EFFECTS OF METACOGNITIVE INSTRUCTION ON THE SELF-EFFICACY AND ACADEMIC ACHIEVEMENT OF BIOLOGY STUDENTS IN SENIOR SECONDARY SCHOOLS IN KATSINA LOCAL GOVERNMENT, KATSINA STATE.

BY

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DECLARATION

I hereby declare that this work is the product of my research efforts undertaken under the supervision of Prof. Sagir A. Abbas and has not been presented anywhere for the award of a Degree, Masters or certificate. All sources have been duly acknowledged.

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CERTIFICATION

This is to certify that the research work for this dissertation of MARYAM JAFARU a postgraduate student in the Department of Science and Technology Education with Registration Number SPS/14/MST/00050 was carried out under my supervision and has satisfactorily completed the requirement for research work for the award of the degree of Master of Science and Technology Education. The dissertation is original and has not been submitted in part or in full for any other Diploma or Degree of this University or any other University.

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APPROVAL PAGE

This dissertation titled: Effects of Metacognitive Skills Instruction on Self-efficacy and Academic Achievement of Biology Students in Senior Secondary Schools in Katsina Local Government, Katsina State by Maryam Jafaru, has been examined and approved for the award of Master Degree in Science Education (Biology) in the Department of Science and Technology Education, Bayero University Kano.

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LIST OF ABBREVIATIONS

MPQ; Metacognitive Prompting Questionnaire

NPE; National Policy on Education

SSCE; Senior Secondary Certificate Examination

WAEC; West African Examination Council

AAAS; American Association for Advancement of Science

SEQ; Self-efficacy Questionnaire

GPST; Genetic Problem Solving Test

ANOVA; Analysis of Variance

ANCOVA; Analysis of Covariance

BSE; Biology Self-efficacy Scale

BAT; Biology Achievement Test

KCSE; Kenya Certificate Secondary Examination

CSR; Cognitive Self-regulated learning strategies

MSR; Metacognitive Self-regulated learning strategies

TSEM; Time and Study Environmental Management Strategies

SEB; Student Self-efficacy Belief

SPSS; Statistical Package of Social Science

KSMOE; Katsina State Ministry of Education

DEFINITION OF OPERATIONAL TERMS

Academic Achievement: This is the performance of students in a given biology achievement test. When a student's score 12marks and above in the BAT is said to achieve.

Metacognition: Students' ability to use previous knowledge to plan a strategy for approaching a given learning task, take necessary steps to solve problem, reflect on and evaluate results, and modify one's approach as required.

Self-efficacy: Refers to the confidence students have to perform a given learning task.

Gender: Refers to culturally and socially constructed difference between male and female that varies from place to place and time to time.

Abstract

This study investigated the Effects of Metacognitive Instruction on the Self-efficacy and Academic Achievements of Biology Senior Secondary School Students in Katsina Local Government, Katsina State, Nigeria. Three research questions and three null hypotheses were developed to guide the study. A Quasi-experimental research design of pre-test and post-test non-equivalence experimental and control group was employed. The population of the study comprises of all the Biology students from the Co-educational Senior Secondary Schools with a total number of nine thousand and thirty eight students (9038) in Katsina Local Government, Katsina State. Two co-educational secondary schools were randomly sampled comprising of one hundred and eighty senior secondary two (180) SS II Biology students from four intact classes. The research instruments were Biology Achievement Test (BAT) and Biology Self-efficacy Scale (BSES) which were both subjected to content and face validation. The reliability coefficient was collected using test-retest method and the result was analyzed using Pearson moment correlation coefficient and the value of r was found to be 0.78 of the Biology Achievement Test and that of Biology Self-efficacy was found to be 0. 96. The BSES and BAT scores were analyzed using descriptive (mean and standard deviation) and inferential statistics (z-test) statistics at $\alpha = 0.05$ level of significance. The study revealed that Students exposed to metacognitive skills instruction improved better in their academic achievement and self-efficacy belief than those that were not exposed to metacognitive skills instruction while female outperformed their male counterpart. Based on the findings, recommendations were made amongst which are Biology teachers should encourage students to use metacognitive skills in learning through adopting strategies that ensure student acquisition of the various metacognitive skills involve in learning.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

The school system is established to facilitate teaching and learning. It empowers the students with necessary knowledge and skills for an effective living in the society. The extent in which school is able to impart knowledge on students would depend largely on the performance of the students. Of interest is that the performance of secondary school students in Nigeria over the years have been on the decline. The present state of students' Achievement as measured by performance in external examinations conducted by West African Examination Council (WAEC) and National Examination Council (NECO) has been in the decline. The students' performance is yet to be satisfactory. The rate of students passing Senior Secondary Certificate Examination is decreasing yearly as a result of the poor performance recorded, while the number of students re-enrolling for the examination keeps increasing annually (WAEC & NECO Chief Examiners Report, 2016, Table 1). The present Nigerian educational system seems to be far from achieving the desired educational goals and objectives as there is an evidence of decline in the standard of education and performance of students especially at the secondary school level (Duze, 2011).

This might be due to the fact that there is no development of biology students' self-reported use of metacognitive learning strategies and self-efficacy in Nigeria secondary schools nowadays. It is expected that classroom learning be transferred into problems solving in real life situation. Hence, there is need to investigate the major banes that hinders the use of metacognitive strategies and self-efficacy on academic achievement of the biology secondary school students which this present study aim to find out. According to Nwagbo and Chukelu

(2011), the study of biology is essential for the nation's scientific and technological development.

Umar (2011) defined biology as a natural science that deals with the living world: How the world is structured, how it functions and what these functions are, how it develops, how living things came into existence, and how they react to one another and with their environment. It is a prerequisite subject for many fields of learning that contributes immensely to the technological growth of the nation (Ahmed, 2008). This includes Medicines, Nursing, Pharmacy, Agriculture, Forestry, Biotechnology, Nanotechnology and many other areas (Ahmed & Abimbola, 2011). Biology is today part of the basic requirements for studying science in the higher Educational system since it is one of the fundamental of science and technologically-based subjects. It affects all aspects of human life at different stages as it is dealing with study of life.

Therefore, for biology students to meet with learning challenges effectively in a world that is experiencing knowledge explosion, they need a kind of exposure that will enable them to learn independently and become active in their learning and thinking skills such as metacognitive skills instruction to increased students' learning skills and improve their achievement. Lack of problem solving skills is another issue of concern demonstrated by students. In spite of extensive research in the field of problem solving over the past few decades, there are still important areas that remain mainly under-explored. Students' self-efficacy beliefs (SEB) in science and metacognitive monitoring in problem solving situations are two of these areas (Aurah, Jerrell & Tom, 2014).For a Learning to be effective in a science classroom it requires students to be self regulated and this goes hand in hand with metacognition and self-efficacy. Thus, there is need to pay attention to the importance of metacognition in learning of science (Efklides, 2008; 2009).

Metacognition which is one of the variables of interest in this present study refers to higher order thinking that involves active control over the cognitive processes engaged in learning. It is the process of thinking about one's own thought processes. Metacognitive activities can include planning how to approach a given learning task evaluating progress and monitoring comprehension" (Ontario Ministry of Education, 2010). David (2010) defined metacognition as one's ability to use prior knowledge to plan a strategy for approaching a learning task, take necessary steps to solve problem, reflect on and evaluate results, and modify one's approach as needed. The role of metacognition for high-quality learning and problem solving is generally accepted (Brown, 1978, Flavell, 1979 & Carr, 2010) and has led to interest in creating learning experiences conducive to developing its use, such as metacognitive prompting. Metacognitive prompts are suggested as an instructional technique for enhancing students' learning (Carr, 2010) and may also be influenced by self-efficacy. Metacognition helps learners choose the right cognitive tool for the task and plays a critical role in successful learning. Metacognition through metacognitive prompting on its own acts as a catalyst that evoke the use of self-regulation strategies, such as understanding the nature of a problem, selecting and monitoring appropriate strategy, evaluating outcomes, and revising and sometimes abandoning strategies if deemed unsuccessful (Hoffman & Spatariu, 2008).

The use of metacognitive skills has been suggested to play a vital role in learning. The skills ensure that the learner will be able to construct meaning from information. To accomplish this, the students must be able to think about their own thought processes, identify the learning strategies that work best for them and consciously manage them as they learn (Flavell, 1987). It has been suggested that students with good metacognitive training demonstrate good academic achievement compared to others who lack the skills. Students without metacognitive skills may

benefit from metacognitive instruction to improve their metacognition and academic achievement (Everson & Tobias, 1998, Moga, 2012).

Metacognitive skills acquisition has also been suggested as an important means for enhancing learner's self-efficacy (Pajares & Urdan 2006). This is because when the skills have been acquired through instructions, learners become more focused to approach learning tasks in a organized manner. The acquisition of skills necessary for tackling problem is also believed to raise the learner's self-efficacy for task accomplishment (Siegler, 1998, Aurah, Cassady, & McConnell, 2014). According to Santrock (2001) and Moga (2012), the mastery of metacognitive skills will develop student feelings of competency and arouse their attention in learning biology and other science related subjects in school which in turn improve their achievement. Another variable of interest is students' self-efficacy which researchers see as supposedly interconnected with metacognition (DeCorte, Verschaffel & Eynde, 2000, Efklides, 2011. Even though, there are little empirical studies that examine how metacognition and self-efficacy function together in the actual learning process (Aurah, 2013).

Self-efficacy refers to the confidence an individual have to perform a task, besides ones' skills, self-efficacy beliefs are important requirement for competent functioning (Tobing, 2013). Pajare and Urdan (2006) defined self-efficacy as the belief that one is capable of performing in a certain manner or attaining certain goals. In a high level study typical of the literature, Brady-Amoon and Fuertes (2011) provided clear evidence for the impact self-efficacy has on student adjustment to the educational environment and academic performance. Enhancing student self-beliefs can promote healthy adjustment and performance across a wide range of settings including school and work. Specifically, teachers can help students set realistic goals and provide ongoing support throughout instruction, assessment, and feedback. It is recommended that future

studies need to focus on different variable like metacognition. This study tends to bridge the gap. Ewing (2012) believed that formal education process, generally intended to prepare students for responsible engagement in society with accrued benefits to the self. In that case, students must learn how to self-direct effectively. This suggests that within the formal education process students need to develop a strong sense of self-efficacy by engaging in regular opportunities such as self-assessment that may result in increased competence to make informed choices leading to the lifelong attainment of their desired academic outcomes. One of the most important concepts related to self-efficacy is the academic self-efficacy belief about capabilities to achieve the tasks in definite academic field (Altunsoy, Cimen, Ekici, Atik & Gokmen, 2012). It has been suggested that students with high level of self-efficacy demonstrate good academic achievement in biology compared to others with low level of self-efficacy (Diseth, 2011, Sadi & Uyar, 2013).

Similarly, students' academic achievement relates to this study. Bell (2013) defined achievement as to perform anything with skill acquisition, effort completely, successfully, the competence to perform efficiently and to respond quickly to a given task. It is regarded as the end of educational instruction. Academic achievement is the best indicator of potential for success in life; it reflects one's abilities and the qualities it takes to have an excellent academic achievement are those required to be successful in life, which include consistency, determination and focus (Abiola, 2012). The factors that influence biology student's academic achievement at secondary school are not conclusively known and could be multivariate in nature; they include student's attitude towards school, interest in learning, study habit (Metacognitive monitoring), attribution, self-efficacy belief, intelligence and motivation (Joe & Okoto, 2014).

Gender is also of interest to this present study, it refers to culturally and socially constructed difference between men and women that varies from place to place and time to time.

In comparison, 'sex' denotes geologically determined, thus unchangeable, differences between them (Bussiness Dictionary, 2017). Okeke (2001) defined gender as the social or cultural construct, characteristics, behaviors and role which humanity ascribes to males and females. However, the influence of gender on students' achievement in science has for a long time been a concern to many researchers and science educators. Oludipe (2012) revealed that, there was no significant difference in academic achievement of male and female students. Opara (2011) found that boys performed better than the girls in biology and chemistry respectively. Similarly, Kolawole, (2007) found that male students performed better than female students in the cognitive, affective and psychomotor skill achievements. Other researchers like Babajide (2010), revealed no significant gender difference among students who were exposed to practical activities at senior secondary schools levels. Studies by Ogunleye (2011); Agommuoh & Nzewi, (2003) lend credence to non-significant gender effect in science achievement.

1.2 Statement of the Problem

Biology is a subject that requires the problem solving skills such as metacognitive learning skills and self-efficacy belief of students for successful accomplishment of academic performance. in spite of the importance and popularity of biology among Nigerian students, performance at senior secondary school level has been poor (Ahmed, 2008)**.** This is evident in the report of Senior Secondary School Certificate Examination (WAEC & NECO) of biology subject 2012-2016 on enrolment and performance of student in Katsina State revealed very low enrolment as well as low academic achievement in the subject (Table 1). Therefore, there is a great need for a critical examination of the teachers' method of teaching as well as the students' learning skills in order to solve the situation.

Evidence suggests that instructional programme that has traditionally relied upon old method of teaching and ineffective learning strategies, making students to become passive recipients of information rather than being active is adopted in most Nigerian classrooms. This brings about poor performance of biology students in most secondary schools. Metacognitive and self-efficacy learning skills are identified as the skills which facilitate classroom learning, enable students to learn independently and become active in their learning and thinking skills (Umaru, 2010). To address this issue teacher can build student self-efficacy through formative assessment by focusing more on the process of learning as opposed to a singular outcome grade (Hughes, 2010).

Onu, Eskay, Igbo, Obiyo and Agbo (2012), identified the effect of metacognitive instructions and self-efficacy has on students' academic performance in primary school level. it should be noted that secondary school students are different from the typical elementary-aged children and therefore reacts differently in their metacognitive and problem solving skills. At secondary school level, the amount of effect metacognitive instruction and self-efficacy belief has on the biology students academic achievement cannot be overemphasized (Schneider & Artelt, 2010; Yang & Lee, 2015). Therefore, the ways and manners by which these variables effects students' academic performance needs to be researched and documented. This will provide better understanding of biology as a subject. Therefore, this study investigated the effects of metacognitive instruction on the self-efficacy and academic achievement of biology students in senior secondary schools in Katsina Local Government, Katsina State.

1.3 Objectives of the Study

The aim of this study was to investigate the effects of metacognitive instruction on self-efficacy and academic achievement of biology students in some selected senior secondary schools in Katsina Local Government, Katsina State. Specifically, the study set out to:

1. find out the effects of metacognitive instruction on biology students academic achievement.
2. examine the effects of metacognitive instruction on biology students'self-efficacy.
3. find out if there is any gender difference in the academic achievement of biology students when exposed to metacognitive instruction.

1.4 Research Questions

1. What is the effect of metacognitive instruction and conventional teaching method on biology students' academic achievement?
2. What is the effect of metacognitive instruction and conventional teaching method on biology students' self-efficacy?
3. Is there any gender difference in the academic achievement of biology students when exposed to metacognitive instruction?

1.5 Research Hypotheses

$H0_1$: There is no significant effect of metacognitive instruction and conventional teaching method on biology students' academic achievement.

$H0_2$: There is no significant effect of metacognitive instruction and conventional teaching method on biology students' self-efficacy.

$H0_3$: There is no significant gender difference in the academic achievement of biology students when exposed to metacognitive instruction.

1.6 Significance of the Study

This study will be beneficial to students, teachers, curriculum planners, authors and researchers. Metacognition forms the bases of students' understanding. Biology Students should be able to understand the instruction given by their teacher to increase their knowledge and improve their academic achievement. Improving student self-efficacy beliefs can promote healthy academic achievement of Biology students. Thus, this study would be significant in the following way.

Instruction in metacognitive skills help the biology students to be aware of the basic skills required to approach and solves learning problems independently and increase their consciousness and knowledge of biology. It enhance students' ability to plan, monitor and regularly evaluates their learning process, this gives them opportunity to excel in their academic endeavors. Thus, it will enable biology students to acquire the metacognitive skills desired for them to successfully and effectively learn the subject.

Biology teachers will gain some benefits of instruction in metacognitive skills which enable the learners to understand problem solving skills and enhance their self-efficacy belief in understanding of biology. It will improve teachers' awareness of the various metacognitive skills in learning and then form the basis for them to include it in the teaching and learning processes. Thus, would enable teachers to train their students on how to effectively apply these skills to improve their achievement.

If the findings of this study reveal that students' self-efficacy belief and metacognitive instruction improve biology students' achievement, then curriculum planners will be enlightened to make some modifications when designing biology secondary schools curriculum by highlighting on use of metacognitive instruction putting into consideration the students' self-

efficacy belief. This will increase biology students' self-efficacy and awareness of metacognitive skills engages in learning process.

Similarly, this study if properly presented in workshops, publication, seminar, training of student teachers, will assist stakeholders in education with significant information on the effects of metacognitive skills instructions on the self-efficacy and academic achievement of biology students in senior secondary schools.

The findings of this study will prepare future researchers to carry out further research work on metacognition or other related variables of this study such as self-efficacy and students' academic achievements to promote the teaching and learning of biology and other science related subjects.

1.7 Scopes of the Study

This study found out the effect of metacognitive instruction on self-efficacy and academic achievement of SS II biology students in senior secondary schools in Katsina Local Government Area of Katsina State, Northwest Nigeria. The independent variable in this study is metacognition, while the dependent variables are the biology students' self-efficacy, gender and academic achievement.

The study was limited to only SSII biology students of two co-educational secondary schools in Katsina Local Government Area of Katsina State. The investigation was restricted only on the topic of Feeding Mechanism and Digestive System because it one of the topics taught under SS 2 Biology curriculum which some students find it difficult (National Curriculum on Biology, 2012). However, the study was delimited to other private senior secondary schools in the area. The study will not also cover other topics in Biology.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter reviewed relevant literatures in relation to Metacognition, Self-Efficacy, Gender and Academic Achievement by adopting thematic method of literature review. Literature review was discussed under the following sub-heading:-

2.2 Theoretical Framework

2.2.1 Flavell's Theory of Metocognitive Development

2.2.2 Models of Instructions in Metacognition

2.2.3 Albert Bandura's Self-Efficacy Theory

2.2.4 Achievement Motivation Theory

2.3 Conceptual Framework

2.3.1 Concept of Biology

2.3.2 Significance of studying biology

2.4 Concept of Conventional Teaching Method

2.5 Concept of Metacognition

2. 5.1 Metacognitive Learning Skills

2.5.2 Significance of Metacognitive Learning Skills in Biology

2. 6 Concept of Self-Efficacy

2.6.1 Significance of students' self-efficacy in biology

2.6.2 Relationships between metacognitive skill, self-efficacy belief, and academic achievement.

2.7 Academic achievement among biology students

2.7.1 Functions of biology students' academic achievement

2.7.2 Factors that influence biology students' academic achievement

2.8 Gender in sciences

2.9 Review of empirical studies

2.10 Implications of the literature reviewed on the present study

2.2 Theoretical Framework

2.2.1 Flavell's Theory of Metacognitive Development

Flavell (1979) proposed a formal model of Metacognitive monitoring which described four components of Metacognition and their relationship. These include;

(I) Metacognitive knowledge (Metacognitive awareness),

(II) Metacognitive experiences (Regulation of cognition),

(III) Goals or tasks,

(IV) Actions or strategies.

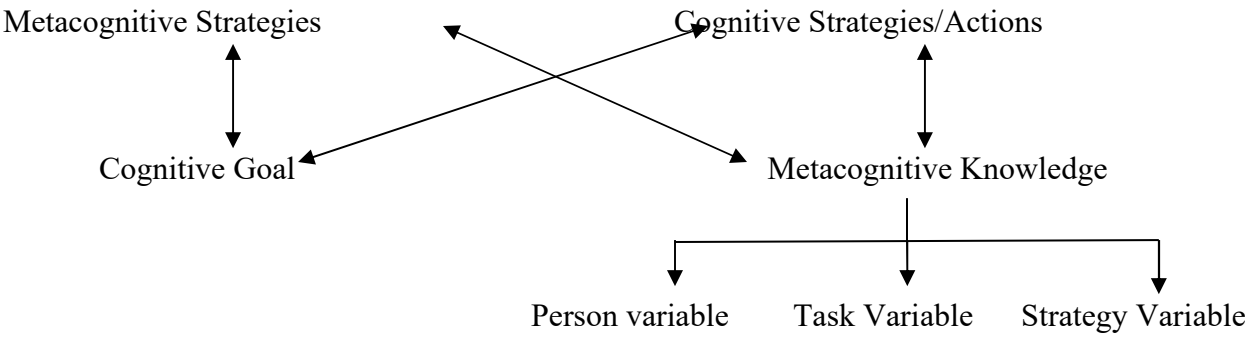

Fig.1. Flavell's Model of Metacognition (Flavell, 1979)

The actions and interactions among these four components determine one's ability to monitor and control a wide variety of cognitive activities.

I. Metacognitive knowledge: refers to acquisition and application of knowledge about cognitive processes. It involves an individual's awareness about ability as well as others. For example, I am very good in biology but Abdu knows mathematics better than me. This statement is an example of metacognitive knowledge. He explained that metacognitive knowledge involves one's knowledge or beliefs about the factors that affects cognitive activities (Flavell, 1979). He also maintained that Metacognitive knowledge consist of three factors:

1. **Knowledge of person variable (Declarative knowledge):** this refers to knowledge about how an individual learn and process information through acquisition. It is the process of understanding one's own capabilities. For example the realization that one is better at studying Biology than calculating mathematics.

2. Knowledge of task variable (Procedural knowledge): this refers to awareness about the nature and the type of task one is dealing with. It entails all the information about a proposed task that is available to person. Task knowledge directs an individual about the range of possible and worthy outcomes of the cognitive enterprises and the goal attached to its accomplishment. For example, one may realize that calculation take little time than memorizing a biological task.

It constitutes knowledge about task difficulty or complexity and mental resources needed for its completion.

3. **Knowledge about strategy variable (Conditional knowledge):** also known as conditional knowledge refers to one's knowledge about the various metacognitive skills strategies involves in learning. It involves an individual capability to effectively use strategies in order to learn given information. Conditional knowledge engages a person's ability to know why and when to use declarative and procedural knowledge (Garner, 1990). It can be seen as one's knowledge and awareness of conditions that affect learning, specifically the "why" strategies and "when" strategies that should be applied when appropriate. This can be limited by inadequate domain knowledge, weak monitoring, lack of awareness, or ineffective strategies of task demands. Conditional knowledge can actually improve an individual's capability to transfer and use strategies in difficult problems and contexts (Tarricone, 2011). Strategy variable enables students to allocate their resources when using strategies, this make them to be more effective as learners (Reynold, 1992). It includes identifying goal and sub-goals and selection of cognitive process to use in achievement (Flavell, 1979). It deals with one's ability to use strategies to learn information and apply these strategies to new situations.

II. Metacognitive Experience (Regulation of Cognition)

Metacognitive experience has been defined as cognitive awareness that is relevant to one's thinking processes. The feeling of something is complex or easy to recall, difficulty in understanding concept, difficulty to solve, comprehend, and the feeling that one is approaching or failing to approach a set of cognitive goals are some of the examples of metacognitive experience (Flavell, 1987). It directs one's understanding of how and when to use or apply certain skills to control one's learning. For example, students reflect on their school task, and

assess themselves by asking question like, how well am I doing in Biology? How could I study my Biology notebook to improve next time? (Madeline, 2017). Metacognitive experience refers to application of metacognitive strategies which are sequential processes uses to control cognitive activities in learning situation (Brown, 1987).These involves planning, monitoring cognitive activities, and evaluating outcomes (Schraw, 2000 & Eker, 2014).

(a) Planning: refers to the selection of appropriate strategies, previewing main ideas or concept and the allocation of resources or materials to learn. For instances, planning involves organization of learning materials, visualization of ideas with aid of diagram for quick recovery, strategy sequencing, time framing, selective attention before approaching a given learning task (Miller, 1985).

(b) Monitoring/Regulation: monitoring refers to learners' judgment about the strength of their memories. It involves an individual's awareness of comprehension and task performance. It directs students to have focus in their learning this allows them to noticeably differentiate their efficient and inefficient efforts and provide a means by which the students might choose the necessary and appropriate skills to successfully succeed academically (Eker, 2014). Monitoring has been viewed as one's awareness of comprehension and task performance which includes the ability to regularly think and test or check their progress in learning situation.

(c)Evaluation: - refers to checking individual's own solution to the problem against the standard procedure of solving strategy (Flavell, 1979). It involves quantifying the outcomes and regulatory processes of students' learning.

III. Metacognitive Goal (Tasks)

Metacognitive goal (task) refers to the real outcomes of a cognitive venture, such as reading and understanding Biological concepts for an upcoming test/examination, which will activates the

application of metacognitive knowledge and gives rise to new metacognitive experiences. Achievement of a goal or task relies wholly on metacognitive knowledge and metacognitive experience for its effectual and successful accomplishment (Flavell, 1979).

IV. Action or Strategies; refers to the processes hired or used to control individual's cognitive activities to ensure that a cognitive goal have been achieved or attained. For instance, the understanding Biological terms / definitions to improved one's comprehension.

The Flavell theory of metacognition is related to this study, because it describes the meaning of metacognitive knowledge, metacognitive experience and various metacognitive skills involve in learning such as planning, monitoring, evaluation and explains the various ways to obtain knowledge about cognitive processes. It provides students with knowledge of cognitive processes and metacognitive strategies. This enables biology students to solve problems more effectively, consciously manage how they approach a given biological task and evaluates their efforts and progress to enable them to achieve successfully and academically.

2.2.2 The Model of Instruction in Metacognition

This model was proposed by McLaughlin and Hollingsworth (2001) to encourage the development of the metacognitive skills and strategies of reflection which are believed to be vital for effective problem solving in science classroom. They put forth eight phases for instructing and developing metacognitive skills in science students, suggesting that these skills need to be taught and monitored in teaching and learning process. According this model, the first phase requires the teacher to identify all the key concept of metacognition. For example, awareness-students need to be aware of the type of problem solving skills involved, analysis of the questions at hand, planning for a solution, choosing strategies, monitoring one's self and evaluation. In the second and third phase teacher design problem situation that require solution.

For example, teacher creates biological questions for students to answer. In the fourth phase, the teacher monitors students as they answer questions. In the fifth phase, the students were guided in the process and strategies require in solving problem and made aware of the various steps used in while answering questions. These includes, understanding the questions (awareness), readiness to find the answer (planning), review the answer obtained. In the sixth phase, students are provided with more questions in the same topic in order to apply their previous metacognitive skills experienced in the third and forth phases. While in the seventh phase, students were provided with chance to manifest on their answers given. And finally refine the entire instruction process to proceed to next problem situation. This provides biology students with the knowledge to actively and independently solve problem not only in biology but apply it on other science related subjects like, chemistry and physics.

Therefore, using this proposed model, the students were provided with a biological task (Feeding Mechanism and Digestive system) to learn independently and in groups' followed by solving problems created by the teacher. Students answer questions and are allowed to compare their answer with each other and that of the teacher to ensure effective transfers of knowledge.

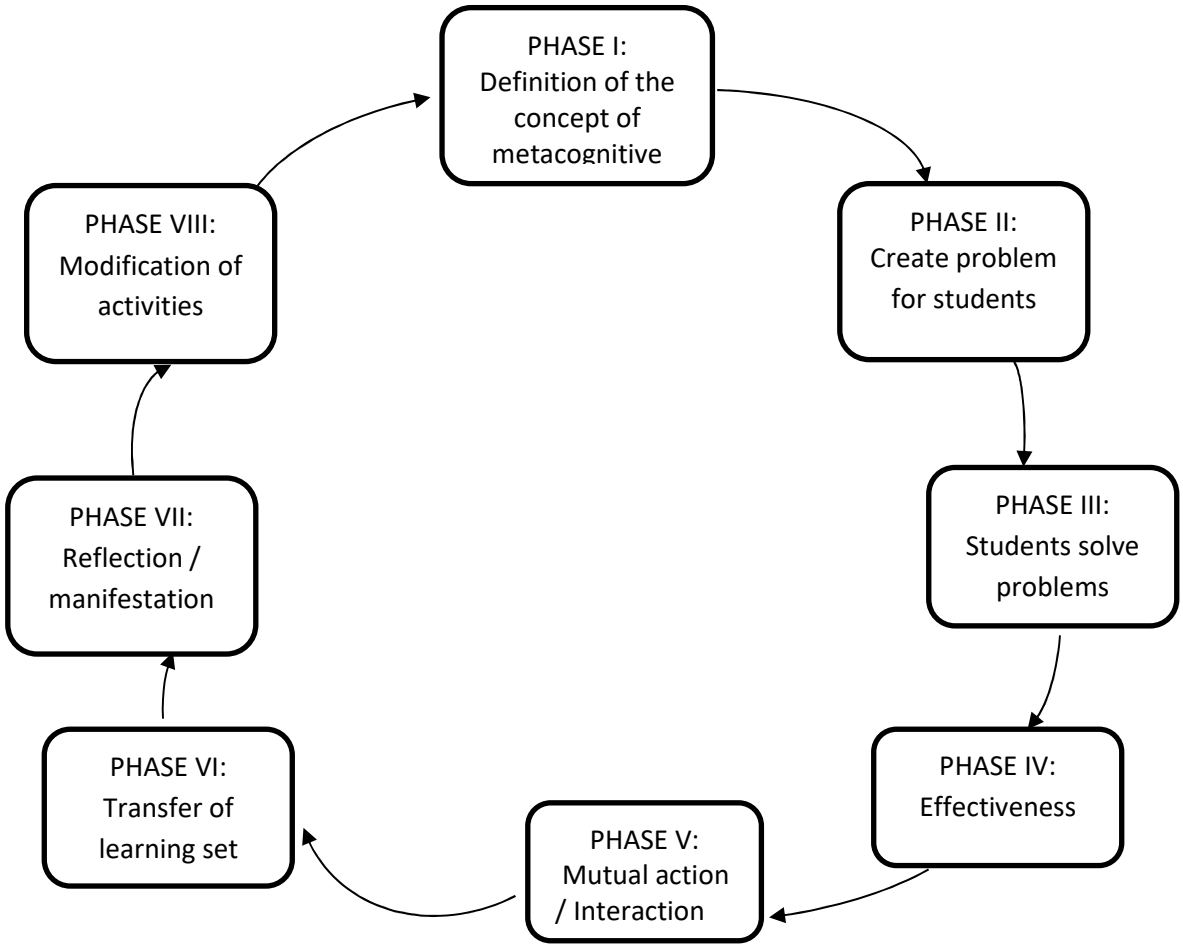

Fig.2. Model of Instruction in Metacognition

Source: *Mc Laughlin and Hollingsworth (2001)*.

The figure 2 above describes how real instruction in metacognitive learning skills should take place. Therefore, the control groups were given instruction by the teacher in the conventional method (Lecture method) and for the experimental groups, the researcher developed and used metacognitive instructional package using this model approach to train the students on different metacognitive skills involved in learning. The model proposed also served as a guide to the researcher on how actual instruction in metacognitive skill should proceed.

2.2.3 Albert Bandura's Self-Efficacy Theory

Bandura (1977a, 1977b, 1986a, 1986b, 1997, 2002, 2006a), Schunk (1998), Bandura, *et. al* (1996) and Schunk and Usher (2011) collectively recorded significant work and created an overview on Self-Efficacy Theory.

Ashford and LeCroy (2010) viewed that self-efficacy was developed by Bandura from Social Learning theory which he progressed to Social cognitive theory (Levin, Culin, & Perrotto, 2001). Bandura (1977a) contended to view an integrated theoretical framework to describe and predict different psychological changes achieved by distinct modes of treatment. He identified the four major sources of efficacy expectations and their associated modes of induction as performance accomplishments, vicarious experiences, verbal persuasion, and emotional arousal.

1. **Performance Accomplishments (Mastery/Past experiences):** these are the most important source of self-efficacy because positive and negative experiences can easily influence one's ability to perform a given task. For example, in positive experience, if one previously performed successful in a task, may likely increase one's competent to perform well in similar task situation. While negative experience for instance may be when one experiences a failure, it may likely decrease their self-efficacy belief. But if luckily, these failures are overcome by conviction, and then it may increase one's self-efficacy when the situation is viewed as an achievable challenge. This means that success rises one's self-efficacy while, failure undermines it. Performance accomplishment mode of induction includes participant modeling, performance desensitization, performance exposure, and self-instructed performance.
2. **Vicarious Experience:** this is a situation where by a person imitates his/her model. People can develop high or low self-efficacy vicariously by watching other people's performances. Some people compare their self-competence with others who they belief

they are similar to them. Therefore, if they see them succeed, their self-efficacy rises and if their role models failed, their self-efficacy decreases. These modes of induction involve live modeling and symbolic modeling.

3. **Verbal persuasion:** this is a situation where by one's efficacy to perform is influenced by encouragement or discouragement. Therefore, positive persuasions increase self-efficacy, while negative persuasions decrease self-efficacy. For example, a teacher can positively persuade his/her student by telling them 'you can make it. I have confidence in you.' This can make them to increase effort, thereby have greater chance of succeeding. Similarly peers or parents can negatively persuade someone by telling them 'you cannot make it. It is not possible.' This can lower one's competence; thereby have lower chances of success (Redmond, 2010). These modes of induction include suggestion, exhortation, self-instruction, and interpretive treatments.
4. **Emotional arousal:** These are psychological feedback experienced by an individual when engaged in a given task which alters their belief of efficacy. These feedbacks such as feeling distress, anxiety, fatigue, aches or pains, fear, e.t.c easily influences one's self-efficacy (Redmond, 2010). Bandura (1997) maintained that emotional arousal mode of induction includes attribution, relaxation and biofeedback, symbolic desensitization, and symbolic exposure. However, People rely on somatic information to judge their capabilities and hence develop greater self-efficacy through "enhanced physical status, which reduces stress levels and negative emotional proclivities, and corrects misinterpretations of bodily states" (p. 106). Bandura (1997) pointed that an ideal academic settings offers an excellent opportunity for the development of self-efficacy. Therefore, teaching methodology and resources should be evaluated for both academic

skills and knowledge, and for enhancing students' perception of themselves and social relationship.

Collins (1982) found that when students were confronted by difficult tasks to solve, across all levels of ability, students who had the stronger belief in their efficacy quickly discard faulty strategies, solved more problems, try to rework more of those they failed more accurately than students of equal ability who doubted their efficacy. Schunk (1998) believed that students with higher self-efficacy are more prepared to perform a given learning task, dedicatedly participate, study harder, persist longer when they encounter difficulties, and achieve at higher levels compared with students who doubt their learning capabilities. Similarly, William and William (2010) proved that learners with high level of self-efficacy approach difficult learning tasks as challenges to master rather as menace to be avoided. Schunk and Usher (2011) opined that Bandura's work on self-efficacy had been explored to various domains including education, health, and business and among individuals varying in age, developmental level, and cultural background. He maintained that self-efficacy influences ones' motivation, achievement, and self-regulation. They further mentioned the sources of self-efficacy information as mastery experiences, vicarious experiences, forms of social persuasion, and physiological indexes and effects of self-efficacy as motivation, learning, self-regulation, and academic achievement.

To the researcher, Bandura's Self-Efficacy theory s is related to this study. Because it explained that, the information we process from observing other people, things, and events influences the way we behave and act. Some students' self-efficacy increases when they see their classmates/models achieving, they try to make necessary preparation to achieve successfully as well. This category is a good example of what Bandura called vicarious experience among the four major sources of self-efficacy. This shows that students' self-efficacy belief influences their

academic achievement. Learners with high level of self-efficacy achieve higher academically compare to those with low self-efficacy. Therefore, social cognitive skills are important in the regulation of academic activities. Development of student's self-efficacy skill is a key variable to this study. Thus, this present study developed a self-prompting questionnaire of biology self-efficacy scale (BSES) to assess the students' level of self-efficacy belief in biology.

2.2.4 Achievement Motivation Theory

The theory of achievement motivation was developed by Atkinson in 1957 (Atkinson, 1964, 1966). Achievement motivation theory also known as achievement goal theory has been one of the most prominent theories of motivation in educational research for more than 31 years. It has undergone extensive review during that span, most notably with the distinction between approach and avoidance goals, debate concerning the critical features of performance goals, and the emergence of a multiple goal perspective that emphasizes the positive potential of performance-approach goals along with mastery goals. This multiple goal perspective has met several criticisms from theorists taking the traditional perspective that emphasizes mastery goals over performance goals (Senko, Hulleman & Harackiewicz, 2011).

The mastery goal perspective of achievement goal theory was developed to determined learners' adaptive and maladaptive responses to achievement challenges (Nicholls, 1984; Dweck, 1986). Thus, two main goals were stressed: mastery goals, which are concerned with acquiring and developing individual's competence, and performance goals, which are concerned with demonstrating individual's competence and outperforming peers. Mastery goals have been believed to produce similar or stronger effects than performance goals on any desirable educational outcome, and certainly never weaker effects (Dweck, 1986; Nicholls, 1984). This hypothesis traces to two distinctions between the two goals.

The first is that the two goals are separated from various aspects of ability. Students pursuing mastery goals tend to consider ability a malleable attribute, something to be developed by struggle and increasing effort. Therefore, enjoy challenge and endure to respond strongly to adversity. While Students pursuing performance goals considered ability a fixed attribute and avoid challenges and respond helplessly to adversity as a result lack hope and self-confidence (Dweck, 1986).

The second key distinction between these goals is in how they define success versus failure. Successful attainment of a performance goal requires outperforming peers. In contrast, successful attainment of a mastery goal requires meeting either task-based criteria (e.g., answering 80% of a biology test correctly) or, more typically, self-defined criteria (e.g., feeling that you have learned or improved). Thus, only a select percentage of students can achieve a performance goal, but every student can in principle achieve a mastery goal (Nicholls, 1979, 1984). Mastery goals should therefore be easier to attain and allow for greater feelings of competence than performance goals, and this should translate into positive academic achievement.

Researchers have recorded an impressive body of work on the effects of mastery and performance goals. Some of these works have been experimental (e.g., Butler, 1987; Jagacinski & Nicholls, 1987; Elliott & Dweck, 1988; Harackiewicz & Elliot, 1993; Senko et al., 2011), but large portion of these studies has been done in the classroom by correlating students' self-reported goals with various educational outcomes, such as achievement (e.g., biology exam grades), interest in the biology material, study strategies, metacognitive monitoring, self-regulation, help-seeking behaviors, etc. The findings for mastery goals have been uniformly most convenient and useful. Learners who pursue mastery goals, compared to those who do not, often

find their classes and lessons more interesting, readily face difficulty, appreciate cooperativeness, seek for assistance in a state of confusion, effectively regulate ones'-self, apply metacognitive learning strategies (i.e., planning to allocate resources, elaborating the material, monitoring learning process, connecting it to other concepts), navigate decisional conflict well, experience positive emotion, and perceive tasks as valuable (e.g., Darnon, Butera, & Harackiewicz, 2007; Harackiewicz, Barron, Tauer, Carter, & Elliot, 2000; Karabenick, 2003; Levy, Kaplan, & Patrick, 2004; Pekrun, Elliot, & Maier, 2006; Wolters, 2004). Despite the fact that, there is a notable omission from these set of beneficial outcomes: Mastery goals are often unrelated to academic achievement (Hulleman, Schrager, Bodmann, & Harackiewicz, 2010). Suddenly, students who adopt mastery goals rarely perform better in the classroom than students who do not pursue these goals. Early research showed less consistent findings for performance goals. Some research studies revealed direct relationships with regards achievement and other favorable outcomes (e.g., Elliot & Church, 1997; Harackiewicz, Barron, Carter, Lehto, & Elliot, 1997; Skaalvik, 1997). Meanwhile, other studies proved negative relationships (such as, Ames & Archer, 1998; Greene et al., 2004).

To the researcher, Achievement Motivation Theory is related to this present study because; it explained how to understand students' adaptive and maladaptive responses to academic achievement challenges. Two primary goals were emphasized: mastery goal, focus on acquiring and developing competence, and performance goals, focus on demonstrating one's competence and outperforming peers. It also describe that, students pursuing mastery goals tend to consider ability a malleable attribute, that is something to be developed by increasing effort. Thus, enjoy challenge and respond strongly to adversity. On the other hand, Students pursuing performance goals consider ability a fixed attribute, thus, avoid challenges and respond

helplessly to adversity as a result lack this self-confidence. This theory also ensured that mastery goal produced similar or stronger effects than performance goals on the academic achievement of students. For instances, some students would strive to outperform their peers in biology test/exam (performance goal approach), while some would strive not to outperform others, but to learn how to improve their skills and achieve high grade in biology test/examination (mastery goal approach). Therefore, students' level of achievement in biology is the key variable of this study and it will be assess by the students' scores in the BAT test.

2.3 Concept of Biology

Biology is the only core science subject at secondary school certificate examination (SSCE), whose study is very vital to man's successful living (Akindele, 2009). The Senior Secondary School Certificate Examination (SSCE) is the final examination that secondary students undertake for the final award of certificate. It is an examination annually conducted uniformly in all the English speaking West African countries for all the Secondary Schools. All the students of these secondary schools undertake this examination at the same time between May and June yearly. This means that all the students are being taught under the same curriculum. Biology is usually one of the core subjects that participating students are expected to enroll into (Moses, Gospel and Femi, 2016). It is a natural science that comprised the contents of microscopic organisms, those in the biosphere and generally all living things (Okwo and Tartiyus, 2004).

According to Sorojini (2016) biology is derived from two Greek words; Bios (life) and logos (study) this means that biology is the study of life. It involved study of plants and animals. He maintained that biology is a study that ranges from microscopic-cellular molecules to the biosphere, earth's surface and its living organism. Being it a standard subject of instruction at all level of educational systems, from pre-primary (elementary) to tertiary. It is generally conceived

by most students as the easiest subject and therefore attracts larger number of enrolment than other basic science subjects (Ajewole, 2006). Similarly, Ofoegbu (2003) had proved that biology has a large student enrolment than any other science subject especially at the upper basic level of the Nigerian education. Despite the fact that biology is the simplest to comprehend among the science subjects, the level of academic achievement is nonetheless not much different from other science subjects among the students. Akubuilo (2004) asserted that in spite of the popularity of Biology among students, the failure rate has remained very high.

2.3.1 Significance of Studying Biology

The study of biology as a subject taught in science cannot be overemphasized. This is because it finds application in medicine, dentistry, veterinary science, agriculture, horticulture, food production industries and biotechnology, genetic engineering and hybridoma technology among others. These are some of many career fields open to biology students.

Similarly, there are some of vital achievements of applied to biological research. These include;

1. Achievement of vaccines and drugs for the prevention and curing many deadly diseases; such as meningitis.
2. Organ transplants
3. Invitro fertilization (IVF) which helps infertile couples to bear children.
4. Production of hybrid crop plants and farm animal with desirable quality
5. The sue of biological pesticides instead of chemicals in the control of agricultural pest
6. Proper utilization of naturally occurring bacterial to clean up oil spills and toxic chemicals also (with possibility in the near future to radioactive uranium waste
7. Application of hybridoma technology to produce antibiotics

8. Production of single cell protein (SCP) by microorganism which may save millions of life from dying of protein deficiency
9. Using genetically engineered microbes to manufactures, at low cost, substances which were previously difficult to produce such as insulin and interferon.
10. Adverse effect of biology at the development of biological weapons which use disease causing microbes to attack enemy, troops so the many provoke considerable protests internationally so that many governments have prohibited their stockpiling and development.
11. Provides ways of dealing with the world's exponential population growth and its demands to a cure for acquired immune deficiency syndrome (AIDS) and so on (Sarojini, Akunwa & Obidiwe, 2016)

Biology which is the study of different forms, their evolution, structures, functions, growth, distribution and taxonomy occupies a unique position in the secondary school science curriculum. Hence, at the senior secondary level science is departmentalized into biology, physics and chemistry. This is because it serves as a pre-requisite to the study of other remunerative and ambitious professions like; medicine, nursing, pharmacology, biochemistry, agriculture among others. The fundamental characteristics and the vital role of this discipline in the economic, industrial and public life of the students and the general humanity cannot be overstressed (Ibe & Ukpai 2013; Akambi and Kolawole, 2014). Biology as a science subject is based on practical and experiment. Its objectives are contained in the National policy on education (FRN, 2013) include among others to equip learners with meaningful and relevant knowledge of Biology, adequate laboratory and field skills. Therefore putting this into

consideration, the researcher tries to examine the effect of metacognitive instruction on biology students' self-efficacy and academic achievement.

2.4 Concept of Conventional Teaching Method

Obunadie (2011) defined Conventional method as the teaching procedure involved in clarification or explanation to the students on some ideas. Teacher centered method is behaviorist in nature. Teacher directed learning that follow the instructive approach which involves careful and meticulous planning of the curriculum and purposeful instructional procedure employed by the teacher. Under such circumstances, students have a definite and fixed perception of their roles as listeners, while teacher are expected to be lie talkers and 'custodians of knowledge'. This means that students' active participation is minimal, until the teacher authorizes them. Ahmad and Aziz (2009) asserted that teacher-centered methods are also known as traditional instructional methods, where teachers are at the centre of classroom activities, including explanations and discussions. Adeyemi (2008) asserted that conventional, which is the most common method, does not stimulate students' motivation to innovation, scientific thinking skills but rather encourages students to cram facts, which are easily forgotten. Teacher centered methods often result to students not enjoying lessons and missing the benefit of intellectual discovery (Tella, Indoshi & Othuon, 2010). Tanner (2009) maintained that teacher dominated classroom talk and students talked only when called upon to answer questions. Teacher-centered methods are however, associated with a number of shortcomings. Similarly Isiugo-Abanihe etal (2010) opined that a traditional method is characterized as poor methods of teaching especially sciences because it limits science skills.

Gambari, Yaki, Gana and Ughouwa (2014) opined that persistent use of conventional method makes students passive rather than active learners and does not promote insightful

learning and long term retention of abstract concept of Biology and emphasize learning through the teacher guidance always. Similarly, Ametefe (2012) maintained that conventional method is primarily used to build upon the learners existing base of knowledge. This method is the most common method of instruction (Sulaiman, 2010). Thus there is need to search and find out the effect of using other methods of teaching to see the effectiveness.

Therefore, this present study investigated the effect of Metacognitive instruction on Biology students' Academic Achievement.

2.5 Concept of Metacognition

Metacognition is one of the latest words in educational psychology. John Flavell originally coined the term metacognition in the late 1970s to mean "cognition about cognitive phenomena," or "thinking about thinking" (Flavell, 1979, p. 906). Metacognition is a combination of two separate concepts: "meta" and "cognition in the anal of knowledge acquisition (Okoza, 2013). "Meta" stands for higher order or beyond the ordinary realm of learning while "cognition" simply means learning. To Gonzalez (2013) metacognition refers to students' ability to develop and apply learning strategies to frequently plan, control and monitor their learning process. Livingstone (2003) viewed metacognitive knowledge as the higher order designative skills that require the knowledge of cognitive processes and found an attempt to control and adjust ones' own learning process through planning, monitoring, and evaluation. Similarly, metacognition have been described as higher order thinking which involves active control over the cognitive processes employed in learning. Metacognitive activities include, planning, monitoring, comprehension, and evaluating one's progress in learning. It plays a significant role in learning process (Sterberg 1997, Borkowswki, Carr & Pressley 2000, & Livingstone, 2007).

Metacognition is defined by Hannah and Shore (2008) as an extra-mental power of awareness of one's capacities and abilities to monitor and regulate learning for productive thinking and qualitative knowledge outcomes. Metacognition comprises of metacognitive knowledge and metacognitive experiences/regulation. Metacognitive knowledge refers to acquired knowledge about cognitive processes, knowledge that can be used to control and monitor learner's cognitive processes in learning. While metacognitive experience/regulation refers to the level at which learners can regulate learning activities. Metacognitive knowledge also constitutes three factors; knowledge of person variables, task variables and strategy variables. (Flavell, 1987, Sperling, Howard & Staley, 2004).

Metacognition is also perceived as the knowledge and control children have over their own thinking and learning activities (Cross & Paris, 1998); awareness and management of one's own thought (Kuhn & Dean,2004);and a multidimensional set of general, rather than domain-specific skills which are empirically different from general intelligence and anterior knowledge during problem-solving situation (Schraw, 1988 & Okoza, 2013). Subsequently, the development and use of the term have remained in favor to its original meaning. Many researchers working in the field of cognitive psychology have provided relevant definitions. Meichenbaum (1985) described metacognition as awareness of one's own knowledge i.e what one knows and doesn't know, and one's ability to understand, control, and manipulate one's cognitive processes. Cross & Paris (1988) defined metacognition as the knowledge and control students have over their own thinking and learning activities. Other researchers viewed metacognition as a form of executive control involving monitoring and self-regulation (McLeod, 1997; Schneider & Lockl, 2002). Winne and Hadwin (1998) believed that students who know better regarding the learning and studying skills such as metacognitive learning skills and strategies learn better. For students to

effectively use metacognitive learning skills and strategies to improve their learning, they need to be aware of their own learning inclinations and control their learning process (Winne, 1995; White & Frederiksen, 1998; Conner, 2006).

To Hennessey (1999) metacognition is the awareness of one's own thinking, awareness of the content of one's conceptions, an active monitoring of one's cognitive processes, an attempt to regulate one's cognitive processes in relationship to advance learning, and an application of a set of rules to rise the probability of one's problem solving as an effective device for helping people organize their methods of attack on problems in general. Kuhn and Dean (2004) described metacognition as the awareness and management of one's own thought which enables students who has been taught a particular strategy in a particular problem context to recall and apply that strategy in a similar but new context. Similarly, Martinez (2006) explained that metacognition is the monitoring and control of one's thought.

Studies on metacognition have provided researchers with clue about the cognitive processes involved in learning and the existing difference between successful students from their less successful peers. It is significance for instructional treatments, such as teaching students how to be more cognizant (aware) of their learning processes and outcomes as well as how to regulate those processes for learning to be more effective and interesting (Livingstone, 1997; 2007). According to Eze (2007) metacognitive skills consist of deliberate planning, monitoring, regulation and evaluation of cognitive processes and their outcome. Metacognitive skills enable students to be aware of, understand, monitor and control learning process. These skills also include taking conscious control of learning, planning and selecting strategies, monitoring the progress of learning, correcting errors, analyzing the effectiveness of learning strategies, and changing learning behaviours and strategies when necessary (Alexander, Fabricius, Fleming,

Zwahr, and Brown 2003). Bahri and Corebima (2015) opined that metacognitive skills have a significant contribution on cognitive learning result.

2.5.1 Metacognitive Learning Skills

Metacognitive skill plays a significant role in learning as it enables students to benefit from instructional process (Carr, Kurtz, Schneider, Turner & Borkowski, 1989; Van Zile-Tamsen, 1996, Kapa, 2007, Carr, 2010 & Moga, 2012,). For instance, metacognitive skills in learning involved ones' awareness of a given learning task, planning and readiness on how to approach or sit for written a biology test or an examination; self- monitoring- checking one's biology learning or reading and self-evaluation: checking one's learning against a given biological tasks (Livingstone, 1997 & Wahl, 2007). Learners who are Metacognitively aware possess unique characteristics, such as the ability to: Know themselves well; Understand their cognitive competence; Devise learning strategies that work for them; Know when and how to use such strategies; Plan, monitor and evaluate learning; Control their emotions; and Self motivate(Gonzalez, 2013). However, Brown (2008) maintained that students that are good at using metacognitive skills in their learning answer questions like: How much time and effort do I need to set aside to learn this material? (Planning), Do I understand what I am studying or learning in biology? (Self-monitoring), How can I assess my learning outcomes? (Self-evaluation).

Therefore, it is important to study about metacognitive development and activity to find out how students can learn and apply it through metacognitive control. Thus, the development and empowerment of metacognitive skills are crucial to be implemented in biology teaching. These suggest that learners with appropriate metacognitive skills are able to organize, monitor and

direct their own learning processes. Dosoeta (2008) opined that metacognitive skills include three (3) main processes, which are:

1. Awareness

This refers to one's attentiveness about the type of learning strategy to use and apply in learning situation. For example, setting learning goals enables students to be aware of the task they are engaged with.

I. Individual's ability to consciously identify what one already knows
II. State and define the learning goal
III. Consider individual's personal resources (e.g., Biology textbook, access to the library, access to computer, work station or quiet study areas)
IV. Consider the task requirements (essay test or multiple choice)
V. Determine how individual's performance will be evaluated
VI. Consider one's level of motivation (high or low)
VII. Determine individual's level of anxiety

2. Planning

This involves one's preparation for the learning process in general and specifically how an individual learn under different conditions of learning. For instance, students realize when to apply a learning strategy or skills to study biology and other similar or different skills to study physics.

I. Estimate the time required to complete the task
II. Plan study time into one's schedules and self-priorities;
III. Make a checklist of what needs to happen and when
IV. Organize learning materials

V. Take steps to learn by using skills like outlining, memorizing, diagramming, revising, checking and testing

3. Control/Monitoring and Reflection

This involves the control one has over his/her learning process which is usually done by self-questioning such as "Have I understood what I am studying in biology?" or "Am I keeping up with my study plans and goals?". This enables students to identify and choose learning strategies that work best for them to achieve their set goals and objectives.

I. Reflect on one's learning process and keep track of what works and what doesn't work for you as a learner.

II. Monitor one's own learning by questioning and self-testing.

III. Provides one's own feedback

IV. Keeping concentration and motivation high.

2.5.2 Significance of Metacognitive learning skills in Biology

Schunch and Nelson (2003) maintained that metacognitive skills form the basis of students' understanding and control over their cognitive activities in learning. It raises students' confidence (self-efficacy) which enable them to learn actively and independently in their learning process. This open opportunity for them to pursue their intellectual needs and discover a wide range of information around the living world, gain motivation to learn and focus their attention on the various metacognitive learning strategies engaged in solving problems in biology. They eventually apply these skills in their learning. Students with good metacognitive skills are capable of planning, monitoring and directing their own learning processes. The main aim and objectives of Stakeholders in educational field is to admit, foster, exploit and heighten the metacognitive capabilities of all students including biology students (Livingstone, 2007).

Metacognition is an independent variable of this present study, therefore, it could be defined as the awareness and understanding of one's own intellectual ability or thought processes. And metacognitive skills could, therefore, be defined the process of monitoring and controlling one's awareness and understanding of a given learning task. It includes knowledge of one's strength and weakness, students' knowledge of strategies to employ, when and where to apply the strategies. The metacognitive skills in this study consist of planning, monitoring, regulating and evaluation of one's performance in biology (Feeding Machanism and Digestive System).

2.6 Concept of Self-Efficacy

The concept of self-efficacy is established in the social cognitive theory proposed by Albert Bandura in 1997 (Su & Due, 2012; Jalaluddin, 2013). Self-efficacy as a psychological term that has been diversely conceptualized is believed to be one of the most important and influential factors of metacognitive knowledge which helps learners to gain enough confidence in order to be independent and more successful as learners (Bandura, 1989; Bouffard-Bouchard, Parent, & Larivèe, 1991; Coutinho, 2007). Bandura (1986) explained that self-efficacy is students' belief of their capabilities to identify and carry out something to master some specific functions. It deals with cognitive and perceived capacities of one's self (Çubukçu, 2008). According to Aurah (2013) Self-efficacy beliefs provide an insight into why students choose to engage in a particular task. Joanne and Shui-fong (2008) viewed self-efficacy as the judgment of personal capacity to perform a specific and prospective task.

Bandura (1998) defined self-efficacy as an individual's belief about their capability to produce desired levels of performance which influences their events or activities throughout their lives. Self-efficacy dictates how individual feel, think, motivate them and behave. High sense of

efficacy improves an individual accomplishment and personal well being in many ways. Those with high assurance of their strength approach difficult task as challenges to be overcome rather than as a threat to be avoided. Such an efficacious outlook raises one's natural interest, deep and immerses focus in one's activities. It helps students set for themselves ambitious goals and dedicatedly retain towards their attainment. Similarly, Zimmerman (2008) believed that students raise and sustain their efforts in confronting failure and quickly regain their sense of efficacy after failure. Such category of students also ascribes failure to insufficient effort or knowledge and skills which can be acquired with increasing effort. Some students confront threatening learning situations with confidence that they can exert control over them. Thus, produces personal achievements; trim back stress and exposed to depression.

Omroid (2006) asserted that Self-efficacy is the belief whether accurate or not that one has the strength to generate a desirable outcome. For example, a person with high self-efficacy confronts more challenging learning tasks, whereas a person with low self-efficacy hinders his/her self from difficulties and entertains feelings of hopelessness with regard to learning tasks. Therefore, students with high self-efficacy not only out-perform those with low self-efficacy but they also place greater attempt to endure and remain active when installing setbacks (Bandura 1997; 2001 Baron; 2004; Joanne & Shui-fong, 2008).

Many researchers showed that high self-efficacy is associated with greater Metacognition, including more efficient use of problem solving strategies and planning of working time, spending greater attempt, and persisting longer to accomplish a task, particularly in the face of obstacles and adversity (Zusho, Pintrich & Coppola, 2003, Pajares, 2005, Britner & Pajares, 2006 & Aurah 2013). Self-efficacy influences the type of activities students choose; how much effort they put forth; how persistent they will be in pursuing their goals in the face of

difficulties. Mih and Mih (2010) believed that advanced metacognition is linked with high self-efficacy and good learning achievements. They added that competency goals are good predictors of advanced processing. Competent pupils use self-regulatory learning strategies in comparison to less competent students.

2.6.1 Significance of Students' Self-efficacy in Biology

Researchers stressed the significance of self-efficacy to have high academic achievement (Israel, 2007; Diseth, 2011). Students who have high self-efficacy generally attribute their failure to low effort rather than low ability, whereas students who have low self-efficacy attribute their failure to low ability (Akin, 2008). Students with higher self-efficacy are likely to be sure of themselves when facing a complex problem, to search for a solution, to be patient in the process of solution, to put greater effort to be successful and to show intrinsic interest in the work (Sungur & Gungoren, 2009). Besides, educational studies showed that self-efficacy is often a predictor of academic achievement (Hampton & Mason, 2003; Ning & Downing, 2010). Students with low- self-efficacy may not achieve at a level that is appropriate with their abilities. They may not have the skills to do well in the learning tasks and thus refuse to attempt it (Bandura 2001; Omroid, 2006). This makes them to lose interest in the task or subject. Moos and Azevedo (2009) indicated that the relationship between self-efficacy and specific monitoring processes (monitoring understanding, monitoring environment, and monitoring progress towards goals) was significantly detectable and proved that the relationship between self-efficacy and hypermedia learning outcomes was mediated by the extent to which participants monitored their understanding and the environment.

Most research findings (Bandura 1997; Schunk 1995; Pajaries 1996, Umaru 2010 & Aurah, 2013) show that students' self-efficacy effects their academic achievement. This indicates

that high self-efficacy belief is associated with high level of academic achievement, while low self-efficacy result in low academic achievement. That is why this present study examines the amount of effects self-efficacy has on biology students' academic achievement using biology self-efficacy scale (BSES).

2.6.2 Relationships between metacognition, self-efficacy and academic achievement.

The declining interest in reading exhibited by many students today is a great concern and challenge to the government, teachers and parents as many students nowadays record poor results in public examinations like the West African Senior School Certificate Examinations (Oso, 2012). There seems to be existing relationship between students' metacognitive skills, self-efficacy and academic achievement.

Diseth (2011), believed that, students' self-efficacy makes a positive contribution to their academic achievement. Therefore, training students with the various metacognitive learning skills in learning has been belief to raise students' self-efficacy and academic achievement in different course subjects including biology. This is because students should be able to understand how to plan, monitor, regulates and evaluates their learning processes to achieve successfully. Meanwhile, high self-efficacy encourages students to achieve their set learning goals and academic achievement also determines the level of students' self-efficacy. Therefore, training in metacognitive skills enable students to improve and have control over their learning and perform well in their academic activities. The relationship is illustrated below;

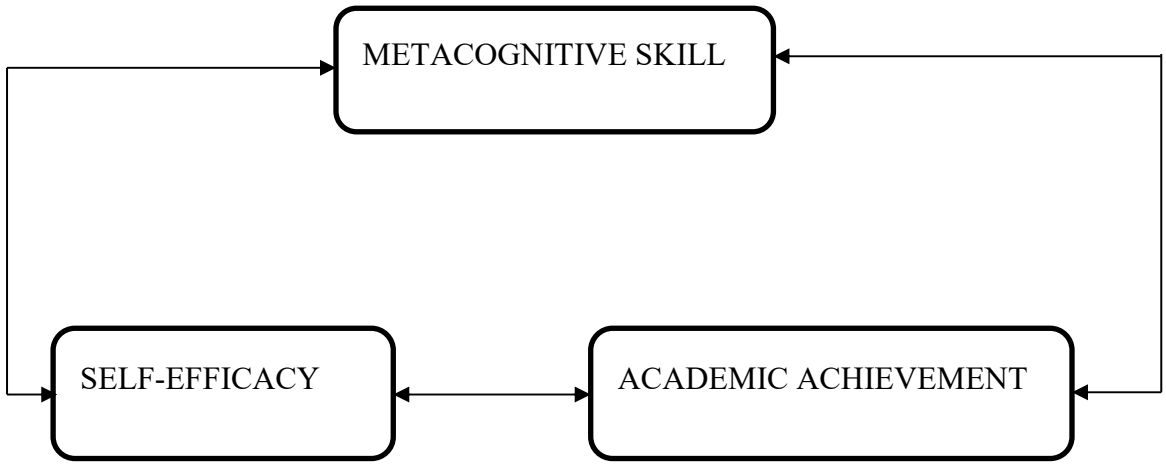

Fig. 3: Relationship between Metacognitive Skills, Self-efficacy and Academic Achievement
Source: ***Umaru, 2010.***

The figure 3 translates that metacognition skills effects students' self-efficacy and academic achievement. Students with high self-efficacy have greater metacognitive skills and vice versa which lead to greater academic achievement. Similarly, students with high academic achievement are expected to have high metacognitive skills and high level of self-efficacy belief. therefore there seems to be an existing relationship among students' metacognitive skills, self-efficacy and academic achievement.

2.7 Academic Achievement among Biology Students

According to Chukwunyeremunwa (2013) academic achievement is defined as the successful accomplishment or performance in a particular subject area. It is indicated by grades, marks and scores of descriptive commentaries. To Jason, Cheri and Ginger (2012) academic achievement refers to students' classroom achievement, particularly with regard to course grades, credit accumulation, and other measures of school success. Academic achievement is strongly related to the next outcome, progress through school. Academic achievement is usually

measured by scores on academic tests or other demonstrations of academic proficiency. It is entails one's performance in a given task which is usually by directed behaviour. It consists of pupils' performance in an examination, tests, assignment, and project work.

Omroid (2006) described academic achievement as the students or pupils' potentials in school subjects such as, listening, speaking, reading, writing, spelling, and arithmetic. Aiken (1979) defined achievement as the degree of success or accomplishment in a given area of endeavor which is usually represented by a score on an achievement test. Acccording to Adeymi (2010) academic achievement is described as the scholastic standing of a learner at a given moment. This scholastic standing could be expressed in terms of the grades obtained in a subject such as biology, chemistry, physics and so on. Meanwhile Akiri and Nkechi (2009) see achievement as a measure of outputs and that the main outputs in education are expressed in terms of learning. That is, there are changes in knowledge, skills, behavior, and attitudes of learners as a result of their experiences within the schools system. Lebata (2014) defined academic achievement as the outcomes of education, the extent to which a learner, teacher or an institution has achieved their educational goals. That is, if set goals are met, it means that school outputs (examination results) are good or learners have performed well, but failure to meet the goals means there has been poor academic achievement. Therefore this present study tends to investigate the effect of metacognitive skills instruction on the biology students' achievement with the hope to increase their performance and achievement in the subject. This study hence, outlines the factors as well as the functions of the academic achievement of biology students.

2.7.1 Functions of Academic Achievement in Biology

These are some of the functions of Academic achievement in an educational setting:

1. **Promotion:** Out comes or results of academic achievement form the basis for promoting students to next class. Students that successfully pass their exams are promoted to proceed to the next class. For example, if a student in SS I science class successfully passed the set of terminal exams is said to proceed to SS II Science class.
2. **Motivation:** Academic achievement motivates students to prepare themselves for a new upcoming test or examination. For example, when students successfully passed a test or exam in biology with distinction (A), they will be motivated either by giving reward or through satisfaction, and try to put more effort in the next or subsequent assessment test/ examination.
3. **Provides insight for placement of student:** It provides stakeholders in education with insight to determine placement of students in a particular section or class.
4. Achievement test helps to effectively determined whether students are performing or gaining some knowledge out of the given information. These include theories and practical activities especially in sciences. It also helps to determine the level of instruction prepared for a learner. High academic achievement usually exposed the mastery of sound resources/materials and readiness for advancement in instruction. While low academic achievement reveals the need for possible remediation or revising instructional process (Hawaii, 1999).
5. It enables teacher to understand or identify students' difficulties or challenging subjects/topics in order to provide solution to the problem or complexity.
6. It also provides significant information about standing position of each student in academic environments.

7. It provides stakeholders in education with insight to observe whether the set objectives or goals have been attain or not. If not, then there is need to review the teaching methodology, sequence of the contents, students acquisition of learning skills/strategies such as metacognitive learning skills among others to better suits students comprehension (Johnson, 2014).

2.7.2 Factors that Influence Biology Students' Academic Achievement

The factors that influence student's academic achievement particularly in biology at the senior secondary school are not conclusively known and could be multivariate in nature; they include student's attitude towards school, interest in learning, study habit, attribution, self-efficacy, intelligence and motivation (Joe & Okoto, 2014). Solomon (2007) opined that factors that impede student's excellent achievement in learning include teacher related factors, parents, society, curriculum, government and school administrators, problems of instructional materials, student's related problems and influence of examination bodies. Similarly Auwal, Muhd and Muhammade (2014) opined that, the level of students academic achievement in biology was very low, and the factors behind this low performance in biology are; lack of qualified teachers, lack of attendance of the lesson by the teachers, insufficient library and laboratory facilities and large number of students in the classrooms.

Sunday and Joe (2013) averred that, poor academic performance and low enrolment in science particularly in biology in Nigerian schools are caused by; poor adoption of methodology, poor reading habit, negative students attitude/interest towards biology, gender inequalities, inadequate laboratory facilities, inadequate staff motivation, inadequate instructional materials and so on. Apart from student's related factor, poor achievement in biology is also attributed to other factors, such as, teachers' qualification, insufficient instructional materials, teaching

methodology (Oladeji, 2011). Moses, Gospel and Femi (2016) observed that, there are four categories of factors that affect academic performance of biology students, namely teacher-based factors, school-based factors, student-based factors and the parent-based factors. These are discussed below:

1. Teacher-based Factors

Ballone-Dura, Czerniak and Haney (2005) found that, science teachers are most important factor in improving biology students' achievement in schools. Poor achievement in the field of science is caused by the poor quality of science teachers, overcrowded classroom and lack of suitable and adequate science equipment among others (Ali, Toriman & Gasim, 2014). Teachers with required teaching qualifications will be expected to provide solutions appropriate for teaching method to impact knowledge. According to Akinfe, Olofinniyi, and Fashiku (2012), professionally qualified/trained teachers plays an important role in enhancing students' academic achievement in biology. However, Akubuilo (2004) had asserted that teachers' methodology has significant effect on students' performance in biology. He then concluded that students under effective teacher's methodology are likely to come out with good performance while students who were not taught well will perform poorly. Moreover, Abdulahi (2007), and Ogbeba (2010), observed that most teachers emphasized theory rather than practical aspects of science subjects and majority of them lack adequate knowledge of subject matter and the competence to deliver. They further stressed that the teaching of science has been reduced to a descriptive exercises through the use of lecture method. Even though, the National Policy on Education (2013) emphasized the activity based and child centered learning, most science lessons are of the traditional lecture. In addition, Okoli (2006) proved that many science teachers prefer the traditional expository/lecture method of teaching that is, a teaching technique in which one

person, the teacher, presents a spoken discourse on a particular subject and shy away from activity-oriented teaching methods which are student centered. Nwagbo (2006) opined that, such teacher-centered approach which places the teacher as the sole possessor of knowledge and the students as passive recipients of knowledge may not enhance achievement or promote positive attitude to science students.

2. The school-based factors

According to Addae-Mensah (2003), results released by WAEC in biology have consistently showed that schools that are well-equipped in term of science laboratories, textbooks and qualified teachers tend to produce better results while poorly equipped schools perform poorly in the subject. This is in line with findings of Moses et al (2016,) indicated that secondary school that are well equipped in term of standard laboratory, adequate laboratory equipment and provision of consumable materials, significantly performed better in biology than those schools that lack these facilities. Akinfe et al (2012) had proved that without modern instructional materials, effective teaching and learning cannot be utilized. The facilities that if lacking or inadequate in schools affect biology students' achievement include:

I. **Inadequate Laboratory Facilities**: Inadequate and non-utilization of laboratory facilities have been identified by some authors as some of the possible factors of students' poor performance. For example, Aderonmu (2006) found that students often complain of non-familiarization with biology laboratory equipment until a few weeks to the external examination, and in most cases, even the teachers of this subject did not know the use of laboratory equipment and chemicals until the practical examination. The situation in many science classrooms in Nigeria is nothing to write home about, this is because in many schools there are no laboratories. Some schools merely have empty rooms labeled

laboratories. Students rarely have hands-on, minds-on experiences. Few days to science practical examinations, most schools acquire practical equipments for teacher demonstration to students. This cannot make for effective learning and eventually results in poor achievement (Omoifo, 2012).

Meanwhile, utilization of biology laboratory equipment have been identified as part of the teaching-learning facilities which teachers and students use to express information and ideas without difficulties, thus making the lesson interesting, motivating clear and easy to understand. Proper utilization of laboratory equipment defines the extent or how often the available science laboratory equipments are used during classes or laboratory sessions. Ihejiamaizu and Ochui (2016) stressed that, utilization of biology laboratory equipment significantly influenced students' academic achievement in biology. This revealed that utilization of biology laboratory equipment is effective in the teaching and learning of biology. Students who utilize these equipments achieve higher than their counterparts academically. According to Lawal (2013), such materials promote learning by doing, make the classroom lively, real, and meaningful and have the potential to make the content permanent thereby increase students' performance. Adding that, utilization of these equipments enable learners to focus their attention to important issues and acquire practical skills in the subject. In effect, acquisition of such skills is capable of helping students' fight unemployment and poverty. Therefore, the need for maximum use of such equipment cannot be overemphasized.

Oluwasegun, Ohwofosirai and Emagbetere (2015) found that, the use of laboratory equipment facilitate the teaching and learning of science, infuse scientific reasoning and raises academic performance in the subject. Olufunke (2012) showed that, schools with highest frequency of utilization of these equipments had highest mean score followed by schools with

average and low frequency of utilization respectively. Similarly, Nwagbo and Uzoma (2014) in their study on the effects of practical activities on secondary school students' process skill acquisition in Abuja municipal council, practical activity method of teaching and learning was found to be more effective in improving students acquisition of science process skills which may eventually improve students' performance. Several researchers on influence of laboratory equipment found significant relationship between utilization of these facilities and students' academic performance (Chukwuemeka, 2008; Nsugbe & Igboabuchi, 2010; Chinwoke, 2010).

II. **Inadequate Library Facilities**

Majority of Nigerian secondary schools lack the essential resources for imparting the knowledge of science concepts to students, many students learn little science, learning tends to be by rote and many students find science not interesting and boring. The teacher and student interactions in many science classrooms are not healthy because of inadequate of resources (Ogunmade, 2006). He added that "Majority of students does not have textbooks and most of the schools do not have libraries and where they have one, the textbooks in the libraries are outdated. In most of our schools, there are no sufficient facilities for the teachers to demonstrate phenomena, let alone allow the students to have opportunities for finding out things for themselves'' (Audu & Oghogho, 2006).

Joy (2013) postulates that, reading materials provided to the students help to boost performance because students will read wide in areas where they do not understand. In addition they will read ahead of their teachers hence enabling quick integration of the concepts. Therefore, availability of reading materials improved biology students' performance. Muruguru (2000) stressed that, availability of text books in schools contributes to high achievement. Some of the reasons advanced by respondents to support the observation showed that text books help

students to read widely on areas which have already been covered but not well understood and that are not covered. In addition to widening students' scope, text books also help to familiarize students with new terms and diagrams that are crucial during examination as well as increasing students' confidence in the subject hence, improving the performance of biology. The researcher notes that the actual problem is that students are unwilling to go an extra mile to build on the knowledge acquired in the classroom.

3. The student-based factor

Haimowitz (quoted by Mbugua, Kibet, Muthaa & Nkanke, 2012) had averred that, the cause of most failures in schools might not be due to insufficient or inadequate instruction but by active resistance of learners. Good student's background has also been identified as factor that could promote high achievement in biology (Araoye, 2012). Academic preparation of students and positive peer influences would enhance academic success and that praise and encouragement by teachers and parents is needed to facilitate students' academic achievement (Fonseca & Conboy, 2006). Besides metacognition and students' self-efficacy belief which are discussed above, other factor that influences students' achievement includes:

III. **Students' Attitude/interest towards Biology**

Joy (2013) believed that, attitude is the inner feelings of an individual towards something or somebody. Positive attitudes in students help to improve performance. Attitude influences one's thought which in the end affects understanding of the individual. Positive attitude activates the thinking, feeling and reacting components on an individual, hence influences the performance. On the other hand, negative attitude contributes to lack of motivation in learners hence hindering them from performing well in the process of learning. Positive attitude foster students' ambitions and morale of what they want to be in future hence, working hard under minimum supervision.

For example, biology teacher can make the subject to be difficult as she/he used complicated terms without clear explanation in teaching the subject. This made students to hate the subject because they did not understand the key concepts in the subject, thus affecting their performance in the subject. The author maintained that, student' attitude affects performance in biology and it lies in the type of attitude; positive or negative that the learner possesses, if positive it influences good performance and if negative it influences poor performance. Owiti (2001) also opined that, attitude affects achievement and achievement affects attitude. Njuguna (1998) found that, emotional attitudes can have a profound effect on our learning efficiency. The type of attitude one holds in a learning situation therefore is of great significance. The attitude aspect has caused considerable concern in education. He further argues that a human infant is born without any concept of themselves, any attitude or value system. Their self-concept and attitudes towards other objects develops with the development and their interaction with their "significant others". Such persons are teachers, peers and parents. A child who receives positive perceptions and expectations from their significant others develops a positive self-concept. Positive self-concept influences motivation and performance in a given tasks. If a child is motivated and achieves highly in a task, that child will have positive attitudes towards that task. However, low motivation leads to negative attitudes thus low performance. Students in schools fail to benefit from teaching, not because they do not have the ability but because of their self-view, which determines to a great extent what they do or avoid, and what they see or ignore (Njuguna, 1998). Thus, the school, home and society offer varied and important conditions for the students' acquisition of values, cultures and or development of self-concept all of which influence academic performance. Joy (2013) further urged that, Students' interest in biology influences performance because it provides the drive within students to participate in the learning process.

IV. **Students' Truant/Indiscipline**

Discipline and hard work is the key to success among students (Kurgat, 2008). Undisciplined students for instance, school sneakers, drug abusers have much of their time and energies directed to these activities while dedicating little or no time for their own study (Kurgat, 2008). Mukhwana (2013) found that lack of discipline influences performance in biology. Addition that, drugs abuse among students lowers the concentration power and therefore, affecting the performance. Rudeness and rebellion also influences students' ambition, interest and attitude which are very important in enhancing performance of the student. Truant behaviour makes students to miss classes which in the end affect their academic achievement because they cannot be able to link what they missed with what they have in their books.

4. The parent-based factor

Fonseca and Conboy, (2006) also opined that parenting practices and parental involvement with the school explain much of the variations in school performance. Similarly, Conger et al (1999), low parental socio-economic status is associated with diminished resources hence contributing to low academic achievement. Parental diminished resources will reflect in the inability to provide needed textbooks for the children. Textbooks are major inputs for performance in examination (Psacharaporous, 1985).

Therefore, academic achievement is one of the variables of this present study. Therefore from the literature reviewed the researcher supported the definition of Umaru (2010), who defined academic achievement as an outstanding performance in a given task or attainment of goal directed behaviour. This is because; academic achievement consists of s' performance in an examination, tests, assignment and project work. Many factors such as insufficient learning materials and laboratory equipment, students' attitude/interest among others effect academic

achievement of biology students and led to poor achievement in the subject. On the other hand, availability of these facilities, positive attitude/interest in the subject and academic motivation among others was functions of academic achievement, hence promote students' achievement in biology. Academic achievement in this study would therefore, be represented by scores in biology achievement tests (BAT).

Table 1: Level of Biology Students' Achievement in SSCE in Katsina LGA from 2012 to 2016

Year	Schools	Exams	Total Number of Students sat for Biology Exam	Number of Students that score credit and above	%	Number of Students that score below credit	%
		WAEC	320	0	0	320	100
	A	NECO	324	34	10.5	290	89.5
		WAEC	—	—	—	—	—
2012	B	NECO	—	—	—	—	—
		WAEC	416	10	2.4	406	97.6
	C	NECO	416	81	19.5	335	80.5
2013		WAEC	378	0	0	378	100
	A	NECO	381	90	23.6	291	76.4
		WAEC	426	14	3.3	412	96.7
	B	NECO	477	94	19.7	383	80.3
		WAEC	422	53	12.6	369	87.4
	C	NECO	422	140	33.2	282	66.8
2014		WAEC	463	5	1.1	458	98.9
	A	NECO	459	45	9.8	414	90.1
		WAEC	597	223	37.4	374	62. 6
	B	NECO	597	165	27.6	432	72.4
		WAEC	656	40	6.1	616	93.9
	C	NECO	659	65	9.9	594	90.1
2015		WAEC	513	3	1	510	99
	A	NECO	517	311	60.2	206	39.8
		WAEC	628	57	9.1	571	90.9
	B	NECO	628	421	67	207	33
		WAEC	625	3	0.5	622	99.5
	C	NECO	628	272	43.3	356	56.7
2016		WAEC	178	47	26.4	131	73.6
	A	NECO	115	92	80	23	20
		WAEC	358	192	53.6	166	46.4
	B	NECO	709	571	80.5	138	19.5
		WAEC	264	142	53.8	122	46.2
	C	NECO	592	264	44.6	328	55.4

Source: Katsina State Ministry of Education, 2017.

Table 1 showed the level of biology students' achievement in SSCE in Katsina Local Government, Katsina state. This proved that the situation is fluctuating, yet persistent under-average performance of biology students in SSCE from 2012 to 2016 which never recorded favorable performance in biology as shown above. The problem of low performance has continued to generate several research concerns among stakeholders on the underlying force responsible for, as well as possible ways to combat this poor trend of performance. Several reasons have been adduced for the problem. Akinolu (2006) hinged it on poor pedagogical skills. Neji (2011) blamed it on learners' personal characteristics such as lack of metacognitive skills and self-efficacy. Several other researchers like Ali et al (2014) attribute it to inadequate and suitable science equipment, inappropriate teaching and learning methodology, poor quality of Biology teachers, and overcrowded classroom among others. These authors laments that teaching Biology subject in secondary schools in conventional classrooms can be defective (Igboabuchi 2010; Omosewo 2011; Olajide 2011; Oludipe 2011; Olufunke 2012).

2.8 Gender in Sciences

Gender refers to culturally and socially constructed difference between men and women that varies from place to place and time to time. In comparison, 'sex' denotes biologically determined, thus unchangeable, differences between them (Bussiness Dictionary, 2017). Okeke (2000) refers gender to many social or culturally constructed characteristics, qualities, behaviors, and roles which different societies ascribe to females and males. Gender in this context can be referred to as the categorization of people into two namely, "male and "female" through interaction with caretakers, socialization in child hood, peers pressure in adolescence, and gendered work and family roles of which women and men are socially constructed to be different in behaviour, attitudes, and emotions (Borgatta & Montgomery, 2000). Gender differentiation in

sciences is an old and long controversial issue in education. There are two opposing school of thought with regards to the effect of gender and achievement in science. Researchers as such Obiekwe (2008) and Okoro (2011) argued that male students achieve higher than their female counterparts in science, the other school of thought such as Okeke (2007), Zeidan (2010) and Nzewi (2010), opposed that females achieve as high as their male counterparts when given equal opportunities. Gender differentiations that exist among science students resulting in variation in the level of achievement of male and female students has been an issue of concern to educationist, researchers, curriculum bodies, sciences teachers. That is why this present study tends to find out the effect of metacognitive instruction on the self-efficacy and academic achievement of both male and female biology students.

2.9 Review of Empirical Studies

Aurah (2013) investigated the effect of self-efficacy beliefs and metacognition on academic performance among high school students in western province of Kenya. The mixed-method study consisted of a quasi-experimental approach and in-depth interviews. The population of 2,138 form four (12th grade) students participated in the study which comprised 1,063 (49.7%) males and 1,075 (50.3%) females. Quantitative data were collected from self efficacy questionnaire (SEQ), Biology ability test (BAT), genetics problem solving test (GPST) and meta-cognitive prompting questionnaire (MPQ). Qualitative data were collected using in-depth interviews. Quantitative data were analysed using both descriptive and inferential statistics (hierarchical linear regression and factorial ANOVA). Qualitative data were coded, categorized and reported thematically. ANOVA analysis displayed statistically significant differences in meta-cognition in form of meta-cognitive prompts between groups. Regression analysis indicated that self-efficacy was a strong predictor of academic performance. The result showed

that there was a positive correlation between constructivist connectivity and genetics problem solving ability. Students indicated a high capacity to make connections between their existing knowledge and concepts to the problem solving activities. The study revealed that gender influences the ability to solve genetics problems, with female students outperforming male students on the genetics problem solving test. Background knowledge (BK) was also found to predict genetics problem solving ability. Research showed that BK promotes the use of self-regulation strategy due to the availability of cognitive resources and knowledge serving as a basis for evaluation of ongoing performance.

The research work investigated the effect of self-efficacy beliefs and metacognition on academic performance among high school students in western province of Kenya hence the need to be carried out in another geographical location like Katsina.

Most of previous study mainly focused on structural relations between university students' academic achievement and motivational self-regulated strategies (Henning & Shulruf, 2011; Rahim & Fariba, 2011; Al-Harthy, Was & Isaacson, 2010; Roman, Fenollar & Cuestas, 2008; Vrugt & Oort, 2008). These studies were interested in psychology, computer-supported learning and social sciences. Also, in recent studies, much is known about the structural relations between high school students' science achievement and their motivational self-regulated strategies (Sungur, 2011; Reyes, 2011; Lou & Roeser, 2010; Partin, 2008).

These studies, however, cannot provide specifically significant evidence in favour of the direct or indirect relations among motivational self-regulated strategies and achievement in biology. Generally, context of the assessments mainly focused on students' natural science achievement, but rarely on pure Biology achievement (Yoon, 2009). However, natural science includes not only biology but also physics, astronomy, geology, and chemistry courses.

Reyes (2011) in his work showed that the types of motivation effecting performance vary across different subjects. Similarly, Mayr (2001) stated that most people receive the meaning of science as physics, mechanics, chemistry and astronomy which rely heavily on mathematics. Unlike other disciplines, biology is the science of the living world. The teaching of biology at high schools focuses on the whole organism, life history, behavior and ecology. Therefore, student's answer could vary according to which science courses they think while filling out questionnaire in the studies (Sadi & Uyar, 2013).

Mojtaba, Parvin, Mohammad, Saber and Ali (2015) investigated the effectiveness of motivational interview on enhancing self-efficacy and improving self-concept in underdeveloped students in iran. The method of research design was semi-experimental pretest-posttest with control group. The statistical population consisted of all male first grade students of high schools in Urmia city. 32 people of first grade students were selected as underdeveloped students and they were randomly divided in two groups (experimental group = 16 people, control group = 16 people). The sample consisted of 32 male first grade students of high schools in Urmia city. The study instruments used was Sherer's self-efficacy questionnaire (1983) and Rogers' self-concept scale before the beginning of and two weeks after the last session of intervention. After the implementation of pretest, the program of motivational interview had implemented for motivational interviewing group during five sessions (each session takes 75 minutes and two times in a week). Covariance was used for data analysis. The results of the study showed that group motivational interview increased the self-efficacy and self-concept of underdeveloped students.

The researchers only investigate effectiveness of motivational interview on enhancing self-efficacy and improving self-concept in underdeveloped students and didn't investigate the effectiveness of metacognitive instruction like the present study.

Zabruckya (2010) carried out his study on metacognition in Taiwan: students' calibration of comprehension and performance. He increasingly investigated the role played by metacognition in students' learning and performance. The researcher maintained that metacognition is comprised of metacognitive knowledge and metacognitive experiences, and these components of metacognition are seen as being important to learning and performance in academic settings. Metacognitive experiences involve students' awareness of progress on cognitive tasks. Such awareness is critical to learning, for students may fail to spend additional time reviewing or studying material if they believe they have understood the material adequately. Students were able to predict comprehension and test performance at better than chance levels and were more accurate at post diction than prediction.

Contrary to this study, the researcher only limited his work to the role played by meta-cognition in students' learning and performance and students' calibration of comprehension and performance with the exception of students' self-efficacy which need to be touch.

Similarly, Begum and Balasubramanian (2008) carried out a study on metacognitive awareness among the medical college students of Tamilnadu. The study measured the level of meta-cognition among the Medical College Students of Thanjavur and Salem Districts of Tamil Nadu. The level of meta-cognitive awareness is highly correlated with the academic performance of the students. The results revealed that the level of meta-cognition among the medical college students is somewhat less. The study expressed the need for meta-cognitive training, counseling and teaching self-regulatory strategies for the successful achievement of intellectual tasks.

The study is limited to Medical College students of Thanjavur and Salem Districts of Tamil Nadu and only focused on the level of metacognitive awareness of the students with the exclusion of their level of self-efficacy.

In a similar study, Sadi and Uyar (2013), investigated both direct and indirect relationships among self-efficacy for learning and performance, cognitive self-regulated learning strategies (CSR), metacognitive self-regulated learning strategies (MSR), time and study environmental management strategies (TSEM), effort regulation strategies and Biology Achievement of Turkish high schools students. The study was based on a survey design and random sample of convenience was used in the study with a purpose of exploring relationships between the ninth and tenth grade students' self-efficacy, self-regulated learning strategies use and biology achievement during the spring semester of 2012 in Anatolian High Schools in Karaman, Turkey. The target population of the study consisted of all tenth and ninth grade students in all Anatolian High School in Karaman and the sample was 428 9th/10th grade students of Karaman, in Turkey. Students' age ranged from 14 to 18 years, with a mean age of 15, 29 (SD=0.60). Of the group, 236 (55.1%) were women and 192 (44, 9%) were men. The Turkish version of the Motivated Strategies for Learning Questionnaire was the instrument used to collected data. Results of a path analysis showed that students who have high self-efficacy, metacognitive self-regulated learning strategies (MSR), time and study environmental management strategies (TSEM), and organizational strategies to complete a task in the face of difficulties can become successful in biology. Also, the findings revealed that higher levels of self-efficacy was directly associated with cognitive self-regulated learning strategies (CSR), metacognitive self-regulated learning strategies (MSR), time and study environmental management strategies (TSEM), and effort regulation strategies. In addition, mediator analyses

explained several mediator effects between these variables with the importance of motivational and learning strategies in achievement. The researchers concluded that data from other school districts and from different school types might provide different results. Therefore, suggested future research studies should use different school types, location and materials to verify the findings of their studies.

Both studies investigated the relationship between cognitive self-regulated learning strategies and biology achievement and the relationship between self-efficacy, self-regulated learning strategies and achievement in Biology: a path model. These studies were conducted on Turkish high school students located in an urban area in Turkey. In line with their suggestions, this present study tends to investigate the effect metacognition and self-efficacy on academic achievement of SS II biology students of Katsina State, Nigeria.

Razmefar (2014) examined the relationship between self-efficacy, locus of control and academic achievement of students – girls and boys- in secondary school of Rustam city. The research design was descriptive – correlative and the purpose was to determine the relationship between roles of self-efficacy and locus of control in academic achievement. The population of the study was 1497, of which 850 were female and 647 were male that based on table of Cerjis and Morgan (1970) 306were selected by stage random sampling. The participants consisted of 305 students –girls and boys- from 3rd grade of secondary school in Rustam city who were selected by random sampling method step by step. The instrument used was self-efficacy questionnaire of Pintrich and de Groot to measure the control locus in control locus questionnaire of Strickland and Nowiki and third-year GPA for the academic year (2011-2012) was used as academic achievement of the students. Pearson correlation and multiple variable regression methods were used to analyze data.

The research findings revealed that there is a positive and significant relationship between self-efficacy variables and academic achievement, while there is a negative and significant relationship between locus of control and academic achievement. Also the results of regression analysis showed that among the predictive variables, self-efficacy has a major role in explaining the educational attainment. The researcher explained that self-efficacy beliefs on desires and efforts to achieve the goal, motivation levels, passing difficulties, resistance against obstacles, quality of analytical thinking, causal attribution for successes and failures and vulnerability to stress and depression. Strength of one's opinions about the effectiveness of themselves whether it has effect their attempt to conform and adapt to given situations. Perceived self-efficacy affect choosing behavioral situation, people avoid situations they afraid of and they think that they are beyond their adaptive skills. But when they perceive themselves capable in managing the situations, they engage in those activities and act with confidence and actively.

Thus, the research was limited to only 305 students (girls and boys) from 3rd grade of secondary school in Rustam city of Iran. And only self efficacy and academic achievement were variable of interest of the present study with the exclusion metacognition which is of interest to this present study.

Wisdom and Emmanuel (2015) investigated the relationship among chemistry students' meta-cognition, attitude and academic achievement in secondary schools. The study adopted correlational research design. A sample of 600 students from eight randomly selected coeducational senior secondary schools in Port Harcourt was used in the study. The researchers utilized two research instruments Metacognitive Awareness Inventory, MAI developed by Schraw and Dennison (1994) and Chemistry Students' Attitude Probe, CSAP developed by the

researchers] to collect data. Data collected were analyzed using pearson product moment correlation, and stepwise multiple regression analysis. Results showed that both metacognition and attitude correlate significantly with academic achievement.

The weakness of the study is that it is limited to chemistry (not biology) student in rivers state and it does not examine variable like self-efficacy. This will result in its limited implication in science education and hence need for further research in such area.

Umaru (2010) in his study investigated the effect of instruction in metacognitive skills on mathematic self-efficacy belief, interest and achievement of low-achieving mathematics students in Kogi State, Nigeria. The design of the study was a quasi-experimental non-randomized pretest-posttest-control-group design, involving one experimental group and one control group. The sample consisted of 129 SSII low achieving mathematics students in four senior secondary schools. The instruments used for the study include mathematics achievement test, mathematics self-efficacy scale and mathematics interest inventory. Mean, standard deviation, and Analysis of Covariance (ANCOVA) were used to analyze the data collected.

The findings of the study showed that instructing students in metacognitive skills significantly enhanced their self-efficacy belief, interest and achievement in mathematics and the gender of the students was not a significant factor on their mathematics achievement, self efficacy belief and interest, There is no significant interaction effect of gender and instruction in meta-cognitive skills on the self-efficacy belief, interest and achievement of low – achieving students in mathematics. He recommended that teachers should develop in students the skills in applying metacognitive strategy in solving problems and that instruction in metacognitive skills should be conducted involving male and female students since both gender benefits from such.

His study was carried out in Kogi State and examined instruction in metacognitive skills on mathematic self-efficacy belief, interest and achievement of low – achieving students in mathematics. However the present study focuses on the effect of metacognition and self-efficacy on the achievement of biology student in Katsina Local Government, Katsina state.

A review of relevant literature on effect of metacognitive instruction on self-efficacy and school achievement of biology students showed that no studies on these skills have been carried out among secondary school biology students in Katsina state. Hence these students lack sufficient information and training in these important skills and this seems to affect their academic achievement.

Finally the empirical studies were mainly carried out in foreign countries and most of the studies were done among primary grade pupils. The findings of the studies indicate that metacognitive instruction and self-efficacy would have positive effect on achievement of biology students.

2.10 Implications of the Literature Reviewed on the Present Study

The review of the related literature indicated that various researchers have worked and shown the effectiveness of instruction in use of metacognitive skills on self-efficacy and students' academic achievement particularly at secondary school level. The literature review also indicated that Students with high level of metacognitive skills outperform those with low /lack metacognitive skills. Similarly, students with high level of self-efficacy achieve higher in their academic endeavors, while those that have low self-efficacy achieve low academically. However it appears that high metacognitive skills have been associated with high self-efficacy. Therefore, students with high metacognitive skills are believed to have high level of self-efficacy belief leading to higher academic achievement.

Therefore, the uniqueness of this study was that researchers work on the effects of metacognitive instruction on self-efficacy with different variables, instruments and also in different part of Nigeria and outside Nigeria, but none of these researches has been conducted in Katsina State. Hence, this current research was aimed at examining the effects of metacognitive instruction on self-efficacy and academic achievement of biology students in Katsina Local Government, Katsina State.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter presents the procedure for carrying out this study. Specifically, it describes the Research Design, Population and Sample size of the study, Sampling techniques, Data Collection Instruments, Validity and Reliability of the instruments, Data Collection Procedure and Data Analysis Procedure.

3.2 Research Design

The research design for this study was a quasi-experimental pre-test-post-test non-equivalent control group design with two treatment groups and two control groups. This research design was recommended by Fraenkle and Wallen (2000). This design was adopted because subjects were not randomly assigned to groups instead intact classes were randomly assigned to experimental and control groups. According to Ali (2006), quasi-experimental research design can only be used where the researcher cannot randomly sample and assign his subjects to groups. The design used in this study is presented in Fig 4.

EG = $O_1 \longrightarrow X_1 \longrightarrow O_2$

CG = $O_1 \longrightarrow X_0 \longrightarrow O_2$

Fig 4: Quasi-Experimental Research Design

Keys:

EG = Experimental group

CG =Control group

O_1 = Pretest administered to treatment and control group respectively,

X_1 = Treatment (Instruction in Metacognitive skills) given to experimental group

O_2 = Post-test administered to the two groups after treatment.

X_0 = No treatment (Conventional teaching method) to the control group.

3.3 Population and Sample size of the Study

3.3.1 Population of the Study

The population of this study consists of 9038 SS II biology students in all the senior secondary schools in Katsina Local Government Area of Katsina State. The choice of SS II students was guided by the assumption that the students had been taught biology, the subject under study and have attained the formal operational stage of cognitive development.

Table 2: Population of SS II Biology Students in Katsina Local Government of Katsina State for 2016/2017 Academic Year

S/N	Schools	Boys	Girls	Total
1	A	518	194	712
2	B	636	757	1393
3	C	422	630	1052
4	D	438	546	984
5	E	524	459	983
6	F	599	564	1163
7	G	351	270	621
8	H	___	711	711
9	I	37	34	71
10	J	257	470	727
11	K	258	265	523
12	L	38	60	98
Grand Total				9038

Source of data: Katsina State Ministry of Education, 2016.

3.3.2 Sample Size

The sample of this study consisted of 180 SSII biology students at the selected schools. Two co-educational public schools were randomly selected through simple random sampling technique to represent the sample of the population. Andale (2017) maintained that in simple

random sampling, each individual in the population has an equal chance of being selected. Four intact classes comprising of two male and two female classes drawn from these schools were assigned to experimental and control group. This is because of the nature of the schools which comprises male and female student in the same premises but different classes.

Table 3: Distribution of sample from the population of Biology Students in Katsina Local Government Area of Katsina State

S/N	Schools	Group	Gender	
			Male	Female
1	A	Control	42	44
2	B	Experimental	50	44
Total			180	

3.3.3 Sampling Technique

The study used simple random sampling technique (hat and draw) to draw sample from the entire population of twelve (12) Senior Secondary Schools. Two co-educational schools were randomly selected with four intact classes of SSII Biology students, two intact classes one of male and one female are assigned for experimental group (metacognitive instruction) and the other two intact classes one of male and one female are assigned for control group respectively. This is because gender is one of the variables under study and intact classes were used so as not to interrupt the normal organizational setting of the classes.

3.3.4 Selection of Topics to be taught

The topics taught under this study were feeding mechanism and digestive system which were in the contents of biology SS II third term curriculum (National curriculum on Biology, 2012) and tend to be among the difficult topics students avoid to answer in external examination. The BAT test items were developed around the learning areas under this topic. The choice of SSII students

was due to the fact that they are not preparing for the external examination (WAEC and NECO) and both boys and girls' students were considered because gender is one of the variables of the present study.

3.4 Data Collection Instruments

Two instruments were used in this study for data collection. They are; Biology Achievement Test (BAT) and Biology Self-efficacy Scale (BSES).

3.4.1 Biology Achievement Test (BAT)

The BAT instrument initially consisted of 60 multiple-choice objective test items on the topics Feeding Mechanism and Digestive system with options letter A – D which were later reduced to 30 questions after the computation of facility index. Items found too difficult or too simple were reduced while some are modified and retained. Each question carries one mark, making a sum total of 30 marks, the multiple choice question items were adopted from standardized West African Examination (WAEC) question papers. BAT was used as pre-test and post-test to determine the students' academic achievement and effects of the treatment.

3.4.2 Biology Self-efficacy Scale (BSES)

The BSES was thirteen item statements to measure students' self-efficacy belief in Biology. The scoring was five-point likert scales ranging from strong disagree to strong agree and the researcher adopted the questionnaire from Tuana, Chinb and Shiehc (2005). The purpose of this instrument was to determine whether students can cope with difficult or normal biological task and measure sense of perceived self-efficacy of the students. The test was administered as pre-test and post-test to both experimental and control group.

3.4.3 Developing Metacognitive Instructional Package for Experimental Group

This instructional package was developed by the researcher with the help of two Senior Lectures in Department of Science and Technology Education. The objective was to develop an instructional package that will facilitate the teaching of metacognitive skills that are assumed to enhance biology students' academic achievement. To develop this instructional package, the researcher stated and identified in behavioral terms the objectives to be achieved, the teacher-students exercise in the four training sessions, the instructional materials, strategies and the evaluation techniques to be employed. The contents in the instructional package include of the meaning and components of metacognition, types of metacognitive learning skills such as planning, monitoring, revising and evaluation, significance and application of metacognitive learning skills to biology students.

3.5 Validity and Reliability of the Instruments

The BAT and BSES instruments were been validated and pilot tested.

3.5.1 Validity of the Instruments

The instruments (BAT and BSES) along with the research questions and hypotheses of the study were subjected to face and content validity by four experts, Bayero University, Kano. Two from the Department of Science and Technology Education, one from Biological Science, another one from microbiology and one from psychology education departments of Bayero University, Kano and a secondary school biology teacher in katsina state with more than 11 years teaching experience. These experts assess the instruments to ensure the appropriateness and adequacy of the test items to measure what they are suppose to measure and clarity of the language used. In both BAT and BSES, recommendations were made in relation to the language used in some of the items that the language was not very clear and direct, while in BSES

recommendations were made on the need to include some questions to make the items clear and understanding. All the recommendations were considered and effected.

The instructional package was also face and content validated by two experts from the Department of Science and Technology Education Bayero University Kano. The objectives, activities, evaluation, techniques, time limits and the number of sessions were provided to serve as a guide for their comments and suggestion. All the comments and suggestions made were considered and effected.

3.5.2 Reliability of the Instruments

The BAT and BSES were subjected to pilot study, it was tested using twenty SS II biology students who were part of the population but not part of the main sample study but were found to be equivalent in all aspects to the students' in the study. The data obtained through the trial testing were collected through test-retest method on BAT and BSES. The first test was initially administered to the group and after two week the second test was also administered to the same group as re-tests. Therefore, the researcher obtained two set of scores and analyzed by Person Product Moment Correlation Coefficient (PPMC) which gave a reliability coefficient of BAT to be 0. 78 while for BSES was found to be 0. 96.

The face validated metacognitive instructional package was also trial tested by the researcher with the help of a trained research assistant. The instructional package was used in instructing twenty SS II biology students within the population of the study but out of the sample study. The purpose is to ensure that the package was accurate and adequate in achieving the stated objectives of the study and provided opportunity to assess the extent the trained research assistant acquired the skills required for teaching students how to apply metacognitive skills in learning.

Facility Index

This is the percentage of the students who obtained the correct answer on items. It is computed using the formula, F=R/T.

Where R= Number of correct answer

T= Total number of students

In computing the difficulty index for each item in the test, the steps are as follows:

i. Ranking – order of the scores on the test from highest to lowest.

ii. Identification of the high scoring group and low scoring group.

iii. Determining the 27% of high scores and 27% of low scores passing an item.

iv. Computation of the item discrimination index by deducting the percentage of those correct in the high scoring and low scoring and divide by the number of test taker ($d = U_P – L_P/ U$).

v. The assumption was that the scores that ranges from 0.3 to 0.8 was considered normal (Si-Mui and Raja, 2006) and therefore as used and retained for this study.

Thus, Discrimination index $d = U_P – L_P/ U$

Where, U_P =Upper group

L_P =Lower group

U = Number of test taker in the U_P (Appendix ix)

3.6 Data Collection Procedure

Immediately after assigning the intact classes to experimental and control groups, BAT and BSES was administered as pre-test to them before the treatment. This is done to measure the student's equivalence. Control groups received normal lesson on feeding mechanism and

digestive system with the validated lesson plan, while metacognitive skills instructional package was used in training the students in the experimental groups in the schools and the same lesson plan was used in teaching feeding mechanism and digestive system. The experimental group received instruction in metacognitive skills of planning, monitoring, regulating or revising and evaluation in the content of biology which lasted for six weeks (1hr.20mins) time duration with the help of research assistants. After the instruction, Biology Self-efficacy Scale (BSES) was administered to them. This instrument served as self-questioning questions to the groups. After the delivery of the lessons to the two groups, the post-test tests were administered by the researcher and research assistants to both groups. The administration of the tests was conducted in a way that the subjects were exposed to the same test condition.

3.7 Data Analysis Procedure

The data collected was collated, organized and analyzed. Data was analyzed using mean and standard deviation to answer each stated research questions while t-test (z-test) was used to test the formulated hypothesis at 0.05% level of significance. Therefore, following the decision rule, if p-value is greater than the alpha value (0.05) level of significance, then the null hypothesis will be accepted but if p-value is less than the alpha value 0.05level of significance, then the null hypothesis will be rejected. The grand mean of the scores of each of the two groups (experimental and control groups) was used for data analysis and the responses to the BSES items were analyzed to provide a measure of students' level of biology self-efficacy.

CHAPTER FOUR

DATA ANALYSIS AND PRESENTATION

4.1. Introduction

In this chapter, the data obtained were analyzed using mean and standard deviation to answer research questions 1 to 3 while the null hypotheses 1 to 3 were tested using z-test for Independent sample at 0.05 level of significance. The Statistical Package for Social Science (SPSS) version 16 was used in analyzing the data and the findings are presented in tables based on the three stated research question and corresponding null hypothesis that guided the study.

4.2 Data Analysis and Results presentation

The results obtained from the two instruments (Tests) were used to answer the research questions.

Research Question 1: What is the effect of metacognitive instruction and conventional teaching method on biology students' academic achievement?

Table 4.1. Descriptive statistics, Mean and Standard Deviation results on effects of Metacognitive instruction on the Academic Achievements of Biology student in Experimental and Control Group

			Pre-test		Post-test		Mean diff.
Group	Teaching Method	No	Mean	SD	Mean	SD	
Experimental	Metacognitive Instruction	94	11.22	2.04	26.68	2.64	2.98
Control	Conventional	86	11.63	2.11	23. 70	2.83	

The result in Table 4.1 showed that students that were taught metacognitive instruction in the experimental group with a post-test mean score of 26.68 and the standard deviation of 2.64 is higher than those in the control group with post-test mean score of 23.70 and the standard

deviation of 2.83 and the mean difference is 2.98, indicating that metacognitive instruction has positive effects on biology students academic achievement.

Research Hypotheses 1: There is no significant effect of metacognitive instruction and conventional teaching method on Biology students' academic achievement.

T**able 4.2: Z-test of Post-test Academic Achievements of Biology students in Experimental and Control Group**

Group	N	Mean	SD	Z-value	Df	P-value	Remark
Experimental	94	26.68	2.64	7.32	178	0.00	H_0 rejected
Control	86	23. 70	2.83				

Significant at $P \leq 0.05$

The result in Table 4.2 indicated that the experimental group has higher mean score of 26.68 which are higher than the control group with mean score of 23. 70. The calculated z-value is 7.32 and the p-value is 0.00 which is less than alpha $\alpha = 0.05$ level of significant at 178 degree of freedom. Therefore this showed that $\alpha = 0.05$ is greater than the p-value (0.00), thus the null hypothesis which stated that there is no significant effects of metacognitive instruction on biology students' academic achievement was rejected. This proved that metacognitive instruction effectively improved biology students' academic achievement.

Research Question 2: What is the effect of metacognitive instruction and conventional teaching method on biology students' self-efficacy?

T**able 4.3: Descriptive statistics Mean and Standard Deviation results on the effects of Metacognitive instruction on Self-efficacy of Biology Students in Experimental and Control Group**

		Pre-test		Post-test		Mean diff.
Group	**N**	**Mean**	**SD**	**Mean**	**SD**	
Experimental	94	21.17	8.04	48.28	9.25	8.14
Control	86	19.58	7.16	40.14	6.26	

The result in Table 4.3 revealed that 48.28 is the post-test mean score of the experimental group those that received metacognitive skill instruction with a standard deviation of 9.25 is higher than those in the control group taught with conventional method of teaching with post-test mean score of 40.14 and the standard deviation of 6.26 and the mean difference is 8.14. This showed that students in the experimental group have high level of biology self-efficacy than those in the control group. This indicated that metacognitive instruction has positive effects on biology students' self-efficacy.

Research Hypotheses 2: There is no significant effect of Metacognitive instruction on Biology Students' Self-efficacy.

Table 4.4: Z-test on the Post-test of Biology Self-efficacy Scale in Experimental and Control Group

Group	N	Mean	SD	Df	Z-value	P-value	Remark
Experimental	93	48.28	9.25	178	6.85	0.00	H_0 rejected
Control	86	40.14	6.26				

The result in Table 4.4 revealed that, the experimental group has higher mean score of 48.28 than the control group with mean score of 40.14.the calculated z-value is 6.85 and the p-value is 0.00 which is less than α 0.05 level of significance at 178 degree of freedom. This showed that α 0.05 is greater than the p-value (0.00), thus the null hypothesis which stated that there is no significant effects of metacognitive instruction on biology students' self-efficacy was rejected. This proved that metacognitive skills instruction significantly increased biology students' self-efficacy.

Research Question 3: Is there any gender difference in the academic achievement of biology students when exposed to metacognitive instruction?

Table 4.5: Descriptive statistics Mean and Standard Deviation scores between male and female Post-test of Biology Students Academic Achievement in Experimental Group

			Post-test		Mean diff.
Group	**Gender**	**N**	**Mean**	**SD**	
Experimental	Male	48	25.54	2.92	
Experimental	Female	42	27.98	1.45	2.44

The result in table 4.5 revealed that, female with 27.98 mean score and standard deviation of 1.45 have high level of academic achievement than male students with the mean of 25.54 and standard deviation of 2.92 and the mean difference is 2.44. This indicated that there is gender difference in the academic achievement of biology students when exposed to metacognitive instruction with female students outperforming males.

Hypothesis 3: There is no significant gender difference in the academic achievement of biology male and female students when exposed to metacognitive instruction.

Table 4.6: Z-test on Post-test of Experimental Group between male and female Students Academic Achievement in Biology

Group	N	Mean	SD	Df	Z-value	P-value	Remark
Male	48	25.54	2.92	92	5.02	0.00	H_0 Rejected
Female	42	27.98	1.45				

The result in table 4.6 revealed that, z-value is 5.02 and p-value is 0.00 which is less than α 0.05 level of significant at 92 degree of freedom. Therefore this showed that α= 0.05 is greater than the p-value (0.00), thus null hypothesis which stated that there is no significant gender difference in the academic achievement of biology male and female students when exposed to metacognitive instruction was rejected. This revealed that there is significant gender difference in the academic achievement of biology male and female students when exposed to metacognitive instruction with female students performing better than male in the biology achievement test.

4.3. Summary of the Findings

The findings of the study are summarized as follows;

1. Students exposed to metacognitive skills instruction (experimental group) performed better in their academic achievement than those exposed to conventional instruction (control group).
2. Findings from this research showed that instructing students in metacognitive skills has a facilitative effect on self-efficacy belief of biology students. students with high level of self-efficacy enhanced better in their academic achievement compare to those with low self-efficacy belief.

3. There is a significant gender difference in the academic achievement of biology male and female students when exposed to metacognitive instruction.

4.4 Discussion

This research work was aimed at determining the effect of metacognitive instruction on the self-efficacy and academic achievements of biology senior secondary school students. Research questions and hypotheses were stated and tested based on the scores of the subjects obtained from the biology achievement test (BAT) and biology self-efficacy scale (BSES) administered on them.

The result in Table 4.1 answers research question one whose result revealed that students exposed to metacognitive instruction achieve higher than those exposed to conventional teaching method in the achievement test. Z-test was used in analyzing hypothesis one in Table 4.2 which revealed that there is significant effect of metacognitive instruction on biology students' academic achievement. This indicates that metacognitive instruction improved biology students academic achievement that is the higher the metacognitive skill acquired by a student, the greater the level of performance in biology achievement test and the lower the metacognitive skill acquired by a student, the less he/she performs in the biology achievement test. This agrees with the findings of umaru (2010) which also indicated that students exposed to instruction in metacognitive skills benefited significantly higher than those not exposed as they showed better self-efficacy and achievement. The finding is also in line with the findings of Cluj-Napoca (2012) who maintained that metacognitive instruction improves students' performance. LeMay (2016) carried out a study on the effects of using selected metacognitive strategies on act mathematics sub-test scores and the outcome indicated that metacognitive strategies significantly improved students' metacognitive processes and their academic achievement. Similarly the

findings of Onu , Eskay, Igbo , Obiyo and Agbo (2012) showed that training in metacognitive strategy improved pupils' achievement in fractional mathematics.

The result in Table 4.3 indicated that students in the experimental group have high level of biology self-efficacy than those in the control group with a mean difference of 6.22. The findings of this study also supports the work of Nicolaidou and Philippou (2006), Halon and Schneider (1999), Nalson and More (2003) who believed that students exposed to metacognitive instruction demonstrate higher sense of efficiency and tend to be more competent in the subject taught than those in the conventional group. Similarly the results of Viko (2010) showed that instruction in metacognitive self assessment strategy significantly enhanced their self-efficacy and significantly improved the achievement of secondary school students.

The result in Table 4.4 summarized how hypothesis two was tested. The z-calculated is 2.59 and the z-critical is 1.96 at α 0.05 level of significant. This means that observed value is more than the critical value thus there is significant difference in the effect of metacognitive instruction on biology students' self-efficacy. This indicated that metacognitive skills instruction increased biology students' self-efficacy.

Table 4.6 revealed that the z-calculated is 3.98 and the z- critical value is 1.96 at α 0.05 level of significance. This result indicated that there is a significant gender difference in the academic achievement of biology male and female students when exposed to metacognitive instruction. The results revealed that females obtained better achievement scores than males. This result is in line with the findings of Aurah (2013) which reported that there is gender difference with female students outperforming male students on the genetics problem solving test and that highly efficacious students did better on the tests than less efficacious students. This finding is also in line with the findings of Dayioglu and Turut–Asit (2004) who also attested to

the fact that girls achieved better than boys in school. Similarly, Zembar and Blume (2011) stated that girls rather than boys achieve better in schools. Njoku (2000) also asserted that girls perform poorly in relation to boys on difficult concepts in biology. The result of this study differs from that of Lemay (2012) that showed a significant gender difference in the achievement of male and female pupils in fractional mathematics with males outperforming females. Odagboyi (2015) in his study also found that the boys achieved significantly higher than the girls in the biology achievement test. This finding is contrary to that of Umaru (2010) who contended that there is no significant interaction effect of gender and instruction in metacognitive skills on students' self–efficacy belief and academic achievement of students. Abubakkar and Oguguo (2011) also found no significant difference in the achievement of boys and girls; which agrees with the findings of Uduosoro (2011) who also found no significant gender difference in the achievement of students. However, Agboghoroma and Oyovwi (2015) found that gender had no effect on difficult concept in biology. The findings of this study also contradicts the opinion of Akpokorie (2000) and Omajuwa (2011) who found that male or female sex had no influence on students experienced difficulty in biology.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter presents the summary of the study, conclusions and recommendations. The chapter also ends with the highlights of the limitations of the study and suggestion for further studies.

5.2 Summary of the Study

This study investigated the effect of metacognitive instruction on the self-efficacy and academic achievements of biology senior secondary school students in Katsina Local Government, Katsina state, Nigeria.

Chapter one of this study observed that the present Nigerian educational system is yet to met the set educational goal and objectives due to declining rate of students' performance in external examination like WAEC. This was revealed in their 2012-2016 exam report on students' enrolment and performance in biology is fluctuating year by year, still the performance of the students remain unfavorable, hence the need to investigate the major problems bedeviling students' performance in biology especially at secondary school level. This is due to the fact that the importance of studying biology cannot be overemphasized, as it prerequisite subject for many professional courses at higher educational level such as Medicine, Nursing, Pharmacy, Agriculture, Teaching among others. Therefore, there is a great need to encourage students acquisition of metacognitive learning skills and strategies which are believed to improved students' awareness and control over their learning process and thereby increased their self-

efficacy belief which as a result allow students to strive as much as they can to achieve successful in their Academic endeavors'

Under chapter two, relevant literatures related to this study were reviewed under theoretical framework, conceptual framework and empirical studies. Theories such as Albert Bandura's Self-efficacy theory, McLoughlin and Hollingsworth's model of metacognitive instruction among other were reviewed. conceptual framework includes, the concept of biology, conventional teaching method, self-efficacy, academic achievement, gender as well as empirical studies were also discussed under this section.

Chapter three of this study adopted quasi-experimental pre-test post-test non-equivalent group design with one control group and one experimental group. The study also covered twelve Governments schools from Katsina Local Government, Katsina state. The population of the study comprises of all the Biology students from Government Senior Secondary Schools with a total number of nine thousand and thirty eight students (9038) in Katsina Local Government, Katsina State. One hundred and eighty senior secondary two (SS II) biology students were randomly sampled from four intact classes of two co-educational secondary schools, two were assigned to experimental group and the other two assigned for control group. The choice of co-educational schools was due to the fact that gender was one of the variables of this study. The equivalence was determined by given both groups pre-test, then experimental group were exposed to Metacognitive instruction and the control group were taught based on conventional teaching method.

Research questions and hypotheses were stated and tested based on the scores of the subjects obtained from the Biology Achievement Test (BAT) and Biology Self-efficacy Scale

(BSES) administered on them. BAT consisted of thirty multiple-choice questions around the learning area of digestive system and feeding mechanism. The test items were drawn from WAEC and JAMB past questions, undergo both face and content validation and was also subjected to item analysis with a reliability coefficient of 0.77, while the validated BSES consisted of thirteen statements of biology self-efficacy, measured on 5-likert point scales ranging from strongly disagree to strongly agree and the researcher adopted the questionnaire from Tuana, Chinb and Shiehc (2005) but undergo modification and pilot tested with a reliability coefficient of 0. 96. Both instruments were pilot tested in different school outside the sampled schools but within the population of the study using test-retest for both BAT and BSES with two weeks interval after the administration of the first test. Both instruments (BAT and BSES) were administered with the help of three research assistants who were Biology teachers.

To achieve the objectives of this study, three research questions and three null hypothesis were developed and tested among which include to find out the effect of metacognitive instruction on biology students' academic achievement. The three research questions were analyzed in tables using descriptive statistics (mean and standard deviation), while the three null hypotheses were analyzed using z-test statistics at α 0.05 level of significance using the scores obtained from pre-test and post-test of both BAT and BSES. This was done with aid of Statistical Packages for Social Science (SPSS) version 16 and the results obtained were presented and interpreted under chapter four of this work.

Finally, findings from this research showed that instructing students in metacognitive skills has a facilitative effect on the self-efficacy belief and academic achievement of biology students. Students with high level of self-efficacy enhanced better in their academic achievement compare to those with low self-efficacy belief. However, female students perform

better than male students in the achievement test when exposed to metacognitive skills instruction. Summary, conclusion, contribution and recommendations made from the study.

5.3 Conclusions

This study investigated the effects of metacognitive instruction on the self-efficacy and academic achievements of biology senior secondary school students, from the findings of this research study, the following conclusions were made;

1. Teaching biology students along with metacognitive skills instruction enhanced their academic achievement. Since it provided the students with useful guide on the various metacognitive skills involve in learning.
2. Training in metacognitive skills has a facilitative effect on biology students' self-efficacy belief. Students with high level of self-efficacy enhanced better in their academic achievement compare to those with low self-efficacy belief.
3. There is a significant gender difference in the academic achievement of biology male and female students when exposed to metacognitive instruction with female students scoring higher than their male counterpart in the biology achievement test. This showed that female students perform better than their male counterparts when exposed to the same treatment condition (metacognitive instruction).

5.3.1 Contribution to Knowledge

The research established that:

1. Metacognitive skills instruction has been found to be effective in enhancing students' academic achievement in biology at secondary school level. Since it provided the

students with useful guide on how to apply the various metacognitive skills involve in learning process (M=26.68, SD=2.64), (Z-cal=7.32, p=0.000).

2. Acquisition of various metacognitive skills in learning significantly raised students' self-efficacy belief in biology and students with higher self-efficacy achieve more success academically than students with low self-efficacy (M=48.28, SD=9.24), (Z-cal=6.85, p=0.000).
3. This study showed that female students have an equal opportunity to perform better than their male counterparts when exposed to the same treatment condition (M=27.98, SD=1.45), (Z-cal=5.02, p=0.000).

5.4 Limitation of the Study

This study has some limitations, which include the following;

1. Only 180 SS II biology students of katsina local government, katsina state were involved in this study, possibly if larger number of subjects were used, results obtained might be seen to have high confidence level.
2. The topic under the study (digestive system and feeding mechanism) was only used out of the various topics under the SS II biology scheme. It may be possible that inclusion of other topics in the subject might be more suitable for the study.

5.5 Recommendations.

Based on this study, the following recommendations were made;

1. Biology students learn better when they are exposed to metacognitive skill instruction to enhance understanding of biology. Therefore, biology teachers should encourage

students to use metacognitive skills in learning by adopting strategies or methods that encourage student acquisition of the various metacognitive skills involve in learning.

2. This study revealed that training biology students in metacognitive learning strategies increase students' self-efficacy belief. Thus, biology teachers should provide students with opportunities to acquire the knowledge of metacognitive learning skills to foster their self-confidence (self-efficacy).
3. Research works on metacognitive learning skills should be sponsored by governments and stakeholders in education to ensure equal opportunities for both male and female learners to bridge gender gap that exist among biology students and also enable them to know more about metacognitive learning approaches that will help them to achieve their set learning goals.

5.6 Suggestions for further Study

1. The result obtained from this study was for biology metacognitive skills on students' self-efficacy and can therefore be tried for other science disciplines like physics and chemistry.
2. Researchers may use the findings of this study to guide them in conducting further research on effect of metacognitive instruction on secondary schools students, colleges of education, polytechnics, universities and primary schools pupils to ensure generalization and consideration of students at different stages of learning across all disciplines.
3. Further work may also be preferred on more demanding components of metacognition such as metacognitive knowledge, metacognitive experience, goal and strategies as they may have an effect on students' performance in sciences.

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APPENDIX I

BIOLOGY ACHIEVEMENT TEST ON FEEDING MECHNISM AND DIGESTIVE SYSTEM

Sex: Male Female Instruction: Answer all questions and circle the correct answer. Time allowed: 60 minutes

1. Which of the following processes takes place in the ileum of humans?

A. Absorption of digested food **B.** secretion of saliva **C.** Swallowing of food **D.** swallowing of water

2. The part of alimentary system of a bird where seeds are grinded is_____

A. Gizzard **B.** Stomach **C.** Crop **D.** Rectum

3. The function of the tongue in food digestion is _____

A. digest proteins to polypeptides **B.** mixes the food with saliva and rolls it into a ball or bolus **C.** separate food with saliva **D.** separate pancreatic juice

4. The only food digested in the stomach is;

A**.** protein food **B.** carbohydrate food **C.** fat and oil **D.** vitamins

5. The mouth parts of a housefly are adapted for ;

A. Lapping and sponging **B.** Sucking and chewing **C.** piercing and sucking **D.** Biting and chewing

6. An example of autotrophic organism include the following except

A. Euglena **B.** Hydra **C.** Chlamydomonas **D.** Spirogyra

7. The digestive system is usually called the _____

A. digestive enzymes **B.** alimentary canal **C.** complete digestive system **D.** incomplete digestive

8. Which of the following organisms has homodont dentition?

A. Rabbit **B.** Man **C.** Sheep **D.** Lizard

9. The mode of nutrition common to green plants is _____

A. Autotrophic **B.** Heterotrophic **C.** Holozoic **D.** Saprophytic.

10. Hydra removes undigested food by_____

A. Passing it through the anus **B.** Passing it through the mouth` **C.** means of contractile vacuole **D.** Egesting it through the body

11. The enzyme that is present in saliva is_____

A. Lipase **B.** Pepsin **C.** Ptyalin **D.** Rennin

12. Pepsin is a digestive enzyme which breaks_____

A. Cellulose into glucose molecule **B.** Carbohydrate into simple sugars **C.** Protein into peptones **D.** Fats into glycerol and fatty acids.

13. The large intestine is also known as _____ **A.** colon **B.** ileum **C.** anus **D.** gall bladder

14. Which of the following organisms is not considered as a parasitic plant?

A. Cassytha **B.** Rhizopus **C.** Dodder **D.** Mistletoe

15. Which of the following enzymes is not one of the main example's of digestive enzymes?

A. Sucrose **B.** Amylases **C.** Proteases **D.** Lipases

16. The protein and carbohydrate digestion completed in the _____

A. Stomach **B.** Ileum **C.** Duodenum **D.** Colon

17. Which of the following organs produces bile?

A. Gall bladder **B.** Pancreas **C.** Spleen **D.** Liver

18. A herbivore cannot feed on a piece of meat because it has no

A. incisors to cut the meat **B.** canines to tear up the meat **C.** Premolar to grind the meat

D. molars to mash the meat

19. The parts used by the tapeworm to fasten itself to the host's intestine are the

A. Neck and suckers **B.** Hooks and suckers **C.** Rostellum and suckers

D. Proglottis and neck

20. The dental formula is i3/3, c1/1, pm 4/4, m 2/3 =42 represents that of a

A. Rabbit **B.** Full grown man **C.** Young child **D.** Dog

21. The absence of alimentary canal in the parasitic flatworm can be attributed to the fact that

A. its body does not feed **B.** it has no enzymes **C.** its body absorbs digested food

D. it has suckers on the scolex

22. Which of the following is an endoparasite?

A. Mice **B.** Mosquitor **C.** Ascaris **D.** Dodder

23. A man suffering from obesity must avoid meals containing

A. margarine and butter **B.** rice and beans **C.** carrots and oranges **D.** beef and fish

24. Which of the following digestive enzymes would be greatly affected if the liver fails to produce bile?

A. Amylase **B.** Cellulase **C.** Lipase **D.** Protease

25. The function of the villi in the alimentary canal is to

A. secrete gastric juice **B.** curdle milk **C.** emulsify fat **D.** increase the surface area for absorption

26. The C-shape structure in the alimentary canals is referred to as;

A. Colon **B.** Duodenum **C.** Stomach **D.** Pancreas

27. The type of nutrition shown by spirogyra is

A. Symbiosis **B.** Holophytic **C.** Holozoic **D.** Chemosynthetic

28. The liver, pancreas and some gastric juices play a significant role in digestion process as

A. digestive organs **B**. accessory organs **C.** secretion organs **D.** regulatory organs

29. Which of the following pH value is the best for the action of the enzymes-renin and pepsin in the stomach?

A. pH 2 **B**. pH7 **C.** pH 8 **D.** pH 9

30. Which of the following is the dental formula of man?

A. $I\frac{2}{2}$, $c\frac{0}{1}$, $pm\frac{2}{2}$, $m\frac{3}{3}$ **B.** $I\frac{2}{2}$, $c\frac{1}{1}$, $pm\frac{2}{0}$, $m\frac{3}{3}$ **C.** $I\frac{2}{2}$, $c\frac{1}{1}$, $pm\frac{2}{2}$, $m\frac{3}{3}$ **D.** $I\frac{2}{2}$, $c\frac{1}{1}$, $pm\frac{3}{3}$, $m\frac{2}{2}$

APPENDIX II

BAT MARKING SCHEME

1. A
2. A
3. B
4. A
5. A
6. B
7. B
8. D
9. A
10. B
11. C
12. C
13. A
14. B
15. A
16. B
17. D
18. B
19. B
20. D
21. C
22. C
23. A
24. C
25. D
26. D
27. B
28. B
29. A
30. C

APPENDIX III
BIOLOGY SELF-EFFICACY SCALE (BSES)

INTRODUCTION: I am Msc. (Ed) Biology student from Bayero University Kano. I'm conducting a research work on the topic above. You are please requested to respond to these questions base on your feeling and experience. All information given would be treated for the purpose of research only.

SECTION A: Personal Information

Sex: Male ☐ **Female** ☐

Biology Class; _____

School: _____

SECTION B:

INSTRUCTIONS: This questionnaire contains statements about your willingness in participating in this biology class. You will be asked to express your agreement on each statement. Think about how well each statement describes your willingness in participating in this class and the most appropriate to you from the scales.

1= Strongly Disagree 2= Disagree 3= No Opinion 4= Agree 5=Strongly Agree

Be sure to give an answer for all questions. If you change your mind about an answer, just cross it out and tick another.

S/N	ITEMS	Responses				
		SD	D	NO	A	SA
1	1 am a good Biology student.					
2	I am not confident about understanding difficult concept in Biology.					
3	I usually work very hard on Biology independently.					
4	Whether Biology lesson is difficult or easy, I am sure that I can understand it.					
5	1 knows how to study and perform well on biology examination.					
6	I have all the skills required to do very well at school during Biology lesson.					
7	During Biology activities, I prefer to ask my classmates for the answer rather than think for myself.					
8	When Biology activities are too difficult, I give up or only do the easy parts.					
9	1 would not study Biology if it were optional.					
10	I have no confidence in performing well in Biology class.					
11	I believe that I have a lot of weakness in Biology.					
12	I hate drawings in Biology lesson					
13	Biology lesson make me feel incompetence					

APPENDIX IV

LESSON PLAN ON FEEDING MECHNISM AND DIGESTIVE SYSTEM FOR CONTROL GROUP

WEEK ONE

Subject: Biology

Topic: Digestion and digestive system

Class: SS II

Date: 15th –May, 2017

Time: 8:40-10:00 am

Sex: Males and females

Average age: 18years

Instructional materials: Model, charts, and drawings of human alimentary canals

Method of instruction: Discussion method and questioning methods

Behavioral Objective: By the end of this lesson, students should be able to:

1. Define ingestion, digestion, assimilation and egestion.
2. Identify part of alimentary canal/tracts in Human.
3. State the shape of some digestive organs

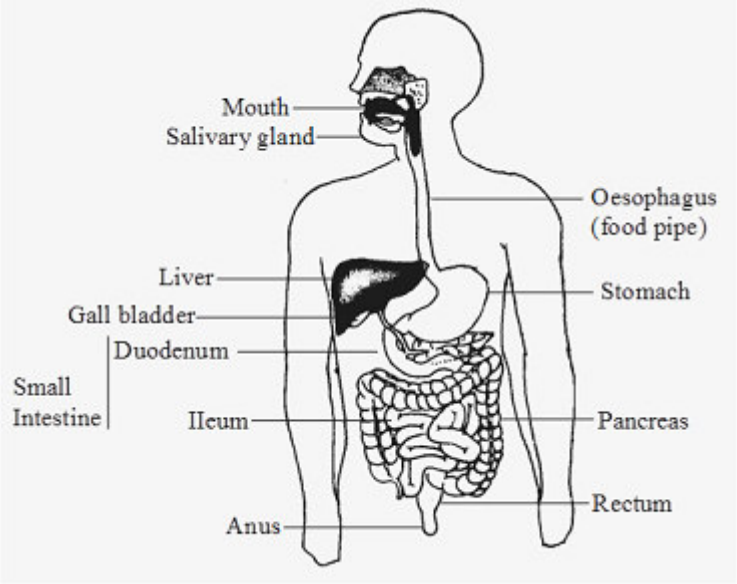
Previous knowledge: The students have the idea of feeding in animals; they know that feeding start from mouth to the stomach and from stomach to the anus. They also know that feeding is required for survival in every living organism.

Introduction: The teacher introduces the lesson by writing the topic on the chalk board and asks the students the following questions;

1. Mention the type of food we eat?
2. Name the part of the body we use to eat food?

Presentation: The lesson will be presented under the following steps;

Step I: The teacher place the chart of the Human alimentary canal on chalk board and ask the students to identify some parts; then the teacher define and discusses the followings with the students;



Ingestion; is the taking of foods substances in the alimentary canals.

Digestion; is the process of changing food item ingested into simpler forms for easy absorption in the body.

Absorption; is the taking of digested food into the blood and lymphatic system for utilization in the body.

Assimilation; is the use of absorbed digested food in the body to derived the energy necessary for the body to function.

Step II: The teacher identifies and discusses the alimentary canals/digestive organs with the students;

Mouth/ Oral cavity/buccal cavity: contain two structures of voluntary muscular tissue called a tongue and bony structural arrangement called the teeth. It begins the digestion of carbohydrates and help in mixing the food together with the tongue.

Oesophagus: is a long tube about 25cm long connecting buccal cavity to the stomach which is the narrowest part of the alimentary canal. It allows the peristalsis passage of food.

Stomach: it is a muscular reservoir. Bolus from the esophagus enters the stomach when the sphincter or muscles open. It serves as a temporary reservoir for food. It also begins the digestion of protein with the help of enzymes (pepsin and rennin).

Duodenum: It is also kwon as small intestine, it is about 225mm in length. Its function is to allow absorption of some food and also provide media for emulsification of fats.

Ileum: this is the terminal part of the small intestine which is 3-metre long with finger like villi (singular: villus) which increase the surface area for absorption in small intestine. It complete carbohydrate, protein and fat digestion.

Large intestine/Colon: this is the last part of alimentary canal also know as colon and rectum. It is a folded structure which descends and ascends respectively. It absorbed useful substances from the undigested food e.g water. It also store undigested part of food in the rectum for egestion.

Step III: The teacher states and discusses the shapes of some alimentary canals;

Oesophagus------- Cylindrical shape

Stomach---------- J-shape

Pancreas---------- C-shape

Ileum----------Folded shape

Step IV: The teacher list and explain the types of digestive system to the students and allow them to ask questions.

Step V: The teacher write notes on the chalk board and allow students to copy it down in their exercise books**.**

Summary: The teacher summarizes the whole lesson to the students.

Conclusion: The teacher concludes the lesson by entertaining questions from the students.

Evaluation: The teacher evaluates and assess student by asking them questions such as;

1. Defined Digestion and Digestive system
2. Describe the process of digestion and digestive system in Human.
3. Mention the functions of the tongue and small intestine in the digestion of food.
4. Identify part of alimentary canal or tracts
5. Describe the process of digestive system in Human

Assignment: Mention any four (4) parts of alimentary canal with their modifications.

WEEK TWO

Subject: Biology

Topic: Alimentary Tracts and Digestive System in Protozoan (Amoeba and Paramecium)

Class: SS II

Date: 15th –May, 2017

Time: 8:40-10:00 am

Sex: Males and females

Average age: 18years

Instructional materials: Model, charts showing the Protozoan's mode of feeding, drawings of human alimentary canals

Method of instruction: Discussion method and questioning methods

Behavioral Objective: At the end of this lesson, students should be able to:

1. Draw and clearly label the alimentary canal of human
2. States the functions of some digestive organs of human
3. Describes the digestion in Paramecium and Amoeba
4. Explain the differences between Alimentary canal of human and that of Paramecium

Previous knowledge: The students have the knowledge of Alimentary tract in man.

Introduction: The teacher introduces the lesson by reviewing previous lesson taught to the students and asks them some questions related to the last lesson;

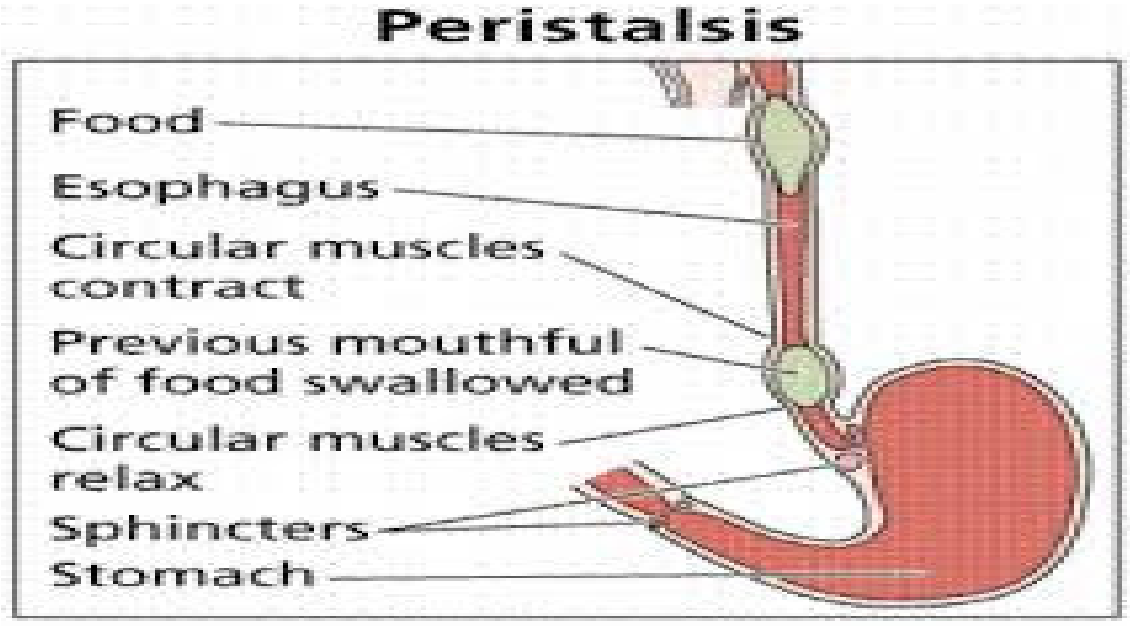
Presentation: the lesson will be presented under the following steps;

Step I: The teacher draws and discusses the alimentary canals of human with students to show all the respected organs of the alimentary canals.

Step II: The teacher states and discusses some digestive organs with the students;

Mouth; mixes food with the saliva, mastication with the help of teeth, grinding for easy passage etc

Oesophagus; allow the passage of food as bolus by peristalsis movement.

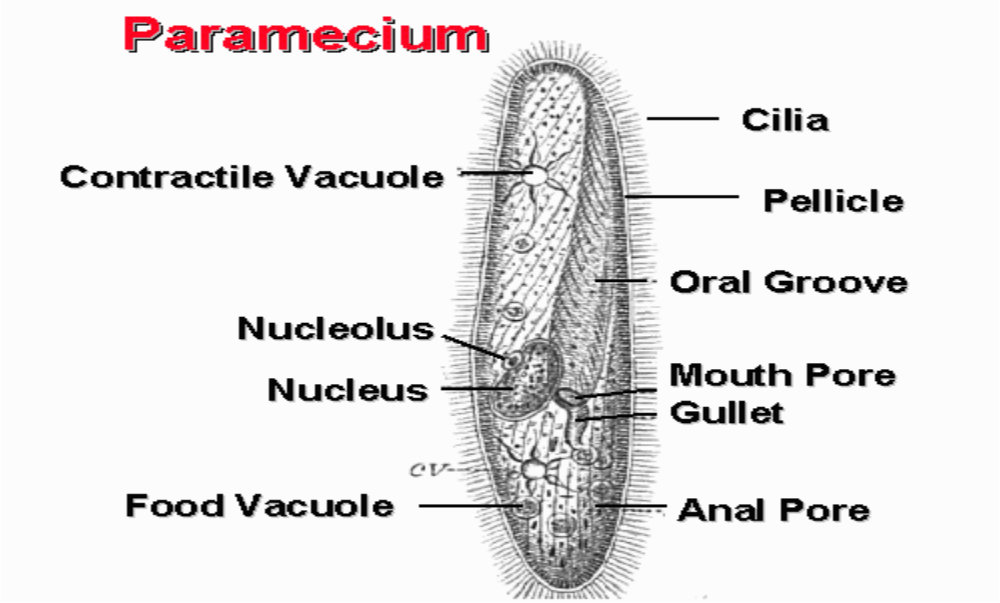


Stomach; temporary reservoir of food, allow mixing of food with gastric juices etc

Ileum; continue and finished the digestion of food and begin the absorption process, etc

Step III: The teacher identifies and explains the part of Alimentary canal such as amoeba feeds with the help of pseudopodia because it lacks mouth while cilia are used to engulf food particles in Paramecium.

Step IV: The teacher describes and discusses the digestion in paramecium; the digestion in paramecium is done by the use of flapping the cilia to drawn the food into its oral groove and digested in the vacuoles.



Step V: The teacher states the differences between the alimentary canals of human and that of paramecium;

Human alimentary canals	Paramecium alimentary canals
1- The organs are well organized 2-The digestion is physical and chemical in nature 3-The alimentary canals has two opening	The organs are organized It mostly physical There is no opening at all, etc

Summary: The teacher summarizes the whole lesson to the students.

Conclusion: The teacher concludes the whole lesson in summary emphasis on areas of difficulties noted during presentation of the lesson.

Evaluation: The teacher evaluates and assess student by asking them questions such as;

1. States the functions of the digestive organs of human
2. Describes the digestion in Paramecium and Amoeba
3. Explain the differences between Alimentary canal of human and that of Paramecium

Assignment: Draw neatly the alimentary canals of human digestive system

WEEK THREE

Subject: Biology

Topic: Alimentary Tracts/Canal of Coelenterates (Hydra) and Bird.

Class: SS II

Date: 29th –May, 2017

Time: 8:40-10:00 am

Sex: Males and females

Average age: 18years

Instructional materials: A Chart showing the Alimentary Canal of a Hydra, Bird.

Method of instruction: Discussion method and questioning methods.

Behavioral Objective: At the end of this lesson, students should be able to:

1. Identify the alimentary canal/tracts of hydra and Bird.
2. Draw and clearly label Hydra feeding mechanisms.
3. Describe how feeding and digestion is taking place in Hydra.
4. Draw and label the alimentary canal of a Bird.
5. Describe the process of digestion in Bird.

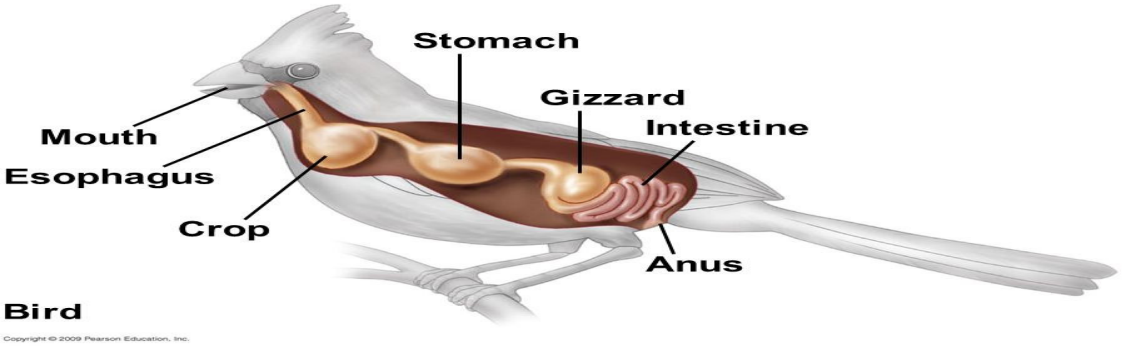
Previous knowledge: The students have the knowledge of Alimentary tract in Amoeba and Paramecium.

Introduction: The teacher writes the topic on the chalk board and briefly explains the previous lesson so as to link with the present lesson.

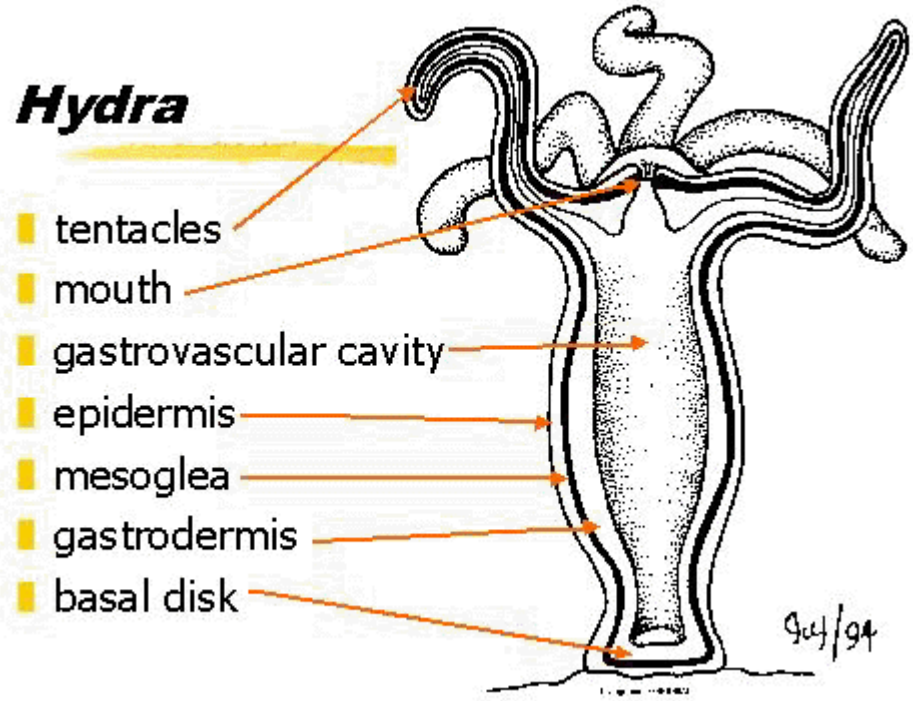
Presentation: the lesson will be presented under the following steps;

Step I: The teacher places the chart of the alimentary canal of bird and hydra on chalk board and explains each to the students.

Step II: The teacher explains the alimentary canal of bird using the charts.



Step III: The teacher explains the alimentary canal of hydra in details using the chart.



Step IV: The teacher explains the whole lesson in details and entertains questions from the students.

Step V: The teacher write notes on the chalk board and allow students to copy it down in their exercise books**.**

Summary: The teacher summarizes the whole lesson to the students.

Conclusion: The teacher concludes and summarizes the whole notes briefly by explaining the main points to the students.

Evaluation: The teacher evaluates and assess student by asking them questions such as;

1. Draw the alimentary canal of a bird.
2. Identify the alimentary canal/tracts of a bird.
3. Mention the alimentary canal/tracts of hydra.
4. Describe the process of feeding and digestion in hydra.

Assignment: Briefly explain how digestion of food takes place in bird.

WEEK FOUR

Subject: Biology

Topic: Dentition

Class: SS II

Date: 5th –June, 2017

Time: 8:40-10:00 am

Sex: Males and females

Average age: 18years

Instructional Materials: A chart/model of different types of teeth (Carnivore, Herbivore, Omnivore)

Method of instruction: Discussion method and questioning methods.

Behavioral Objective: At the end of this lesson, students should be able to:

1. Define dentition.
2. Mention the types of dentition we have.
3. Name and identify the types of teeth we have with function.
4. Write down the dental formula of Man, dog and Rabbit.

Previous knowledge: The students have the knowledge of digestive system and digestion in man, protozoan, coelenterates and bird.

Introduction: The teacher writes the topic on the chalk board and briefly explains the previous lesson so as to link with the present lesson.

Presentation: The lesson will be presented under the following steps;

Step I: The teacher defines dentition as the type, number and arrangement of the normal teeth of an organism.

Step II: The teacher explains the two types of dentition that is primary and permanent dentition to the student.

Step III: The teacher further explains the four types of teeth such as incisors, canine, premolar and molar with their functions and the dental formula.

Step IV: The teacher describe the number of teeth that man, rabbit and dog posses with clear illustration.

Step V: The further teacher place the charts of different types of teeth and explains it in details to the students

Step VI: The teacher write notes on the chalk board and allow students to copy it down in their exercise books**.**

Summary: The teacher summarizes the whole lesson to the students.

Conclusion: The teacher concludes and summarizes the whole notes and entertains questions from the students.

Evaluation: The teacher evaluates and assess student by asking them questions such as;

1. Define dentition.
2. Mention the two types of dentition we have.
3. Write down the dental formula of Man, dog and Rabbit.

Assignment: Name and identify the types of teeth we have with their functions.

WEEK FIVE

Subject: Biology

Topic: Modification and mechanism of feeding in some animals.

Class: SS II

Date: 5th –June, 2017

Time: 8:40-10:00 am

Sex: Males and females

Average age: 18years

Instructional Materials: A chart of Human alimentary canal.

Method of instruction: Discussion method and questioning methods.

Behavioral Objective: At the end of this lesson, students should be able to:

1. Mention the five feeding mechanisms and modification found in some organisms.
2. Describe the mechanism and modification of a given organism with examples.
3. Mention the features of feeding mechanism in tapeworm, housefly, grasshopper, mosquitor and mammal.

Previous knowledge: The students have the knowledge of Dentition of different types of organisms.

Introduction: The teacher writes the topic on the chalk board and briefly explains the previous lesson so as to link with the present lesson.

Presentation: The lesson will be presented under the following steps;

Step I: The teacher places the chart of different feeding mechanisms of some animals on chalk board, identifies and explains the chart to the students.

Step II: The teacher explains in detail the five feeding mechanisms and modification commonly found in different organisms.

Step III: The teacher further explains the whole lesson in detail and entertains questions from the students.

Step IV: The teacher write notes on the chalk board and allow students to copy it down in their exercise books**.**

Summary: The teacher summarizes the whole lesson to the students.

Conclusion: The teacher concludes and summarizes the whole notes and entertains questions from the students.

Evaluation: The teacher evaluates and assess student by asking them questions such as;

1. Mention the five feeding mechanisms and modification found in some organisms.
2. Describe the mechanism and modification of a given organism with examples.
3. Draw and label clearly the feeding mechanisms of different organisms.

Assignment: Mention the features of feeding mechanism in tape worm, housefly, grasshopper, mosquito, bladderwort and mammal.

WEEK SIX

Subject: Biology

Topic: Feeding Habits and Digestive enzymes in the human alimentary canal.

Class: SS II

Date: 12th –June, 2017

Time: 8:40-10:00 am

Sex: Males and females

Average age: 18years

Instructional Materials: A chart of Human alimentary canal.

Method of instruction: Discussion method and questioning methods.

Behavioral Objective: At the end of this lesson, students should be able to:

1. Define digestive enzymes.
2. Mention the digestive enzymes each with functions.
3. Name and identify where digestive enzymes are produce.
4. Provide a clear explanation of where the digestive enzymes are secreted.
5. State and describe the feeding habit of a named animal.

Previous knowledge: The students have the knowledge of different types of modification and mechanism of feeding in some animals.

Introduction: The teacher writes the topic on the chalk board and briefly explains the previous lesson so as to link with the present lesson.

Presentation: The lesson will be presented under the following steps;

Step I: The teacher places the chart of human digestive system on chalk board, identifies and explains the chart to the students.

Step II: The teacher explains the meaning of digestive enzymes as the enzymes are proteinous substances that speed up or slowdown the rate of digestive process and discusses with the students.

Step III: The teacher explains and identifies the process of digestion in human and the secretion of digestive juice in the human body;

Ptyalin------start the digestion of starch in the mouth

Renin-------- coagulate mil in children

Pepsin------- commences the digestion of protein in the stomach

Amylase--------- continue the digestion of starch in the duodenum, etc

Step IV: The teacher further explains to the students where the enzymes are produced, secreted and the type of food they acts on,

Ptyalin---------- in the mouth

Renin and Pepsin--------- in the stomach

Amylase, Pepsinogen, Trypsin and Lipase--------- in the Duodenum

Lactase, Maltase, Sucrase, Galactase, Fructase---------- in the ileum

Step V: The teacher explains the feeding habits in detail to the students.

Step VI: the teacher write notes on the chalk board and allow students to copy it down in their exercise books**.**

Summary: The teacher summarizes the whole lesson to the students.

Conclusion: The teacher concludes and summarizes the whole notes and entertains questions from the students.

Evaluation: The teacher evaluates and assess student by asking them questions such as;

1. Define digestive enzymes.
2. Name and identify where digestive enzymes are produce.
3. Provide a clear explanation of where the digestive enzymes are secreted.
4. State and describe the feeding habit of a named animal.

Assignment: Mention the digestive enzymes each with their functions.

APPENDIX V
METACOGNITIVE SKILL TRAINING PACKAGE FOR EXPERIMENTAL GROUP (MSTPEG)

The following are the activities of the teacher and students in the four (4) sessions of the training exercise.

Session 1: Introduction

Behavioral Objective: At the end of this session, the teacher:

1. Creates good relationship with the students
2. State and explain the reason of the training to the students
3. Explain the significance of the training to the students.

Presentation: Teacher-Students' Exercise

Step I: The teacher starts by introducing himself to the students

Step II: The students introduce themselves indicating their names and class. This is done to create good relationship with the students.

Step III: The teacher state and explains the reason and significance of the training to the students and seeks their cooperation.

Step IV: The teacher make used of double free periods in the week that is suitable for the students.

Step V: The teacher entertaining questioning from the students and make necessary clarification.

Session 2: The Concept of Metacognition

Behavioral Objective: At the end of this lesson, students should be able to:

1. Define metacognition
2. Mention the four components of metacognition

Presentation: Teacher-Students' Exercise

Step I: The teacher writes and explains the meaning of metacognition to the students.

Step II: The teacher outlines and explains the components of metacognition such as metacognitive knowledge, metacognitive experience, goal and strategies to the students with illustrative examples in the concept of feeding mechanism and digestive system.

Step III: The teacher further outlines and explains the types of metacognitive knowledge such as person, task and strategies variable and its significant roles in learning. These include, declarative knowledge (understanding of one's own capabilities in learning), procedural

knowledge (one's awareness about the nature and type of learning task available at hand) and conditional knowledge (individual understanding of the various metacognitive strategies and ability to effectively apply it in learning process).

Step IV: The teacher explains in details the internal connections that exist between the four components of metacognition.

Summary: The teacher summarizes the whole lesson to the students.

Conclusion: The teacher concludes the whole notes and entertains questions from the students.

Evaluation: The teacher evaluates the lesson by asking students the following questions:

1. Define metacognition
2. Mention any three (3) components of metacognition.

Assignment: Mention any four (4) components of metacognition with examples.

Session 3: Metacognitive Learning skills

Behavioral Objective: At the end of this lesson, students should be able to:

1. State and identify the types of metacognitive learning skills
2. Explain the various metacognitive skills used in learning biology (feeding mechanism and digestive system).
3. Identify other topics in which metacognitive skills could be applied

Presentation: Teacher-Students' Exercise

Step I. The teacher writes and explains the meaning of metacognitive skills to the students, with illustrative examples.

Step II. The teacher outlines and explains the various metacognitive skills in learning such as planning, monitoring and evaluation to the students with examples in biology (feeding mechanism and digestive system).

Step III. The teacher further explains the types of metacognitive strategies in learning. These include, awareness (students' recognition of learning task), planning (organization of learning materials), monitoring (one's adopting strategies that work for them), reflection (referring back to what one previously learn) and evaluation (self-testing to check one's progress in learning).

Step IV. The teacher asks the students to identify and explains how these skills could be appropriately applied in learning.

Step V. The teacher guides the students to find out other topics in which metacognitive skills could be appropriately employed.

Summary: The teacher summarizes the whole lesson to the students.

Conclusion: The teacher concludes the whole notes and entertains questions from the students.

Evaluation:
The teacher evaluates the lesson by asking students the following questions:

1. Identify the types of metacognitive learning skills

2. Outline and explain any three types of metacognitive skills used in learning biology (feeding mechanism and digestive system).

Assignment: Mention other topics in which metacognitive skills could be applied

Sessions 4: Application of metacognitive learning skills in biology

Objectives: at the end of the session, the students should be able:-

1. Explain the significance of metacognitive skills in learning biology.
2. Mention the type of learning tasks in which metacognitive skill may be applied.
3. To recognize the steps involve in learning the concept of feeding mechanism and digestive system taught in the classroom.

Instructional Material: Chart of human alimentary canal/tracts, exercises on feeding mechanism and digestive system. Modern biology textbook for senior secondary schools, plane sheets, pencils etc.

Presentation: Teacher-Students' Exercise:

Step I. The teacher begins by informing the students that they are going to start the actual exercise in the use of metacognitive skills in problem solving.

Step II. The teacher create problem to the students by providing them with the chart illustration of the human alimentary canal using them to identify and describe step by step the parts of alimentary canal such as, mouth, esophagus, stomach, small and large intestine (ileum and colon), rectum and anus to the student and explain how digestion takes place from the mouth to the anus, and indicate the metacognitive skills involved while saying the answer.

Step III. The students solve the problem by explaining and identifying the part of alimentary canal by looking at the model and the chart while the teacher listens and makes corrections on mistake the students makes as they are trying to describe and identify the charts. The teacher

then asks them to explain digestive system and the type of the metacognitive skills involves in solving the problem based on their understanding.

Step IV. Teacher asks the students to write down notes on their exercise books then goes round to supervise what they are doing. When they are finish, the teacher together with the students then identify and describe the part of alimentary canal, the process of digestion and the digestive system and the metacognitive strategies involved in explaining the process (task).

Step V. The teacher write notes on the chalk board and allow students to copy it down in their exercise books and the students are expected to compare the ones on the chalkboard with the ones on the exercise books to monitor, revise/regulate and evaluate their own work. This is done to encourage students to learn independently and actively. The teacher later entertains questions from the students.

Step VI. The teacher explains to students the various metacognitive strategies such as awareness, preparation (planning), monitoring, evaluation that could be used when solving tasks at hand.

Step VII. The teacher gives students exercises to answer independently, the teacher go through their exercises, marks and then gives individual students correction where necessary.

Step VIII. The teacher explains how metacognitive skills increases students' confidence and motivate them to learn independently and actively participate in the learning process.

Step IX. The teacher guides the students to mention the significant role of metacognitive skill in biology.

Summary: The teacher summarizes the whole lesson to the students.

Conclusion: At the end of the training sessions, the teacher briefly concludes the whole lessons and entertains questions from the students. The teacher further encourages the students to keep applying metacognitive learning skill in their learning process in order to enhance their achievement in biology.

Evaluation:

1. Explain any four (4) types of metacognitive skills involved in learning biology.
2. Mention any two importances of metacognitive skills to biology students.

Assignment: List and explain any four (4) types of metacognitive skills involved in learning biology.

APPENDIX VI

Department of Science and Technology Education
Faculty of Education
Bayero University, Kano.
March, 2017

REQUEST FOR VALIDATING OF A RESEARCH INSTRUMENT

Dear Sir/Madam

I am carrying out a research on the topic 'Effects of metacognitive instruction on the self-efficacy and academic achievement of biology student in senior secondary schools in Katsina L.G, Katsina State' which requires the assessment of Achievement in biology of senior secondary class two (SSII) students.

Therefore two instruments were developed for the study:

(I) Biology Achievement Test (BAT),

(II) Biology Self-efficacy Scale (BSES)

I therefore request that you kindly help with the validation of the test items.

I enclosed here a copy of the Draft test items for scripting and necessary action please.

Yours maximum contribution will be highly appreciated.

Yours faithfully

MARYAM JAFARU

APPENDIX VII

NAME AND ADDRESS OF SCHOOL IN KATSINA L.G.A KATSINA STATE NIGERIA

KATSINA L.G.A

1. Government Pilot Secondary School kofar Sauri.
2. Government College Senior Day Wing.
3. Katsina College, Katsina
4. Government Day Secondary School Dutsen Safe
5. Government Day Secondary School kofar Yandaka
6. Government Day Secondary School kofar Kaura
7. Government Girls College School
8. Sir Usman Nagwaggo College of Arabic And Islamic Studies(ATC)
9. Family Support Programme Secondary School
10. Sir Emeka Offer Kambarawa
11. Dikko College
12. Government School for the Blind

APPENDIX VIII

ITEM ANALYSIS OF BIOLOGY ACIEVEMENT TEST

Items	R	F=R/T	F(%)	Item ranking		$D=U_P - L_P/U$
1	13	0.65	65%	16	Upper. G	0.60
2	12	0.60	60%	16		0.60
3	13	0.65	65%	16		0.60
4	14	0.70	70%	16		0.60
5	9	0.45	45%	15		0.40
6	13	0.65	65%	15	Middle. G	
7	14	0.70	70%	15		
8	9	0.45	45%	15		
9	14	0.70	70%	15		
10	10	0.50	50%	15		
11	10	0.50	50%	15		
12	13	0.65	65%	15		
13	14	0.70	70%	15		
14	13	0.65	65%	15		
15	9	0.45	45%	15		
16	7	0.35	35%	14		
17	7	0.35	35%	14		
18	13	0.65	65%	14		
19	11	0.55	55%	14		
20	14	0.70	70%	14		
21	14	0.70	70%	14		
22	14	0.70	70%	14		
23	12	0.60	60%	14		
24	14	0.70	70%	13		
25	7	0.35	35%	13		
26	10	0.50	50%	13	Lower. G	
27	7	0.35	35%	13		
28	8	0.4	40%	13		
29	7	0.35	35%	13		
30	8	0.4	40%	13		

APPENDIX IX

ITEM SPECIFIXATION OF BAT BASED ON BLOOMS TAXONOMY LEVEL OF COGNITIVE TABLE

COGNITION LEVEL	ITEMS	TOTAL
Knowledge	1,2,5,7,11,13,19,20,26,30	10
Comprehension	3,4,6,9,10,12,16,17,18,21,25,27	12
Application	28,29	1
Analysis	8,14,15,22,23,24	6
Synthesis		
Evaluation		
Total		30

SPSS OUTPUT OF BAT

Correlations

		Battest	batRetest
Battest	Pearson Correlation	1	.777**
	Sig. (2-tailed)		.000
	N	20	20
BatRetest	Pearson Correlation	.777**	1
	Sig. (2-tailed)	.000	
	N	20	20

**. Correlation is significant at the 0.01 level (2-tailed).

SPSS OUTPUT OF BSES

Correlations

		Bsestest	bsesretest
Bsestest	Pearson Correlation	1	.958**
	Sig. (2-tailed)		.000
	N	20	20
Bsesretest	Pearson Correlation	.958**	1
	Sig. (2-tailed)	.000	
	N	20	20

**. Correlation is significant at the 0.01 level (2-tailed).

APPENDIX X

DISCRIPTIVE STATISTICS OUTPUT OF CONTROL AND EXPERIMENTAL GROUPS

Group Statistics

	GROUP	N	Mean	Std. Deviation	Std. Error Mean
PRE TEST BAT	EXPERIMENTAL	94	11.2234	2.04337	.21076
	CONTROL	86	11.6279	2.11464	.22803
POST TEST BAT	EXPERIMENTAL	94	26.6809	2.63644	.27193
	CONTROL	86	23.6977	2.82872	.30503

Z-TEST OUTPUT OF BAT FOR CONTROL AND EXPERIMENTAL GROUPS

Independent Samples Test

		Levene's Test for Equality of Variances		z-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	Z	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
PRE TEST BAT	Equal variances assumed	.238	.626	-1.305	178	.194	-.40450	.31003	-1.01631	.20731
	Equal variances not assumed			-1.303	175.319	.194	-.40450	.31051	-1.01732	.20831
POST TEST BAT	Equal variances assumed	1.414	.236	7.323	178	.000	2.98318	.40736	2.17930	3.78705
	Equal variances not assumed			7.300	173.586	.000	2.98318	.40864	2.17663	3.78972

DISCRIPTIVE STATISTICS OUTPUT OF BAT MALE AND FEMALE IN EXPERIMENTAL GROUPS

Group Statistics

	GENDER	N	Mean	Std. Deviation	Std. Error Mean
POST TEST BAT	MALE	50	25.5400	2.91520	.41227
	FEMALE	44	27.9773	1.45456	.21928

Z-TEST OUTPUT OF BAT MALE AND FEMALE FOR EXPERIMENTAL GROUPS

Independent Samples Test

		Levene's Test for Equality of Variances		z-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	Z	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
POST TEST BAT	Equal variances assumed	22.548	.000	-5.021	92	.000	-2.43727	.48544	-3.40139	-1.47315
	Equal variances not assumed			-5.219	73.906	.000	-2.43727	.46696	-3.36773	-1.50681

DISCRIPTIVE STATISTICS OUTPUT OF BSES FOR CONTROL AND EXPERIMENTAL GROUPS

Group Statistics

	GROUP	N	Mean	Std. Deviation	Std. Error Mean
POST TEST BSES	EXPERIMENTAL	94	48.2766	9.24506	.95355
	CONTROL	86	40.1395	6.25566	.67456
PRE TEST BSES	EXPERIMENTAL	94	21.1702	8.03840	.82910
	CONTROL	86	19.5814	7.16111	.77220

Z-TEST OUTPUT OF BSES FOR CONTROL AND EXPERIMENTAL GROUPS

Independent Samples Test

		Levene's Test for Equality of Variances		z-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	z	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
POST TEST BSES	Equal variances assumed	6.174	.014	6.852	178	.000	8.13706	1.18761	5.79345	10.48067
	Equal variances not assumed			6.966	164.342	.000	8.13706	1.16803	5.83077	10.44335
PRE TEST BSES	Equal variances assumed	2.220	.138	1.395	178	.165	1.58882	1.13885	-.65856	3.83619
	Equal variances not assumed			1.402	177.879	.163	1.58882	1.13300	-.64704	3.82468

APPENDIX XI

Population of SS II Biology Students in Katsina Local Government of Katsina State for 2016/2017 Academic Year

S/N	Schools	Boys	Girls	Total
1	A= Government Pilot Secondary School K/ Sauri	518	194	712
2	B= Government Day Secondary School K/ Yandaka	636	757	1393
3	C= Katsina College Katsina	422	630	1052
4	D= Government Secondary School Dutse Safe	438	546	984
5	E= Government College Senior Day Wing	524	459	983
6	F= Government Secondary School K/Kaura	599	564	1163
7	G= Sir Usman Nagwaggo College Of Arabic And Islamic Studies (ATC)	351	270	621
8	H= Government Girls College Senior Katsina (WTC)	___	711	711
9	I= Family Support Programe Secondary School	37	34	71
10	J= Sir Emeka Offer Kambarawa	257	470	727
11	K= Dikko College	258	265	523
12	L= Government School For The Blind	38	60	98
Grand Total				9038