compound contains 92.3% carbon. Determine its empirical formula.[**H**=1.00; **C**=12.0] A. CH B. CH_2 C. CH_3 D. C_2H_3

5. The liquid hydrocarbon likely to be found in the fraction of crude oil used for domestic cooking is A. C_3H_8 B. C_5H_{12} C. $C_{13}H_{28}$ D. $C_{20}H_{42}$

6. In the structural compound $RCH_2CH_2CH_2CH_3$, R is an alkyl group classified as an

A. alkanoic acid B. unsaturated compound C. alkyl halide D. alkane

7. When bromine is added to ethane at room temperature. The compound formed is

A. 1, 1-dibromoethane B. 1, 1-dibromoethene C. 1, 2-dibromoethane D. 1, 2-dibromoethene

8. An organic compound contains 40.0% carbon, 6.7% hydrogen and 53.3% oxygen. What is the empirical formula of the compound? [O=16.0, C=12.O, H=1.0]
A. C_2HO B. CHO C. CH_2O D. CHO_2

9. If 3rd member of a homologous series is C3H8, the 5th member will be A C_5H_9 B. C_5H_{10} C. C_5H_{11} D. C_5H_{12}

10. Which ofthe following compounds determines the octane rating of petrol? A. 1, 2, 3-trimethy1 pentane B. 2, 3, 5- trimethy1 octane

    C. 2, 3, 5- trimethy1 pentane D. 2, 2, 4- trimethy1 pentane

11. Which type of reaction is illustrated by the following equation? $C_{12}H_{26} \rightarrow 5C_2H_4 + C_2H_6$
    A. addition B. cracking C. hydrogenation D. polymerization

12. Consider the reaction represented by the following equation

    $C_2H_{4\,(g)} + 3O_{2(g)} \rightarrow 2CO_{2\,(g)} + 2H_2O_{\,(g)}$

    How many moles of ethane would be burnt to produce 0.1 mole of water?

    A. 0.05 mole B. 0.10 mole C. 0.20 mole D. 2.00 moles

13. Which of the following is produced during the decomposition of plant matter in the absence of air? A. benzene B. cyclobutane C. methane D. pentane

14. Octane number is highest in petrol containing a high proportion of A. heptane B. 2,2,4-trimethylpentane C. 2-methylpentane D. 2,4-dimethylpentane

15. Which of the following is not direct petroleum product? A. methane B. ethanol C. vaseline D. kerosene

16. If the 3rd member of a homologous series is C3H8, the 5th member will be

    A. C_5H_9 B. C_5H_{10} C. C_5H_{11} D. C_5H_{12}

17. Dehydration of ethanol produces A. Ethanoic acid B. propan-1,2,3-triol C. ethene D. propan-1, 2-dioic acid

18. An organic compound which react readily with bromine to form a compound with the formula $CH_3CHBrCH_2$ is A. ethane B. propyne C. butane D. propene

19. The product of the reaction between CH_2H_5OH and concentrated H_2SO_4 at 170C is A. $(C_2H_5)_2SO_4$ B. $CH_3CH_2HSO_4$ C. $(C_2H_5)_2O$ D. $CH_2=CH_2$.

20. Ethene molecules can be added to one another to form a long chain compound called a

A. dimer B. monomer C.polymer D. trimer

21. When acidified $KMnO_4$ solution is decolourized by ethane, the gas act as A. a saturated hydrocarbon B. a reducing agent C. an oxidizing agent D. a dehydrating agent

22. Which of the following raw materials is used in a plastic industry? A. Ethene B. methane C. calcium D. hydrogen

23. What is the product of the reaction between propene and 1 mole of hydrogen iodide?

A. CH_3CHICH_3 B. $CH_3CH_2CHI_2$ C. $CH_3CH_2CI_3$ D. CH_3CHICH_2I .

24. Ethene undergoes mainly addition reactions because it is A. a gas B. a hydrocarbon C. unsaturated D. easily polymerised

25. What is the IUPAC name of the compound with the following structures. $CH_3C(CH_3)=CH_2$ A. 2-methylbutene B. 2-methylprop-2-ene C. 2-methylprop-1-ene D. but-1-ene.

26. Ethyne combines readily with hydrogen iodide at room temperature to form

A. iodoethyne B. 2-iodoethyne C. 1,1-diiodoethane D. 1,1-diiodoethene

27. Which of the following organic compounds is highly unsaturated?

A. alkanols B. alkynes C. alkanones D. alkenes

28. Which of the following compounds would not precipitate with ammoniacal $AgNO_3$ solution? A. $CH_2C=-CCH_3$ B. $HC=-CH$ C. $CCH_3=-CH$ D. $CH_3CH_2C=-CH$

29. Which of the following compounds can be prepared by the action of calcium carbide on cold water? A. ethane B. ethane C. ethyne D. ethanol

30. The reaction of ethyne is mainly A. substitution B. addition C. catalytic hydrogenation D. catalytic halogenation

31. Consider the reaction represented by the following equation: H-C=_C-H>X>Y; X and Y respectively are A. ethane & ethane B. ethane & ethane C. ethyne & ethene D. ethane & propene

32. What amount of hydrogen will be required to complete hydrogenation of one mole of pent-3-yne A. 1 mole B. 2 moles C. 3 moles D. 4 moles 44. Which of the molecules below is chemically more reactive?

A. alkanes B. alkenes C. alkynes D. benzene

33. Hydrocarbons which react with ammoniacal copper (1) chloride solution conform to the general molecular formular A. CnHn B. CnH2n C. CnH2n+2 D. CnH2n-2

34. Consider the reaction below Vegetable oil $\underline{H_2}$; Ni catalyst/high catalyst product

The reaction is applied in the manufacture of A. drugs B. margarine C. paraffin D. soapy detergents

35. Fats and oils are used as raw materials in the following industries except A. paint industry B. plastic industry C. margarine industry D. cosmetics industry

36. Which of the following exhibits resonance?

A. benzene B. propylene C. propyl-2-yne D. propanol

37. The complete hydrogenation of C_6H_6 in the presence of nickel catalyst at 200C gives

A. C_6H_8 B. C_6H_{10} C. C_6H_{12} D. C_6H_{14}

38. How many carbon atoms are there in benzene ring?

A. 3 B. 6 C. 8 D. 9

39. A colorless hydrocarbon with a sweet smell, and undergoes substitution reaction. The hydrocarbon is likely to be

A. alkanol B. benzene C. ester D. methane

40. Ethanol reacts with excess acidified $K_2Cr_2O_7$ to produce

A. ethanal B. ethane C. ethanoic acid D. ethylethanoate

41. On exposing palm wine to air for some days, it becomes sour owing to the conversion of A. glucose to ethanol B. glucose to gluconic acid C. ethanol to ethanoic acid D. palm-wine to palmitic acid

42. The enzyme that catalyses the conversion of glucose to ethanol and carbon (IV) oxide is A. diastase B. maltase C. ptyalin D. zymase

43. Which of the following substances is a suitable solvent for perfumes?

A. benzene B. ethanol C. turpentine D. water

44. Methanol is obtained from wood by A. bacterial decomposition B. combustion C. fractional distillation D. destructive distillation

45. Arrange the following compounds in order of increasing boiling point

I. $CH_3CH_2CH_2OH$ II. CH_3CH_2OH III. $CH_3CH_2CH_2CH_2OH$ IV. $CH_3CH_2CH_2CH_2CH_3$

A. I<II<IV<III B. IV<III<II<I C. I<II<III<IV D. IV<II<I<III

46. Which of the following substances is trihydric? A. Ethanol B. Glycol C. Glycerol D. Phenol

47. A tertiary alkanol has a molecular formular $C_4H_{10}O$. What is the structural formula of the compound? A. $(CH_3)_2CHCH_2OH$ B. $CH_3CH_2CH(OH)CH_3$ C. $(CH_3)_3COH$ D. $CH_3CH_2CH_2CH_2OH$

48. The compound that makes palm wine taste sour after exposure to the air for few days is A. ethanol B. ethanoic acid C. methanol D. methanoic acid

49. The organic compound with the following structure represents CH_3-C-C_2H_5 A. primary alkanol B. secondary alkanol C. tertiary alkanol D. an alkanal

50. The products of fermentation of sugar are A. carbon (IV) oxide and water B. ethanol and carbon (IV) oxide C. ethanol and water D. ethanol and enzymes

Appendix D: Marking Guide for Chemistry Achievement Test (CAT)

1 A 2D 3B 4A 5C 6D 7C 8A 9D 10D 11B 12A 13C 14B 15A 16D
17C 18D 19D 20C 21B 22A 23A 24C 25B 26C 27B 28A 29C 30B 31A
32B 33D 34B 35B 36A 37D 38B 39B 40A 41C 42D 43B 44D 45C 46C
47C 48B 49C 50A

Appendix E: Chemistry Attitude Questionnaire (CAQ)

S/N	Items	SA	A	D	SD
1	I like chemistry subject				
2	I enjoy answering chemistry questions				
3	I approach chemistry questions with confidence				
4	I am extra-motivated in learning chemistry				
5	I participate in student discussion of chemistry contents				
6	I always study chemistry on my own				
7	I have never miss chemistry class deliberately				
8	I enjoy reading chemistry textbooks				
9	I am very attentive during chemistry class				
10	I read ahead after learning chemistry in the classroom				
11	I take chemistry subjects serious				
12	I seat myself at the front sit during chemistry class				
13	I enjoy practicing chemistry contents on my own				
14	I always take down note during chemistry classes				
15	Chemistry makes me feel uncomfortable and impatient				
16	Chemistry makes me feel as though I was in a jungle of formulae or equation and can't find my way				
17	The contents in chemistry are very difficult				
18	Only brilliant students study chemistry				
19	Chemistry textbook is not found to be interesting				
20	I study chemistry in order to secure admission into higher classes				

Appendix F: Reliability Coefficient (r) on CAT for 40 students

Scores of the students on total test obtained from testing are shown below

27	19	17	41
23	21	32	30
19	23	31	21
23	29	12	17
30	24	41	27
22	25	30	23
41	19	30	19
30	25	25	10
31	27	21	26
12	17	16	19

$$r = \frac{Kd^2 - \bar{X}(K - \bar{X})}{d^2(K-1)}$$

Where,

K = number of items = 50

$\bar{X}$= mean score = 24.37

d = standard deviation = 7.37

$$\boldsymbol{r} = \frac{50(7.37)^2 - 24.37\,(50 - 24.37)}{7.32^2(50-1)}$$

$$r = \frac{2091.2419}{2661.5281} = 0.79$$

Appendix G: Reliability Coefficient of Chemistry Attitude Questionnaire (CAQ)

Reliability

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	40	100.0
	Excluded[a]	0	.0
	Total	40	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.884	.885	20

Summary Item Statistics

	Mean	Minimum	Maximum	Range	Maximum / Minimum	Variance	N of Items
Item Means	2.258	1.925	2.675	.750	1.390	.066	20
Item Variances	1.060	.692	1.353	.662	1.956	.040	20

Appendix H: List of Secondary in Delta North senatorial District According to Local Government Areas

Aniocha North Local Government Area

S/No	Name of School	Town
1	Azagba mixed Sec. Sch.	Issele-Azagba
2	Boys model Sec. Sch.	Onicha-Olona
3	Comprehensive Sec. Sch.	Idumuje-Ugboko
4	Comprehensive Sec. Sch.	Onicha-uku
5	Ezechima Mixed Sec. Sch.	Obior
6	Ezi Sec. Commrecial Sch.	Ezi
7	Idumuje-Unor Mixed Sec. Sch.	Idumuje-Unor
8	Idumu-Ogo Mixed Sec. Sch	Idumu-Ogo
9	Issele-Uku Technical College	Issele-Uku
10	Martins College	Issele-Uku
11	Obomkpa Mixed Sec. Sch.	Obomkpa
12	Odiani Mixed Sec. Sch.	Ukwu-Nzu
13	Okalete Sec. Sch.	Issele-Mkpitime
14	Olona Mixed Sec. Sch.	Onicha-Olona
15	Onicha-Ugbo Girls Grm. Sch.	Onicha-Ugbo
16	Pilgrim Baptist Gram. Sch.	Issele-Uku
17	St. Pius Xth Gram. Sch.	Onicha-Ugbo
18	Ubulubu Sec. Sch.	Ubulubu
19	Ugbodu Sec. Sch.	Ugbodu

Aniocha South Local Government Area

S/No	Name of School	Town
1	Abah-UnorSec. Sch.	Abah-Unor
2	Adaigbo Sec. Sch.	Ogwashi-Uku
3	Adonte Mixed Sec. Sch	Adonte
4	Ashama Comprehensive Sec. Sch	Ashama
5	Comprehensive Sec Sch.	Ogwashi-Uku
6	Egbudu Mixed Sec. Sch.	Egbudu-Akah
7	Ejeme Sec. Sch.	Ejeme-Anigor
8	Ewulu Mixed Sec. Gram. Sch.	Ewulu
9	Ezemu Girls Gram. Sch.	Ubulu-Uku
10	Ifite Sec. Sch.	Iseagu
11	Isho Mixed Sec. Sch.	Ubulu-Uku
12	Ngwu Mixed Sec. Sch.	Ogwashi-Uku
13	Nshiagu College	Ogwashi-Uku
14	Nsukwa Gram. Sch.	Nsukwa
15	Okiti Mixed Sec. Sch.	Ubulu-Okiti
16	Olluh Mixed Sec. Sch.	Ogwashi-Uku
17	Otulu Mixed Sec. Sch.	Otuli-Ogwashi
18	St. Anthony's Model Sec. Sch.	Ubulu-Uku

19	Ubulu-Unor Mixed Sec. Sch.	Ubulu-Unor

Ika North-East Local Government Area

S/No	Name of School	Town
1	Akumazi Sec. Sch.	Akumazi-Umuocha
2	Comprehesive High Sch.	Igbodo
3	Ede Gram. Sch.	Umunede
4	Ekwuoma Sec. Sch.	Ekwuoma
5	Elugu Sec. Sch.	Ogbe-Ute-Elugu
6	Erumu Sec. Sch.	Ute-Erumu
7	Idumuesah Sec. Sch.	Idumuesah
8	Mbiri Mixed Sec. Sch	Mbiri
9	Otolokpo Mixed Sec. Sch.	Otolokpo
10	Owa Sec. Sch.	Owa-Oyibu
11	Owa-Alero Sec. Sch.	Owa-Alero
12	Owa-Alizomor Mixed Sec. Sch.	Owa-Alizomor
13	Owa-Nta Sec. Sch.	Bojiboji-Owa
14	Owerre Olubor Sec. Sch.	Owerre-Olubor
15	Umunede Mixed Sec. Sch.	Umunede
16	Ute-Ugbeje Sec. Sch.	Ute-Ugbeje
17	Te-Ukpu Sec. Sch.	Ute-Okpu

Ika South Local Government Area

S/No	Name of School	Town
1	Abavo Girls Sec. Sch.	Abavo
2	Agbor Technical College	Agbor
3	Agwa-Ewuru Sec. Sch.	Ewuru-Agbor
4	Alidinma Sec. Sch	Agbor-Alidinma
5	Alisimie Mixed Sec. Com. Sch	Aliosimie
6	Dein Palace Sec. Sch.	Agbor-Obi
7	Ekuku-Agbor Sec. Sch	Ekuku-Agbor
8	Emuhu Sec. Sch.	Emuhu
9	Ihu-Iyase Sec. Sch.	Agbor-Nta
10	Ime-Obi Sec. Sch.	Agbor
11	Irenurha ll Sec. Sch.	Idumugbo
12	Jegbefume Sec. Sch.	Abavo
13	Mixed Sec. Sch.	Abavo
14	Obi-Anyinma Sec. Sch.	Obi-Anyinma
15	Ogbemudein Sec. Sch.	Agbor
16	Okpe mixed Sec. Sch.	Okpe-Abavo
17	Omumu Sec. Sch.	Omumu
18	Oza-Nogogo Sec. Com. Sch.	Ozanogogo

Ndokwa East Local Government Area

S/No	Name of School	Town
1	Abala Sec. Sch.	Abala
2	Aboh Sec. Sc.	Aboh
3	Afor Sec. Sch.	Afor
4	Ase Gram. Sch.	Ase
5	Ashaka Mixed Sec. Sch.	Ashaka
6	Azagba Sec. Sch.	Azagba
7	Basic School	Isselegu
8	Government Sec. Sch.	Akaria-Obodo
9	Ibedeni Sec. Sch	Ibedeni
10	Ibrede Sec. Sch.	Ibrede
11	Igulu Sec. Sch.	Igulu
12	Inyi Sec. Sch.	Inyi
13	Iyede-Ame Sec. Sch.	Iyede-Ame
14	Mixed Sec. Sch.	Okpai-Olichi
15	Mixed Sec. Sch.	Utchi
16	Ndam Sec. Sch.	Benekuku-Uno
17	Obetim-Uno Com. Sch.	Obetim-Uno
18	Oduga Sec. Sch.	Ushie-Oduga
19	Okpai-Obeze Sec. Sch.	Okpai-Obeze
20	Oloa Sec. Sch.	Oloa-Ossisa
21	Onuaboh Sec. Sch.	Onuaboh
22	Onyah Sec. Sch.	Onyah
23	Ossisa Sec. Com. Sch.	Ossisa
24	Ossisa Sec. Sch.	Ossisa
25	Umuolu Sec. Sch.	Umuolu

Ndokwa West Local Government Area

S/No	Name of School	Town
1	Abbi Girls Comp. Sec. Sch.	Abbi
2	Abbi Gram. Sch.	Abbi
3	Community Sec. Sch.	Ogbole-Ogume
4	Ebendo Sec. Sch.	Emu-Ebendo
5	Ebologu Gram. Sch.	Utagba-Uno
6	Emu Sec. Sch.	Emu-Uno
7	Estate Sec. Sch.	Utagba-Uno
8	Ezebaja Sec. Sch.	Utagba-Uno
9	Girls Sec. Sch.	Ndemili
10	Girls Sec. Sch.	Utagba-Uno
11	Isumpe Sec. Sch.	Ulogwe-Ogbe

12	Mixed Sec. Sch.	Ogbagu-Ogume
13	Mixed Sec. Sch.	Onicha-Ukwuani
14	Mixed Sec. Sch.	Ogiliamai
15	Ndemili Gram. Sch.	Ndemili
16	Obodeti Sec. Commercial Sch.	Emu-Obodeti
17	Ogume Gram. Sch.	Ogume
18	Oliogo Sec. Sch.	Oliogo
19	Utagba-Ogbe Sec. Sch.	Kwale
20	Utagba-Ogbe Technical Col.	Kwale

Oshimili North Local Government Area

S/No	Name of School	Town
1	Akwukwu-Igbo Gram. Sch.	Akwukwu-Igbo
2	Atuma-Iga Govt. Sec. Sch.	Atuma-Iga
3	Basic Sec. Sch.	Illah
4	Ebu Gram. Sch.	Ebu
5	Ibusa Girls Gram. Sch.	Ibusa
6	Ibusa Mixed Sec. Sch.	Ibusa
7	Illah Gram. Sch.	Illah
8	Okpanam Community High Sch.	Okpanam
9	Omu Boys Sec. Sch.	Ibusa
10	St. Thomas College	Ibusa
11	Ugbolu Sec. Sch.	Ugbolu
12	Ukuala-)kpunor Mixed Sec. Sch.	Ukala-Okpunor

Oshimili South Local Government Area

S/No	Name of School	Town
1	Asagba Mixed Gram. Sch.	Asaba
2	Basic Sec. Sch.	Oko-Anala
3	Niger Mixed Sec. Sch.	Asaba
4	Oko Mixed Sec. Sch.	Oko
5	Oko-Ogbele Sec. Sch.	Oko-Ogbele
6	Okwe Sec. Sch.	Okwe
7	Osademe Sec. Sch.	Asaba
8	West-End Mixed Sec. Sch.	Asaba
9	Zappa Basic Sec. Sch.	Asaba
10	Zappa Mixed Sec. Sch.	Asaba

Ukwuani Local Government Area

S/No	Name of School	Town
1	Akashiede Girls Sec. Sch.	Obiaruku

2	Amai Sec. Sch.	Amai
3	Boys Sec. School	Obiaruku
4	Ebedei Sec. Sch.	Ebedei
5	Eziokpor Sec. Sch.	Eziokpor
6	Ezionum Sec. Sch.	Ezionum
7	Mixed Sec. Sch.	Akoku-Ebedei
8	Obiaruku Gram Sch.	Obiaruku
9	Obonomba mixed Sec. Sch.	Obinomba
10	Umuaja Sec. Sch.	Umuaja
11	Umuebu Sec. Sch.	Umuebu
12	Umukwata Sec. Sch.	Umukwata
13	Umutu mixed Sec. Sch.	Umutu

Appendix I: Analysis Output

Research Question 1 and Hypothesis 1

Descriptives

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
Pretest Achievement Scores	Self-Regulated Learning Strategy	128	29.47	6.440	.569	28.34	30.60	16	42
	Lecture Method	124	29.79	7.789	.699	28.41	31.17	18	48
	Total	252	29.63	7.124	.449	28.74	30.51	16	48
Posttest Achievement Scores	Self-Regulated Learning Strategy	128	59.69	12.640	1.117	57.48	61.90	40	90
	Lecture Method	124	48.94	10.860	.975	47.00	50.87	18	70
	Total	252	54.40	12.948	.816	52.79	56.00	18	90

Oneway

ANOVA

Pretest Achievement Scores

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	6.513	1	6.513	.128	.721
Within Groups	12730.423	250	50.922		
Total	12736.937	251			

Oneway

Descriptives

Posttest Achievement Scores

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Self-Regulated Learning Strategy	128	59.69	12.640	1.117	57.48	61.90	40	90
Lecture Method	124	48.94	10.860	.975	47.00	50.87	18	70
Total	252	54.40	12.948	.816	52.79	56.00	18	90

ANOVA

Posttest Achievement Scores

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	7281.334	1	7281.334	52.310	.000
Within Groups	34798.984	250	139.196		
Total	42080.317	251			

Research Question 2 and Hypothesis 2

Oneway

Descriptives

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
Pretest for male and female	Male	68	28.32	6.942	.842	26.64	30.00	16	42
	Female	60	30.77	5.598	.723	29.32	32.21	16	42
	Total	128	29.47	6.440	.569	28.34	30.60	16	42
Posttest for male -and female	Male	68	59.76	12.760	1.547	56.68	62.85	40	90
	Female	60	59.60	12.610	1.628	56.34	62.86	42	90
	Total	128	59.69	12.640	1.117	57.48	61.90	40	90

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Pretest for male and female	Between Groups	190.259	1	190.259	4.721	.032
	Within Groups	5077.616	126	40.299		
	Total	5267.875	127			
Posttest for male and female	Between Groups	.865	1	.865	.005	.942
	Within Groups	20290.635	126	161.037		
	Total	20291.500	127			

Univariate Analysis of Variance

Between-Subjects Factors

		Value Label	N
Sex and Achievement	1	Male	68
	2	Female	60

Descriptive Statistics

Dependent Variable: Posttest for male and female

Sex and Achievement	Mean	Std. Deviation	N
Male	59.76	12.760	68
Female	59.60	12.610	60
Total	59.69	12.640	128

Tests of Between-Subjects Effects

Dependent Variable: Posttest for male and female

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	68.131[a]	2	34.065	.211	.810
Intercept	22137.972	1	22137.972	136.834	.000
Pre	67.266	1	67.266	.416	.520
SexAchieve	.417	1	.417	.003	.960
Error	20223.369	125	161.787		
Total	476304.000	128			
Corrected Total	20291.500	127			

a. R Squared = .003 (Adjusted R Squared = -.013)

Research Question 3 and Hypothesis 3

Oneway

Descriptives

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
Pretest Attitude Scores	Self-Regulated Learning Strategy	128	23.30	9.342	.826	21.66	24.93	6	44
	Lecture Method	124	22.50	9.720	.873	20.77	24.23	6	44
	Total	252	22.90	9.519	.600	21.72	24.09	6	44
Posttest Attitude Scores	Self-Regulated Learning Strategy	128	57.42	7.218	.638	56.16	58.68	38	73
	Lecture Method	124	55.11	9.928	.892	53.35	56.88	28	77
	Total	252	56.29	8.718	.549	55.20	57.37	28	77

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Pretest Attitude Scores	Between Groups	39.996	1	39.996	.440	.508
	Within Groups	22705.719	250	90.823		
	Total	22745.714	251			
Posttest Attitude Scores	Between Groups	335.790	1	335.790	4.480	.035
	Within Groups	18739.638	250	74.959		
	Total	19075.429	251			

Research Question 4 and Hypothesis 4

Oneway

Descriptives

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
Pre-attitude scores for male and female	Male	68	22.24	10.107	1.226	19.79	24.68	6	44
	Female	60	24.50	8.313	1.073	22.35	26.65	10	40
	Total	128	23.30	9.342	.826	21.66	24.93	6	44
Post-attitude scores for male and female	Male	68	57.29	7.318	.887	55.52	59.07	38	73
	Female	60	57.57	7.162	.925	55.72	59.42	38	73
	Total	128	57.42	7.218	.638	56.16	58.68	38	73

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Pre-attitude scores for male and female	Between Groups	163.483	1	163.483	1.886	.172
	Within Groups	10921.235	126	86.676		
	Total	11084.719	127			
Post-attitude scores for male and female	Between Groups	2.368	1	2.368	.045	.832
	Within Groups	6614.851	126	52.499		
	Total	6617.219	127			

Research Question 5 and Hypothesis 5

Descriptive Statistics

Dependent Variable: Pretest Achievement Scores

Teaching Methods	Sex	Mean	Std. Deviation	N
Self-Regulated Learning Strategy	Male	28.32	6.942	68
	Female	30.77	5.598	60
	Total	29.47	6.440	128
Lecture Method	Male	28.40	7.068	50
	Female	30.73	8.153	74
	Total	29.79	7.789	124
Total	Male	28.36	6.966	118
	Female	30.75	7.098	134
	Total	29.63	7.124	252

Univariate Analysis of Variance

Between-Subjects Factors

		Value Label	N
Teaching Methods	1	Self-Regulated Learning Strategy	128
	2	Lecture Method	124
Sex	1	Male	118
	2	Female	134

Descriptive Statistics

Dependent Variable: Posttest Achievement Scores

Teaching Methods	Sex	Mean	Std. Deviation	N
Self-Regulated Learning Strategy	Male	59.76	12.760	68
	Female	59.60	12.610	60
	Total	59.69	12.640	128
Lecture Method	Male	49.92	8.427	50
	Female	48.27	12.246	74
	Total	48.94	10.860	124
Total	Male	55.59	12.118	118
	Female	53.34	13.595	134
	Total	54.40	12.948	252

Tests of Between-Subjects Effects

Dependent Variable: Posttest Achievement Scores

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	7380.311[a]	4	1845.078	13.134	.000
Intercept	41249.263	1	41249.263	293.619	.000
Pretest	16.903	1	16.903	.120	.729
Methods	6908.941	1	6908.941	49.179	.000
Sex	40.213	1	40.213	.286	.593
Methods * Sex	34.179	1	34.179	.243	.622
Error	34700.007	247	140.486		
Total	787752.000	252			
Corrected Total	42080.317	251			

a. R Squared = .175 (Adjusted R Squared = .162)

Research Question 6 and Hypothesis 6

Descriptive Statistics

Dependent Variable: Pretest Attitude Scores

Teaching Methods	Sex	Mean	Std. Deviation	N
Self-Regulated Learning Strategy	Male	22.24	10.107	68
	Female	24.50	8.313	60
	Total	23.30	9.342	128
Lecture Method	Male	24.32	8.145	50
	Female	21.27	10.529	74
	Total	22.50	9.720	124
Total	Male	23.12	9.346	118
	Female	22.72	9.700	134
	Total	22.90	9.519	252

Univariate Analysis of Variance

Between-Subjects Factors

		Value Label	N
Teaching Methods	1	Self-Regulated Learning Strategy	128
	2	Lecture Method	124
Sex	1	Male	118
	2	Female	134

Descriptive Statistics

Dependent Variable: Posttest Attitude Scores

Teaching Methods	Sex	Mean	Std. Deviation	N
Self-Regulated Learning Strategy	Male	57.29	7.318	68
	Female	57.57	7.162	60
	Total	57.42	7.218	128
Lecture Method	Male	54.64	10.638	50
	Female	55.43	9.478	74
	Total	55.11	9.928	124
Total	Male	56.17	8.933	118
	Female	56.39	8.556	134
	Total	56.29	8.718	252

Tests of Between-Subjects Effects

Dependent Variable: Posttest Attitude Scores

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	359.384[a]	4	89.846	1.186	.318
Intercept	112023.444	1	112023.444	1478.400	.000
PretestAtti	2.489	1	2.489	.033	.856
Methods	351.259	1	351.259	4.636	.032
Sex	17.746	1	17.746	.234	.629
Methods * Sex	5.016	1	5.016	.066	.797
Error	18716.044	247	75.773		
Total	817432.000	252			
Corrected Total	19075.429	251			

a. R Squared = .019 (Adjusted R Squared = .003)