EFFECT OF SELF – REGULATED – LEARNING STRATEGY ON MATHEMATICS SELF – CONCEPT AND PERFORMANCE AMONG COLLEGES OF EDUCATION INTEGRATED SCIENCE STUDENTS IN KADUNA AND NASARAWA STATES

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**A MASTER THESIS SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES, AHMADU BELO UNIVERSITY, ZARIA
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DECLARATION

I, Jonah Anzah AYUBA with registration Number P16EDSC8315 declared that the work in this dissertation titled "Effect of Self – Regulated –Learning – Strategy on Mathematics Self – Concept and Performance Among Colleges of Education Integrated Science Students of Kaduna andNasarawa States"has been carried out by me under the supervision of Prof. Y.K. Kajuru and Dr. M.O. Ibrahim in the Department of Science Education, Ahmadu Bello University, Zaria.

The information derived from the literatures has been duly acknowledged in the text and a list of references provided. No part of this thesis was previously presented for another degree or diploma at this or any other Institution.

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Jonah Anzah AYUBA Date

CERTIFICATION

This dissertation titled “Effect of Self – Regulated – Learning – Strategy on Mathematics Self-Concept and Performance Among Colleges of Education Integrated Science Students of Kaduna and Nasarawa States”byJonah Anzah AYUBA with registration number (P16EDSC8315) meets the regulations governing the award of Masters Degree (Mathematics Education) of the Ahmadu Bello University, Zaria and is approved for it’s contribution to knowledge and literary presentations.

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DEDICATION

This research work is dedicated firstly to my Lord and Saviour Jesus Christ who gave me the life and grace to do it, and secondly to my wife Afiniki Jonah Anzah and children (Charity, Beulah, Jemimah, Cyrus, and Favour my adopted daughter).

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LIST OF ABBREVIATIONS

ANCOVA Analysis of Covariance

ANOVA Analysis of Variance

BEESS Bureau for Exceptional and Students Services,

CG Control Group

COEAKWG College of Education Akwanga, Nasarawa State.

CSI Cognitive Strategy Instructions

EGExperimental Group

FME Federal Ministry of Education

KSCOEKaduna State College of Education

MSC Mathematics Self - Concept

MSCQ Mathematics Self – Concept Questionnaire

MSPT Mathematics for Science Performance Test

NCCE National Commission on Colleges of Education

NCE National Certificate in Education

NCTM National Council of Teachers of Mathematics

NERDC Nigerian Educational Research and Development Council

NOUN National Open University of Nigeria

NPE National Policy on Education

Ph.DDoctor of Philosophy.

PPMC Pearson product moment coefficient

RSE Rossier School of Education, University of Southern California

SCQ Self –Concept Questionnaire

SRL Self – Regulated Learning

SRLQ Self – Regulated Learner Questionnaire

t –testTest Statistic for the difference in Means of two samples

U– testMann – Whitney Statistical analysis test.

OPERATIONAL DEFINITION OF TERMS

Mathematics Self – Concept: This is a person's self – related perceptions in the area of Mathematics that are formed through experiences with others and one's own interpretation of their environment.

Metacognition:Metacognition refers among other things, to the active monitoring and consequent regulation and orchestration of these processes in relation to the cognitive objects on which they bear, usually in the service of some concrete goal or object

Cognitive Strategies: These are mental routines or processes for accomplishing cognitive goals like problem solving, studying for test or exams or understanding what is being learnt or studied.It emphasizes the development of thinking skills and processes as a means to enhance learning. It enables learners to become more Strategic, Self – Reliant, flexible, and productive in their learning endeavors.

Self – Regulated – Learning Strategy: Learning that occurs largely from the influence of Students' Self generatedthoughts, feelings, strategies, and behaviours,which are systematically oriented towards the attainment of goals.

Quasi Experiment: This refers to an empirical study used to estimate the causal effect of an intervention on its target population without random assignment.

ABSTRACT

This Research investigated the Effect of Self – Regulated – Learning Strategy on Mathematics Self – Concept and Performanceamong Colleges of Education Integrated Science Students in Kaduna and Nasarawa States, Nigeria. The Survey and Quasi experimental Pre – Test/ Post – Test control group design was used and the population of the research is 673 with 301 males and 372 females. A Sample of 60 (30 males and 30 females) subjects were selected using the Purposive and Stratified Sampling technique for the experimental and control group each with 30 subjects having 15 males and 15 females. The Experimental Group was taught Mathematics for Science topics drawn from 100 level Integrated Science Curriculum using Self – Regulated – Learning Strategy while the Control Group were taught using the Lecture method. The treatment period lasted for six weeks. Three research questions, and three null hypotheses were raised and postulated, which where all tested respectively. The data was collected using three instrument, Mathematics Self – Concept Questionnaire with reliability 0.88 (MSCQ), Self – Regulated – Learning Strategy Questionnaire (SRLQ)with reliability 0.94, and the Mathematics for Science Performance Test (MSPT) with reliability 0.61which were analyzed using Descriptive Statistics, *U* – Test, and the *t- test* at a significant level of $p \leq 0.05$to investigate the difference (if any) in the mean score of subjects Mathematics Self – Concept, SRL Strategy capacity, and Academic Performance in Mathematics for Science. One of the findings is, there is a significant difference in the Academic Performance of ISC students taught Mathematics for Science using SRL Strategy and those taught using Lecture method. The conclusion from the study is that Integrated Science teachers of Mathematics can help their students to Self – Regulate in their learning, thus improving their Academic Performance in Mathematics. It is recommended that teachers of Mathematics should use SRL guide/manual to enhance/improve their instructional skills and encourage students to participate and become Self – Regulated Learners.

CHAPTER ONE

THE PROBLEM

1.1 Introduction

One subject that cut across all the Science related subjects is Mathematics, and every nation's Industrial, Scientific, and Technological development is hinged on a system of education that has sound Mathematical knowledge (Uzo 2002; Salman 2005). This subject is enshrined in the National Policy on Education (NPE) as a core and compulsory subject for Primary, and Secondary Schools in Nigeria (FME 2004).

Mathematics as a specialized tool is an undisputed agent of nation development and wealth creation. It's application is universal to all learning and everyday life from counting possession to measuring proportions, predicting events, computing taxes/profits, drawing maps/plans, planning budget for warfare, providing models, synthesizing results e.t.c. All these are indications that Mathematics is useful in domestic and business deals, scientific discoveries, technological breakthroughs, problem solving, and decision making in different situations in life (Kolawole & Oluwatayo, 2005).

According to Eze (2008), Mathematics is defined as the study of Size, Numbers, and Patterns, while Pilant (2009), defines Mathematics as "the study of relationships among numbers, shapes, and quantities. It uses signs, symbols, proofs, and it includes algebra, calculus, geometry, and trigonometry". Encyclopedia Britannica defines Mathematics as "the science of numbers and their operations, intersections, combinations, generalizations, abstractions, space configurations and their structures, measurement and transformations".

Schoenfeld (2009) describes mathematics as a living subject which seeks to understand patterns that permeates both the world around us and the mind within us.

Science Teacher Education, especially at the National Certificate of Education (NCE) level, forms the solid foundation on which further educational training can be built (Borko & Whitcomb, 2008). Bajah and Okebukola (1984), defines Integrated Science as an approach to teaching of Science in which concepts and principles are presented so as to express the fundamental unity of scientific thought and avoid premature and undue stress on the distinction between the various scientific fields.

Integrated Science teaching emphasizes those concepts which are common to all sciences, the process of Science and the skills associated with them. It also lays emphasis on cognitive ability to formulate questions, to identify variables and design experiments, to interpret results, recognize patterns, generate hypotheses, draw conclusions, and develop theoretical models (NCCE, 2013).

Some of the objectives of preparing teachers of Integrated Science at the NCE level include enabling students gain the concept of the fundamentals of science, increasing students' understanding of the role and functions of Science in everyday life and in the world in which they live, make student well informed and scientifically literate, enabling students acquire and demonstrate the intellectual competence and professional skills necessary to the teaching of Integrated Science in Primary and Junior Secondary Schools, as inquiry – based subject in conformity with national curriculum, and developing in students the ability to impart and encourage in their pupils the spirit of inquiry into the living and non – living things in the environment.

In view of the above, Mathematics for Science was included as a course content of Integrated Science Students at the NCE level. The course is meant for both single and double major students where the single major offer it in the first and second semester of 100 level and the double major offer it in both first and second semester 200 level.

Schoenfeld (2009), stated the goals of Mathematics Instruction as follows:

Mathematics Instruction should provide students with a sense of the discipline, a sense of its scope, power, uses, and history. It should give them a sense of what mathematics is and how it is done, at a level appropriate for the students to experience and understand. As a result of their instructional experience, students should learn to value mathematics and feel confident in their ability to do mathematics.

It should develop students' understanding of important concepts in appropriate core content i.e the curriculum. It should aim at conceptual understanding rather than at mere mechanical skills, and developing in students the ability to apply the subject matter they have studied with flexibility and resourcefulness.

It should also provide students with the opportunity to explore a broad range of problems and problem situations, ranging from exercises to open ended problems and exploratory situations. It should provide students with a broad range of approaches and techniques (ranging from the straight forward methods, various modeling, and the use of heuristic problem solving strategies) for dealing with such problems.

Mathematics instruction helps students to develop what might be called a mathematical point of view to analyze and understand, to perceive structure and structural relationships, to see how things fit together. It should help students to develop analytical skills, and the ability to reason.

Schoenfeld (2009) again emphasized that Mathematics instructions will help students to develop precision in both written and oral presentation. It should help students learn to present analyses in clear and coherent arguments reflecting the mathematical styles and sophistication appropriate in their mathematical levels. Student should be able to communicate with their teachers as well as with fellow students using language of mathematics.

And lastly, Mathematics instruction should be geared to help students develop the ability to read and use text and other mathematical materials. It should prepare them as much as possible to be independent learners, interpreters, and users of mathematics.

1.2 Statement of the Problem

The Performance of Integrated Science students in Mathematics generally has been reported to be positive (Okafor, 2012). However, when the Performance is assessed based on grade obtained by the students in Mathematics, it is discovered that a large portion of these Integrated Science students end up with the average and lower grades of C, D, E, and F.

The interest to undertake this research was kindled by Bergstresser (2005) in her research work “Metacognition and its Effect on Learning High School Calculus” in which twenty seven students (12 males and 15 females) were involved and it was the first time any of the students had taken a Calculus course. A pre and post – tests were administered to the subjects and the result obtained showed a highly significant performance in High School Calculus (See appendix 1A and 1B). Thus, this studyinvestigated the Effect of Self – Regulated Learning Strategy (SRL) on the Mathematics Self – Concept and Academic Performance of 100 level ISC students.

Table 1.1 shows the distribution of Upper and Lower grades in Mathematics for Science of 100 level Integrated Science students for nine (9) academic sessions (2008/2009 to 2016/2017).

Table 1.1 Distribution of Upper and Lower grades in Mathematics.

Session	**No of Students**	**UPPER GRADES**	**PERCENTAGE**	**LOWER GRADES**	**PERCENTAGE**
2016/17	1047	252	24.07	795	75.93
2015/16	931	220	23.63	711	76.37
2014/15	536	214	39.93	322	60.07
2013/14	600	200	33.33	400	66.67
2012/13	447	278	62.19	169	37.81
2011/12	401	162	40.40	239	59.60
2010/11	260	158	60.77	102	39.23
2009/10	253	85	33.60	168	66.40
2008/09	155	53	34.19	102	65.81
Total	**4630**	**1622**	**35.03**	**3008**	**64.97**

Source*: Research & Statistics Unit, K.S.C.O.E. Gidan Waya (2017)/ ISC Dept. N.S.C.O.E. Akwanga(2017).*

1.3 Objectives of the Study

The main objective of this research was to investigate the effect of Self Regulated – Learning Strategy on the Mathematics Self – Concept and Academic Performance among Integrated Science students of Kaduna and Nasarawa state Colleges of Education. However, the study specifically sought to:

1 determine the effect of Self Regulated – Learning (SRL) Strategy on the Mathematics Self – Concept of 100 level Integrated Science students.

2 examine the effect of Self Regulated – Learning (SRL) Strategy on the Academic Performance in Mathematics for Science of 100 level Integrated Science students.

3 determine if SRL Strategy results in any differences in the average score of male and female Integrated Science Students' Academic Performance in Mathematics for Science.

1.4 Research Questions

The following research questions helped the researcher in achieving the objectives stated above.

1 To what extent does SRL Strategy influence the Mathematics Self – Concept of l00 level Integrated Sciences students?

2 To what extent does SRL Strategy mediate Academic Performance of 100 level Integrated Science students in Mathematics foe Science?

3 Does SRL Strategy influence Academic Performance on gender in Mathematics for Science among 100 level Integrated Science Students?

1.5 Hypotheses

The following hypotheses were formulated for the purpose of this research and tested at $p \leq 0.05$ level of significance

H_{o1} :There is no significant difference in the average score for Mathematics Self – Concept of Integrated Science students taught Mathematics for Sciences using SRL Strategy and those taught using the Lecture methods.

H_{o2} :There is no significant difference in the average score in Academic Performance of 100 level Integrated Science students taught using SRL Strategy and those taught using the Lecture method.

H_{o3} :There is no significant difference in the academic Performance average score of male and female ISC students taught Mathematics for Science using SRL Strategy and those taught using the Lecture method.

1.6 Significance of the Study

This research identified SRL as one way to improve teaching and learning of Mathematics for better Academic Performance in Mathematics among Integrated Science students in particular and the study of Mathematics generally.This study was conducted in two Colleges of Education, it is hoped that the findings will provide Mathematics instructors the evidence on what the implication of SRL Strategy on learning Mathematics. Thus, it will provide beneficial and convincing information to Colleges of Education and Institutions of higher learning to include SRL Strategy in the preparation of course and study material in Mathematics. The following are groups who will benefit from this research:

Mathematics Teachers: SRL learning strategy will lead to developing effective Mathematics teachers who will be responsive to the diverse academic needs of learners. SRL will improve their quality of instructions, which in turn will result in better academic performance in learners.

Students/Learners: The findings of this study will expose learners and students to become active users of SRL Strategy, and will equip them to plan (Fore – thought), control (Performance), and reflect (Self – reflective) in their own learning process (Zimmerman, 2010) which transform them into better Academic Performers in Mathematics.

Curriculum Planners: Self – Regulated Learning strategy can be used by Curriculum planners for capacity building in Mathematics curriculum to enhance reform in schools and institution of higher learning.

Professional Bodies/Organizations: This research will provide helpful information to associations, research institutes and organizations such as STAN, NERDC, NTI, to include SRL strategy in Mathematics teaching innovation. Theoretically, the findings of this study will have a strong implication for Mathematics instruction in order to promote Self – Regulation among learners. It is desired that this work will add to existing literature and shall serve as a landmark for further research on the effect of SRL Strategy on Mathematics Self – Concept and Academic Performance of students.

Educational Publishers: Teachers guide in teaching Mathematics especially at the Secondary schools and Colleges of Education can be improved by publishers to include the findings of this research in order to enhance new innovation. Also, textbooks on Mathematics can be improved based on SRL strategy.

Researchers: Researchers may find the new information in this dissertation which can be added to existing literatures to encourage further research on the Self – Regulated Learning Strategy in the teaching/learning process.

1.7 Scope/Delimitation of the Study

The study investigated the Effect of Self – Regulated – Learning (SRL) Strategy on the Mathematics Self – Concept and Academic Performance among Integrated Science students. One hundred level NCE students of Integrated Science will be the area of focus.

The research is delimited to two Colleges of Education, the Kaduna State College of Education, Gidan Waya and the Nasarawa State Colleges of Education, Akwanga. Three (3) instruments were used for the research, the Mathematics for Science Performance Test (MSPT), the second is the Mathematics Self-Concept Questionnaire (MSCQ) constructed by Marsh (1998), and the third instrument is the Self – Regulated Learner Questionnaire (SRLQ) developed by Callan (2014).

1.8 Basic Assumptions

The following assumptions were made with respect to this research:

a. That all subjects are of varying degree of intellectual ability
b. That the students in both Experimental and Control groups have similar physiological characteristics and socio – economic background.

CHAPTER TWO

REVIEW OF RELATED LITERATURES

2.1 Introduction

In this chapter, the Researcher addressed key principles of Mathematics Self – Concept and SRL as related to this project work. The author also looked at some literatures on SRL as causal attribution to Academic Performance. The review of related literature was organized and presented under the following sub – headings:

2.2 Theoretical Framework

2.3 Definitions of Mathematics

2.4 Concept of Teaching

2.4.1 Methods of Teaching

2.4.2 Types of Teaching Methods

2.4.3 Teaching Styles

2.4.4 Problem Solving Method

2.4.5 Polya's Problem Solving Approach

2.5 Concept of Academic Performance in Mathematics

2.6 Mathematics Self – Concept

2.6.1 Structure/Components of Mathematics Self – Concept.

2.6.2 Mathematics Self – Concept and Academic Achievement

2.6.3 Factors Affecting Mathematics Self-Concept

2.6.4 Measuring Mathematics Self – Concept

2.7 Cognitive Strategy Instruction (CSI)

2.7.1 Cognitive Strategies

2.2 Theoretical Framework

Pintrich (2004), proposed four shared assumptions between models of SRL. The first is that learners are more active in their own learning, that is, Self – Regulated Learners set up their own goals, and select the strategies to implement towards the achievement of their goals. The second assumption is that students' monitor, control, and regulate their Cognitive abilities, motivation behaviour, and their environment. The third assumption is that, goals, criteria, and standards are part of Self – Regulated process because students evaluate the progress they've made in comparison to them. The fourth assumption is that it is not just the personality of the students, the context (Classroom), or the culture of the students that determines Self – Regulation, but also the students Self – Regulated cognition, motivation, and behaviour.

The Social Cognitive Theory (Bandura, 1989), the Phenomenological Theory (McCombs, 2001), and the Operant Theories (Mace, Belfiore, & Shea, 1989), all lent their support to the development of Self – Concept and Self –Regulated learning,

The knowledge of subject matter in teaching and learning of Mathematics has been shown by researchers of Mathematics Education and Psychology to be very important. The Mathematics teacher is expected to have acquired a sufficient amount of knowledge in Mathematics before he/she could really teach the contents of School Mathematics Curriculum (NOUN, 2006).

Teaching of Mathematics is a multi – dimensional human endeavor, involving a complex, moment-by-moment interplay of different categories of knowledge. Teachers' Mathematical knowledge, pedagogical competence and reasoning are keys to improving students' mathematical achievement (Tsafe, 2013).

Ball and Forzani, (2009) stated that Teaching means the core tasks that teachersmust execute to help pupils learn. These include activitiescarried on both inside and beyond the classroom, such asleading a discussion of solutions to a Mathematics problem,probing students' answers, reviewing material for a sciencetest, listening to and assessing students' oral reading, explainingan interpretation of a poem, talking with parents, evaluatingstudents' papers, planning, and creating and maintaining anorderly and supportive environment for learning.

The workof teaching includes broad cultural competence and relationalsensitivity, communication skills, and the combinationof rigor and imagination fundamental to effective practice. It also requires appropriately using and integratingspecific moves and activities in particular cases and contexts,based on knowledge and understanding of one's pupilsand on the application of professional judgment.

2.3 Definitions of Mathematics

Mathematics has been interpreted and explained in various ways. This is due to our empirical knowledge and various types of knowledge that abound. However, all types of explanations conclusively end at some kinds of relationship with numbers and space. Thus, Mathematics deals with quantitative facts and relationships as well as with problems involving space and form.

The Encyclopedia Britannica (2012) defines Mathematics as

> *" the science of structure, order, and relation that has evolved from elemental practices of counting, measuring, and describing the shapes of objects. It deals with logical reasoning and quantitative calculation, and its development has involved an increasing degree of idealization and abstraction of its subject matter"*

John Locke defines Mathematics as " the way to settle in the mind a habit of reasoning".

Mathematics enables man to study various phenomena in space and establish different types of relationship between magnitude of quantitative and qualitative facts. Therefore, it may be concluded that Mathematics is the enumerative and calculative part of human life and knowledge that enables the person to give an exact interpretation (Eze, 2008).

Okereke (2006) stated that Mathematics is the science of things that have a pattern of regularity and logical order and finding and exploring that regularity. Mathematics is the foundation of Science and Technology and the functional role of Mathematics to science and technology is multifarious, that no area of science, technology and business enterprise escapes its application.

2.4 Concept of Teaching

According to Ishola (2015), he defined Teaching as "Process by which the learner is made to learn a given subject in accordance with the pre-determined goals and objectives", and again he said it is a Process of imparting knowledge, skills, and professional attitudes in order for people to gain idea, information, concepts, and experiences.

Thus, Teaching can then refer to the general principles, pedagogy, and management strategies used for classroom interactions (RSE, 2015).

On the other hand, the essence of all educational processes is to ensure that students acquire certain skills and behave in a way that they had hitherto not behaved. This acquisition of skills and attitudes that leads to a change in behaviour, which is the goal of education, is referred to as learning.

2.4.1 Methods of Teaching

TOU (2008), defined "Method" as the planning and directing of an activity to achieve something, while Makokha and Ongwao (2014), opined that Teaching Methodology means the Techniques and procedures that arises from deliberate choice and practical experience of the teacher/instructor which governs the instructional process. It facilitates the acquisition of knowledge, skills, and values by the learners.

2.4.2 Types of Teaching Methods

Makhoka and Ongwao (2014), RSE (2015), and Makinde (2012) agreed that there are different types of teaching models which can be categorized into three broad groups. These are:

i. **Teacher/Instructor – centered method**: The teacher is the main authority and he/she stands as a master of the subject matter. Learners become passive and copious recipients of knowledge via lectures and direct instructions. An example is lecture method.

ii. **Learner – centered method**: In this approach the teacher and learner both play an equally active role in the learning process. The teachers' primary role is to facilitate students' learning and comprehension of materials. Examples of these methods include Discussion, Discovery, or inquiry – based methods.

iii. **Content – focused methods**: In this method, both teacher and learner have to fit into the content that is taught. Generally, the information and skills to be learnt are regarded as sacrosanct or very important in which a lot of emphasis is laid on the clarity and careful analysis of the content. This method negates the interest and hinders both teacher and learner from being critical of anything to do with the content. An example is Programmed learning approach.

iv. **Interactive/participatory methods**: This category borrows a bit from the three other methods without necessarily laying emphasis unduly on the learner, content, or teacher. It is driven by the situational analysis of what is the most appropriate thing for us to learn/do now given the situation of learners and the teacher.

2.4.3 Teaching Styles

To better understand the above methods, it is important to discuss what is generally understood as the three (3) main teaching styles in Educational Pedagogy: Direct Instruction, Inquiry – based Learning, and Cooperative Learning.

(i). Direct Instruction: Direct instruction is the general term that refers to the traditional teaching strategy that relies on explicit teaching through lectures and teacher – led demonstrations. Direct instruction is the primary teaching strategy under the teacher –

centered approaches were teachers are the sole supplier of knowledge and information.

Direct instruction is effective in teaching basic and fundamental skills in mathematics (RSE, 2015). Three (3) teaching styles can be identified under the Direct instruction approach, and these are Formal authority, Expert, and Personal model.

(ii). Inquiry – based Learning: Inquiry – based Learning is a teaching method that focuses on learners' investigation and hands –on learning (RSE, 2015). In this style, the teacher's primary role is that of a facilitator, providing guidance and support for learners through the learning process. The Inquiry – based learning falls under the Learner – centered approach, in that learners play an active and participatory role in their own learning process. Under the Inquiry – based learning, three styles can be identified which are Facilitator, Personal model, and Delegator.

(iii.) Cooperative Learning: Cooperative Learning refers to a method of teaching and classroom management that emphasizes group work and a strong sense of community.

This method fosters learner's academic and social growth, and it falls under the Learner – centered Method because learners are placed in responsibility of their learning and development. This method focuses on the believe that learners learn best when working with and learning from their peers. In this method, the teacher acts as a facilitator and delegator.

2.4.4 Problem Solving Method

Problem solving method is an approach which is centred on learner, develops active and motivated learning, problem solving skills, and broad field knowledge, and based on deep understanding . This method of Mathematics instruction turns the learner from passive listener of information received to active, free self – listeners, and problem solvers. It also shifts emphasis of educational programs from teaching to learning (Ali, Akhter, &Khan, 2010).

Yee (2012), opined that Problem Solving is a process. It is the means by which an individual uses previously acquired knowledge, skills, and understanding to satisfy the demands of an unfamiliar situation. The process begins with the initial confrontation and concludes when an answer has been obtained and considered with regards to the initial conditions. The individual must synthesize what he or she has learned and apply it to the new and different situation. This is in agreement with NCTM (2012).

2.4.5 Polya's Problem Solving Approach

George Polya's problem solving method has influenced generations of Mathematicians and non-Mathematicians alike. In 1945, he published a book, *How to Solve It*in which he identified four basic principles of problem solving. Viz:

First Principle: Understand the problem

Polya taught teachers to ask students questions such as:

- Do you understand all the words used in stating the problem?
- What are you ask to find or show? What is the unknown? What are the data? What is the condition?
- Can you restate the problem in your own words?
- Can you think of a picture or diagram that might help you understand the problem or introduce suitable notation?
- Is there enough information to enable you find a solution?

Second Principle: Devise a plan

- Find the connection between the data and the unknown.
- Have you seen it before? Or have you seen the same problem in a slightly different form?

- Do you know a related pattern? Do you know a theorem that could be useful?
- Look at the unknown! Try to think of a familiar problem having the same or similar unknown
- Here is a problem related to yours and solved before. Could you use it? Could you use its result? Could you use its method? Should you introduce some auxiliary elements in order to make its use possible?
- Could you restate the problem? Could you restate it still differently? Go back to definitions.
- Do you use all the data? Did you use the whole conditions? Have you taken into account all essential notions involved in the problem?

Third Principle: Carry out the Plan

- Carrying out the plan of the solution, check each step. Can you see clearly that the step is correct? Can you prove that it is correct?
- You need care and patience given that you have the necessary skills
- Persist with the plan that you have chosen
- If it continues not to work, discard it and choose another
- Don't be misled, this is how Mathematics is done, even by professionals.

Fourth Principle: Look/Looking Back

- Examine the solution obtained
- Can you check the result? Can you check the argument, what worked and what didn't?
- Can you derive the solution differently? Can you see it at a glance?
- Can you use the result, or the method, for some other problem?

2.5 Concept of Academic Performance in Mathematics

Santrock (2006), opined that Academic Performance refers to what the student have learned or what skills the student has learned that is usually measured through assessment like standardized tests, performance assessment, and port folio assessment. Meanwhile, Carter, Greenberg, and Walker (2016) stated that Student's Performance measures the amount of academic content a student learns in a determined amount of time.

Academic Performance refers to standardized test scores, grades, and overall academic ability and performance outcomes. Mathematics Academic Performance is defined as gains in knowledge in the content area of Mathematics by students as measured by an outcome assessment (Koshy, Ernest, and Cassey, 2009)

2.6 Mathematics Self – Concept

Mathematics skills does not develop in a vacuum, reliant only on sources external to the learner, such as curriculum, teacher knowledge, and pedagogical techniques but is susceptible to multiple internal and external sources, including Mathematics achievement (Geronime, 2012).
Lazarides and Ittel (2012), broadly defined Mathematics Self – Concept as a person's self – related perceptions in the area of Mathematics that are formed through experiences with others and one's own interpretation of their environment.

Learners' Mathematics Self – Concept, or belief in their own abilities, is an important outcome of education and stronglyrelated to successful learning (Marsh and O'Mara, 2008). Longitudinal studies of Mathematics Self-concept andachievement show that they are reciprocally related over time (Marsh, Xu and Martin, 2012; Marsh and Martin, 2011). It can also be seen as student's rating of their skills, ability, enjoyment, and interest in Mathematics (Erdogan & Sengal, 2014).

Marsh and O'Mara (2008), defined Mathematics Self – Concept as student's belief in their own abilities in handling Mathematical problems, while Michell (2003) states that: "*Mathematics Self – Concept refers to a person's perception of their ability to learn new topics in Mathematics and to perform well in Mathematics classes and tests".*

Mitchell et al. (2003: 42) states that: Mathematics Self – Conceptrefers to a person's perception of their ability to learn new topics in mathematics and to perform well in mathematics classes and tests.

Mathematics Self – Concept of a learner can either be positive or negative, and either way affects his/her ability to comprehend or internalize Mathematical concepts (Isiksal & Cakiroglu, 2008).

2.6.1 Structure/Components of Mathematics Self – Concept.

Geronime (2012), Marsh and O'Mara (2008) postulated that Mathematics Self – concept can be structured into four (4) components viz: Mathematics Self – efficacy, Mathematics Self – belief, Mathematics interest, and Mathematics anxiety.

i. **Mathematics Self – Efficacy**: This refers to the extent to which students believe in their own ability to handle mathematical tasks effectively and overcome difficulties. It can also mean students' convictions that they can successfully perform given academic tasks in Mathematics at designated level. Mathematics self-efficacy is defined as beliefs about one's ability to perform Mathematics tasks, and this is highly associated with choice of careers in the Mathematics/Science field (Betz and Hackett, 1983).

ii. **Mathematics Self – Beliefs**: This refers to students' personal conviction/Disposition intheir own Mathematics abilities

iii. **Mathematics Interest:** Mathematics Interest can be referred to as a feeling or emotion ofjoy that causes an individual’s attention to focus on a Mathematical tasks, solutions, or process.

iv: **Mathematics anxiety:** Mathematics anxiety refer to thoughts and feelings about Self in relation to Mathematics, such as feeling of helplessness and stress when with Mathematics. Sahin (2000), defined Mathematics anxiety as feeling the emotions of anxiety and tension in solving Mathematical problems and using numbers in daily and academic life.

2.6.2 Mathematics Self – Concept and Academic Performance

Several studies have examined the relationship between Mathematics Self-Concept and academic achievement or performance.Most of these studies support that MSC is a strong facilitator of academic achievement and thata positive or negative change in Self – Concepttends to produce a commensurate change in academic achievementor performance (Wadlington &Wadlington, 2008).

In a study by Leeand Kung (2016), they investigated the relationship between MSC and achievement in Mathematics as well as its influence on gender achievement inMathematics among junior High School student in Taiwan. The sample consisted of 1,256 students (653 boys 51.99%, and 603 girls(48.01%) in seventh grade and data wasprimarily collected using a questionnaire, with items designed to measure MSCamong the students. The Mathematics Self-Concept Questionnaire developed by Marsh (1998) withreliability coefficient of 0.85 (Cronbach alpha) and the Mathematics achievement testinstrument is the teachers’ evaluations of students’ average Mathematics performance in class. The results have suggested that certain social cognitive factors are critical in influencing students’ Mathematics achievement. Among these, a positive Mathematics Self – Concept is frequently posited as a variable that facilitates certain desired outcomes, such as academic achievement (Ercikan et al., 2005; Kung & Lee, 2017; Marsh, Trautwein, Lüdtke, Köller, & Baumert, 2005; Marsh & Yeoung, 1998). Results generally show a positive relationship between students' Mathematics achievement and MathematicsSelf – Concept. In addition, the general consensus in related studies is that boys outperform girls in mathematics due to a higher exhibition of positive Mathematics self – concept.

In another research by Koshkouei, Shahvarani, Behzadi, and Malkhalifeh (2016) titled *Structural Modeling for Influence of Mathematics Self-Concept, Motivation to Learn Mathematics and Self-Regulation Learning on Mathematics Academic Achievement* carried out to investigate the influence of Mathematics Self – Concept (MSC), Motivation to learn Mathematics (SMOT) and Self – Regulation Learning (SRL) on students' Mathematics academic achievement. The study was of a descriptive survey type where 300 female students at the first grade of high school were selected by multiple step cluster sampling method and completed MSC, SMOT and SRL questionnaires. Mathematics academic achievement was measured by Mathematics scores and results obtained by data analysis indicated that influence of Mathematics Self – concept, motivation to learn Mathematics and Self – Regulation learning on Mathematics academic Performance was confirmed. On the other hand, it has also revealed that MSC had influence on motivation to learn Mathematics, and thus is a stronger predictor for Mathematics academic Performance.

In another work by Obilor (2011),heexplored the extent to which the Self-Concept of students in Port Harcourt relates to their Mathematics, and general Academic Achievement.

Theresults of the research indicated that Mathematics Self – Conceptis significantly related to Mathematics Performance, general Academic Achievement and Academic Self – Concept.

2.6.3 Factors Affecting Mathematics Self-Concept

Sax (2011), postulated that two factors are associated with the development of MSC and these are Personal and Environmental factors.

i. **Personal factors:** These may include Learner's perception about their Mathematics ability, peer and family influence, degree of learner's aspiration e.t.c (Adegoke, 2015; Koshkouei, Sharavani, & Behzadi, 2016; Lee & Kung, 2017)

ii. **Environmental factors:** Environmental factorsconsist of Learning experiences in the school especially from Mathematics teachers at the elementary level, interacting with other learners, and or teaching other learners,

2.6.4 Measuring Mathematics Self – Concept

Mathematics Self – Concept can be measured using instruments such as Self Report and Rating scale (Marsh, 1998; Sax, 2011; Ellis, Marsh, & Richards, 2002). These scales are designed to examine the self – view a Learner brings to specific area of Mathematics Self Efficacy, Mathematics Self Belief, Mathematics Interest, and Mathematics Anxiety experiences. Each area is an important contributor to the overall Mathematics Self – Concept of the Learners. Comparing scores obtained on the Self Report scales will show whether a Learner's MSC is positive or negative (Wilkins, 2004).

For this research, the Mathematics Self-Concept Questionnaire (MSCQ) constructed by Marsh (1998) having twenty two (22) items spread over four sub – scales, Mathematics Self Efficacy, Beliefs, Interest, and Anxiety will be adopted.

2.7 Cognitive Strategy Instruction (CSI)

The genesis of CSI lies in the cognitive psychological work conducted in the 1970's and 80's by the likes of John Flavel who began researching on how people understand and control their own learning processes, and his work became the foundation for much educational research in Metacognition.

Cognitive Strategy Instruction (CSI) is an explicit instructional approach that teaches Learners specific and general cognitive strategies to improve learner's performance by facilitating information processing. CSI embeds Metacognitive strategies in structured cognitive routines that help learners monitor and evaluate their progress during the learning process (Dole, Nokes, and Drits, 2009).

Before the researcher can address CSI, Metacognition must first of all be dealt with. What is Metacognition? Researchers have studied how to improve student's learning of Mathematics and have found that "doing Mathematics requires not only a knowledge of rules, facts, and principles, but also an understanding of when and how to use that knowledge" (Boekaerts, 1995).

The classical definition of Metacognition comes from Flavel's Seminar paper in 1976, "Metacognition" refers to one's own cognitive process and products or anything related to them, for example the learning of relevant properties of information or data. Metacognition refers among other things, to the active monitoring and consequent regulation and orchestration of these processes in relation to the cognitive objects on which they bear, usually in the service of some concrete goal or object.

Hacker, Dunlosky, &Graesser (2009) explained that Metacognition allows learners to take charge of their own learning. It involves awareness of how they learn, an evaluation of their learning needs, generating strategies to meet those needs and then implementing the strategies. In concise terms, Metacognition involves both conscious awareness and conscious regulation of one's learning (Wilson & Bai, 2010).

2.7.1 Cognitive Strategies

This is a mental routine or procedure for accomplishing a cognitive goal. An excellent description of Cognitive Strategies is given by Dijk and Kintsch (1993) in Dole, Nokes, and Drits (2008)

> "Thinking and problem solving are well known examples: we have an explicit goal to be reached, the solution of a problem, and there may be specified operations, mental steps, to be performed to reach that goal. These steps are under our conscious control and we may be at least partly able to verbalize them, so that we can analyze the strategies followed in solving the problem".

Cognitive Strategies, then are mental routines or processes for accomplishing cognitive goals like problem solving, studying for test or exams or understanding what is being learnt (VanDijk & Kintsch, 1993).

Cognitive Strategy Instruction is an instructional approach which emphasizes the development of thinking skills and processes as a means to enhance learning. It enables learners to become more strategic, self – reliant, flexible, and productive in their learning endeavors (Scheid, 2000). Cognitive Strategy Instruction is based on the assumptions that there are identifiable cognitive strategies, previously believed to be utilized by only the best and the brightest students which can be taught to most students. The use of these strategies have been associated with successful learning (Borkowski, Carr, & Pressley, 1997)

According to Read (2005), Cognitive Strategy Instruction is effective for a variety of learners, but particularly students with learning disabilities. However, research has shown that normal students who are actively involved in the education process, have better retention, motivation, and overall attitude towards learning.

BEESS(2010) gave the following list of Cognitive Strategies:

i. Survey, Question, Read (SQR)

ii. Frayer Model (Concept Mapping)

iii. Mnemonic Device

iv. Graphic Organizers

v. Self – Regulated Learning (SRL)

vi. Cooperative Learning

vii. Thinking Aloud

viii. Problem Solving

ix. Modeling

2.7.2 Aspect of Cognitive Strategy

Schoenfeld (2009), Veenman, Van Hout-Wolters and Afterback, (2006) stated that there are five (5) aspect of cognitive Strategy, viz:

- The Knowledge base
- Problem Solving Strategy (Heuristic)
- Monitoring and Control (Self – Regulation)
- Beliefs and Affects
- Practices.

(i). The Knowledge Base

This refer to the pool of information (resources) possessed by an individual learner that is relevant to the mathematical situation or problem at hand, and how this information/resources is/are accessed and used (Schoenfeld, 2009). He further explained that broadly speaking, aspect of the Knowledge base relevant for important performance in a problem include: informal and inductive knowledge about the problem; facts, definitions, algorithmic procedures, routine procedures, relevant competencies, and knowledge about the rule of problem solving. The main stream idea is that humans are information processors, and in their minds construct symbolic representations of the world (Schoenfeld, 2009, &Van Garderen, 2006).

An example will buttress the above statements. Suppose a learner finds him/her self in a situation that calls for the use of mathematics either for the purpose of interpretation or problem solving, then in order to understand the learner's behaviour, the following questions is asked. What information (Mathematical tools, skills, options etc) relevant to the Mathematical situation or problem at hand does he or she possess, and how is that information accessed and used? The facts, definitions, and algorithmic procedures that the learner brings to the problem determine to a large extent the degree of the use of his/her knowledge base (Schoenfeld, 2009).

(ii). Problem Solving Strategy (Heuristic)

Problem Solving as one aspect of Cognitive Strategy was propounded by Polya (1945), when he publish his famous book " Solve It". He later published another book " How to Solve it" in 1957 in which he presented four phases/principles or areas of problem solving which became the framework often recommended for teaching and assessing problem solving skills. These four principles are:

i. Understanding the problem
ii. Devising a plan to solve the problem
iii. Implementing the plan
iv. Reflecting on the problem.

(iii). Self – Regulated – Learning or Monitoring and Control

Self –Regulation or Monitoring and Control is one of the broad arenas of Cognitive Strategy (Schoenfeld, 2009). It deals with resource allocation during cognitive activity, and or problem solving. Zimmerman (2001) defined Self –Regulated Learning as " Learning that occurs largely from the influence of students' self generated thoughts, feelings, strategies, and behaviours, which are systematically oriented towards the attainment of goals". For example, as you work a mathematical problem, you may realize that the problem is more complex than you had thought at first. Perhaps, the best thing to do is to start over again, and make sure that you've fully understood it. Note, in the mist of intellectual activity, you keep tabs on how well things were going. If things appeared to be proceeding well, you continue along the same path but if they appeared to be problematic, you take stock and consider the options.

Monitoring and assessing progress and acting in response to the assessments of progress are the core components of Self –Regulation (Zimmerman & Schunk, 2001).

Zimmerman and Schunk (2011) stated that Self Regulatory Learning consist of three phases; Planning, Practice, and Evaluation. These three phases are also known as Forethought or planning, Performance control or Monitoring, and Self – reflection or Evaluation. It is a cyclical model as can be seen below.

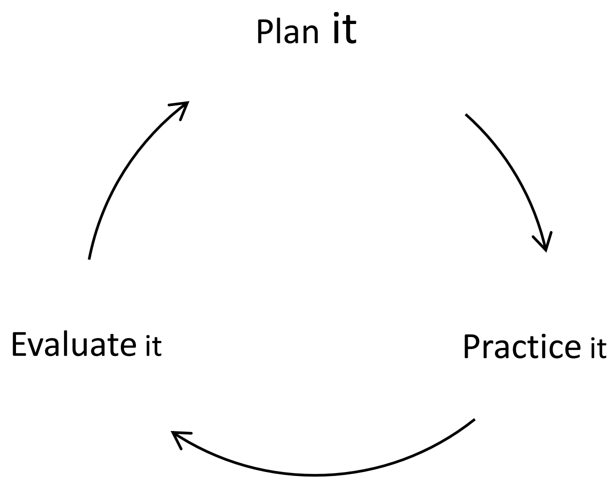

Fig. 2.1: The three Phases of Self - Regulated Learning by Zimmerman and Schunk.

A brief explanation of the model is given below.

Plan it: i. What is the problem?

ii. Set learning goals and make sure they are clear

iii. Review prior performance

iv. Conduct a task analysis of ways to approach the learning task

Practice it: i. Am I doing the plan correctly?

ii. Set processing goal to implement a learning strategy

iii. Self – observe your strategy behaviour and outcomes.

Evaluate it: i. Did the plan work?

ii. Self – evaluate strategy used and goal achievement

iii. Maintain or adapt the strategy.

This research will focused on the effect of Self – Regulated Learning as a Cognitive Strategy on Self- Concept and Academic Achievement in Mathematics.

(iv). Beliefs and Affects

Goldin (2002), defines belief as “multiply - encoded, internal cognitive/affective configurations, to which the holder attributes truth value of some kind (e.g., empirical truth, validity, or applicability)”. Beliefs are highly individualized and interwoven with affect – emotional feelings, attitudes, and values.

The Beliefs that a learner and or teacher holds about learning Mathematics have an ever – present impact on learning and teaching (Bergstresser, 2005). Knowledge also includes beliefs, whether factual or not, and beliefs are often intertwined with confidence and motivation, which can have a deep impact on a student’s academic performance (Lester, 1994)

Schoenfeld (2009) reported that Beliefs and Affects can be identified in the learner, the teacher, and, even the society in which both learner and teacher lives. He further stated that the beliefs a student holds about Mathematics have a significant relationship with the beliefs about the same subject in his society.

Student’s Beliefs

Schoenfeld (2009) opined that the beliefs a student holds about Mathematics have a profound effect on the student’s action and can shape what he perceives as the goals of Mathematical activity/learning. Examples of typical student’s beliefs about the nature of Mathematics include:

- Mathematics problems have one and only one right answer.
- There is only one correct way to solve any Mathematics problem – usuallythe rule the teacher has most recently demonstrated to the class.
- Ordinary students cannot expect to understand Mathematics; they expect simply to memorize it, and apply what they have learned mechanically and without understanding.

- Mathematics is a solitary activity, done by individuals in isolation.
- Students who have understood the Mathematics they have studied will be able to solve any assigned problem in five minutes or less.
- The Mathematics learned in school has little or nothing to do with the real world.
- Formal proof is irrelevant to processes of discovery or invention.

Yoong (2002) stated that it is obvious students do not learn Mathematics in the same way. The differences are constrained by Belief systems constructed by students about the nature of Mathematics and how it should be learned. These differences are the outcomes of many years of in-class and out of class experiences working on Mathematical task.

Teacher's Beliefs

It is well known that good teachers have immense impact on students understanding, quality of learning, and student achievement. Belief structures are important not only for students, but for teachers as well because the teacher's sense of Mathematical enterprise determines the nature of the classroom environment that he creates. However, if students' beliefs can be positively influenced by their teachers, then students' actions can be positively influenced, which means that students' achievement in Mathematics will improve (Schoenfeld, 2009 & Smith, 2014). Examples of teacher's beliefs include:

- Mathematics can be best understood by rediscovering its ideas.
- Discovery and verification are essential processes in Mathematics.
- The main objective of the study of Mathematics is to develop reasoning skills that are necessary for solving problems.
- The teacher must create and maintain an open and informal classroom atmosphere to insure the students' freedom to ask questions and explore their ideas.

- The teacher should encourage students to guess and conjecture and should allow them to reason things on their own rather than show them how to reach a solution or an answer.
- The teacher should appeal to students' intuition and experiences when presenting the material in order to make it meaningful.

A teacher's conception of Mathematics instructions can be characterized in terms of his/her role in teaching the subject matter. For example, if a teacher beliefs in learning Mathematics for examination purposes only, then he will direct his teaching towards showing learners how to tackle examinations questions only to the detriment of learning Mathematical concepts (Efklides, 2011). Phipps (2007) opined that "It is evident that teachers' beliefs about teaching and learning have powerful effect on teachers' pedagogical decisions. What they think and do is the reflection of their beliefs".

Societal Beliefs

Mathematics is the product of Society and the Beliefs held by a particular society whether conscious or unconsciously, shapes Mathematical behaviour both in the teacher and learner. These beliefscan be organized into three broad categories: beliefs about what is possible, (i.e. what children are able to learn about Mathematics at different ages); beliefsabout what is desirable (i.e., what children should learn); and beliefs about whatis the best method for teaching Mathematics (i.e., how children should be taught), (Stigler & Perry, 1989, in Schoenfeld, 2013).

(v). Practice

This refer to the epistemological activities which teachers and learners engaged in as they either teach or assert and examined hypotheses about a Mathematical structure /problem that underlie their solution respectively (Lampert, 2010).

The Beliefs and Affects above exerts to a large extent consequences for teachers Mathematics to enter into a wrong kind of Mathematical practice, which may results in using an unfair approach to Mathematics instruction. Practice on the part of the teacher maybe in methodology, sequencing of topics, resourcefulness, and how he can bring the practice of knowing Mathematics in the school closer to what it means to know Mathematics. While on the part of the learner, Practice involves developing a good understanding of Mathematical subject matter as demonstrated in their ability to solve a substantial collection of exercises on topics and concepts that were taught to them (Schoenfeld, 2013).

2.7.3 Theory of Cognitive Strategy

The theoretical underpinnings of CSI are rooted in both Cognitive and Behavioral Theories of Learning (Kwarec and Montague, 2012).

The Cognitive Theory of Learning explains why the brain is the most incredible network of information processing and interpretation in the body as we learn. It is divided into two broad specific theories, the Social Cognitive Theory, and the Cognitive Behavioral Theory (Sincero, 2016). In the Social Cognitive Theory, three variables are considered, viz Behavioral factor, Environmental factor (Extrinsic), and Personal factors (Intrinsic). Meanwhile, the Cognitive Behavioral Theory describes the role of Cognition (Knowing) to determining and predicting the behaviour pattern of a learner. The theory also says that individuals tend to form Self – Concepts that affects the behavior they display. These Concepts can be positive or negative and can be affected by a person's environment. (Sincero, 2016).

The Cognitive Learning Theory, according to Seliko, Erisen, and Sahin (2016), it implies that the different processes concerning learning can be explained by analyzing the mental processes first. They posits that with effective Cognition processes, learning is easier and new information can be stored in the memory for a long time. On the other hand, ineffective

Cognition processes results to learning difficulties that can be seen anytime during the lifetime of an individual.

2.7.4 Models/Skills of Cognitive Strategy

Cognitive Strategy Instruction consists of models/Skills which several authorities have given and the following are some of them.

Toit and Kotze (2009) enumerated the following Cognitive Skills

i. Planning strategy

At the start of a learning activity, teachers should make learners aware of skills, rules and steps in problem solving. Time restrictions, goals and ground rules connected to the learning activity should be made explicit and internalized by the learners. Consequently, learners will keep them in mind during the learning activity and assess their performance against them. During the learning activity, teachers can encourage learners to share their progress, their cognitive procedures and their views of their conduct. As a result, learners will become more aware of their own behaviour and teachers will be able to identify problem areas in the learners' thinking.

ii. Generating questions

Learners should ask themselves what they know and what theydo not know at the beginning of a research activity. As the learning activity progresses, their initial statement about their knowledge of the learning activity will be verified, clarified and expanded. Learners should pose questions for themselves before and during the learning process and pause regularly to determine whether they understand the concept; if they can link it withprior knowledge; if other examples can be given; and if they can relate the main concept to otherconcepts. Thisintegration of prior knowledge and new concepts enables the learner to understand the unified andinterconnected nature of knowledge, while also facilitating profound understanding of subject matter.

iii. ***Choosing consciously***

Teachers should guide learners to explore the results of their choices before and during the decisionprocess. Therefore, learners will be able to recognize underlying relationships between their decisions,their actions and the results of their decisions. Non-judgmental feedback to learners about theconsequences of their actions and choices promotes self-awareness, and it enables thelearners to learn from their mistakes, thereby supporting the principle of the understanding and actively building new knowledge from previous experience.

iv. ***Setting and pursuing goals***

Goals are defined as expectation about the intellectual, social and emotional outcomes for learners as a consequence of their classroom experiences. Learners who are self – regulatingstrive to attain a self-formulated goal while self-regulated behaviour can be adapted withchanging circumstances. The teacher should encourage learners to set attainable goals for themselves before being exposed to the learning experiences in the classroom.

v. ***Evaluating the way of thinking and acting***

Cognitive Skills can be enhanced if teachers guide learners to evaluate their learning activity. Learners could be asked toassess the learning activity by stating helpful and hindering aspects and their likes and dislikes of the Mathematical concept or activity. Guided self – evaluationcan be introduced by the teacher to help learners focus on thinking processes.

vi. Identifying the difficulty

Teachers must discourage learners from the use of phrases like “I can’t”; “I am too slow to…”;or “I don’t know how to…”. Rather, learners should be encouraged to identify the resources, skills and informationrequired to attain the learning outcome. As a result of this, learners are assisted to distinguish between theircurrent knowledge and the knowledge they need. They also have more conviction in seeking the rightstrategy for solving the mathematical problem.

vii. Paraphrasing, elaborating and reflecting learners’ ideas

Teachers should support learners to restate, translate, compare and paraphrase other learners’ ideas. Consequently, learners will be better listeners to other learners’ thinking and also to their own thinking. The ability to reflect as a prerequisite forarticulation requires the identification of the essence and critical elements of anactivity.

viii. Clarifying learners’ terminology

Learners regularly use vague terminology when making value judgments, for example “The question isnot fair” or “The question is too difficult”. Teachers should elucidate these value judgments, for example“Why is the question not fair?” or “Why is the question too difficult?”. This helps in clarifying the terms of the learner’s thinking.

ix. Problem-solving activities

Problem-solving activities are ideal opportunities to enhance cognitive strategies, as good problem solvers are generally self-aware thinkers. Learners with superiorcognitive abilities are better problem solvers. The ability to analyze their problem-solving skills and reflect on their thinking reveals the learners’cognitive skills.

Problem solving provide learners with a range of problem-solving skills (heuristics), and trains them to use those skills effectively which promotes the use of Self-Regulated strategy, for example, the teacher informs the learners that they are going to be asked the followingquestions whenever they work on a problem: “What exactly are you doing?”; “Why are you doing it?”; and “How does it help you?”. Gradually, it becomes a matter of practice for the learners to start asking the questions themselves, thereby improving their problem-solving skills and operation on a cognitive level.

x. Thinking aloud

Teachers should promote the habit of thinking aloud when learners solve problems Talking about their thinking will help learners to identify their thinking skills. Muijs (2009) used the term “articulation” to describe learners’ expression of their own thoughts and ideas and recommend that learners should discuss complex tasks and present their ideas tofellow learners. They furthermore suggest that group work could be very effective in promoting the cognitive skill of Thinking Aloud. In this regard, Blakey and Spence (1990) mention paired problem solving, where onelearner describes his/her thinking processes while his/her partner helps him/her to clarify his thinking bylistening and asking questions. Learners are taught to use the following four questions whensolving problems: “What is my problem?”; “How can I do it?”; “Am I using my plan?”; and “How did I*do”*?which consequently leads to improvement in Self control learning.

xi. Journal-keeping

Keeping a personal diary throughout a learning experience facilitates the creation and expression ofthoughts and actions. Learners make notes of ambiguities, inconsistencies, mistakes, insights, and ways tocorrect their mistakes. Preliminary insights can be compared with changes in those insights as moreinformation is gathered or obtained through feedback from assessment which supports the learning of mathematics. Costa and McCrae (2001),Blakey& Spence(1990), NCTM, (2000).

xii. Cooperative learning

Cooperative learning creates the opportunity for learners to work together in small groups to enhancelearning. It entails more than group work, as group work is considered a modification of whole – classdiscussion. In cooperative learning, the teacher gives indirect guidance as the group works together toachieve specific learning outcomes (Killen, 2007). Cooperative learning may promote awareness oflearners' personal thinking and of others' thinking. When learners act as "tutors", the process of planningwhat they are going to teach, lead to independent learning and clarifying the learning material (Blakey &Spence, 1990).

xiii. Modeling

Modeling occurs when teachers demonstrate the processes involved in performing a difficult task, or when teachers tell learners about their thinking and the motivation for selecting certain strategies when solving problems (Muijs 2009). Modeling enhance learners' thinking and talking about their own thinking (Blakey & Spence, 1990) and the chief purpose of Modeling strategy is to create awareness of Cognitive behaviours. Costaet tal (2001) suggested that modeling could be the most effective strategy used to enhance Cognitive skills acquisition among learners because they learn best by imitating adults.

2.7.5 Application of Cognitive Strategy to Education

Teachers will, by the implementation of these Cognitive Strategies demonstrate learners' thinking processes. Van der Walt and Maree (2007) found out that Mathematics teachers employed question-posing strategies and think-aloud models, butthat they did not sufficiently promote the implementation and practice of these strategies among learners.

Aspects that denote teachers' modeling behaviour include explaining their planning, goals and objectivesto the learners and motivating their actions; acknowledging their temporary inability to answer a question,but developing pathways for finding the answer; making human mistakes, but demonstrating how tocorrect those mistakes; requesting comments and assessment of their actions; acting in accordance withan explicitly stated value system; the ability to explain what their strengths and weaknesses are; andexpressing an understanding and valuing of learners' ideas and feelings (Costa et tal 2001).

2.8 Self – Regulated – Learning (SRL) or Monitoring and Control

Self –Regulated or Monitoring and Control is one of the broad arenas of Cognitive Strategy in Metacognition (Schoenfeld, 2009). It deals with resource allocation during cognitive activity, and or problem solving. Zimmerman (2001) defined Self – Regulatory Learning as

> *" Learning that occurs largely from the influence of students' self generated thoughts, feelings, strategies, and behaviours, which are systematically oriented towards the attainment of goals".*

For example, as you work a Mathematical problem, you may realize that the problem is more complex than you had thought at first. Perhaps, the best thing to do is to start over again, and make sure that you've fully understood it. Note, in the mist of intellectual activity, you keep tabs on how well things were going. If things appeared to be proceeding well, you continue along the same path but if they appeared to be problematic, you take stock and consider the options.

Self –Regulatory Learning can also be defined as an active, constructive process whereby learners set goals for their learning and then attempt to monitor, regulate, and control their cognition, motivation, and behaviour, guided by their goals and the contextual features in the environment, (Wolters, Pintrich, & Karabenic, 2003)

Zumbrunn, Tadlock, and Robert (2011) define Self-Regulated Learning as a process that assists students in managing their thoughts, behaviors, and emotions in order to successfully navigate their learning experiences. This process occurs when a student's purposeful actions and processes are directed towards the acquisition of information or skills.

Self – Regulated – Learning(SLR) is recognized as an important predictor of student academic motivation and achievement. This process requires students to independently plan, monitor, and assess their learning. A self-regulated learner is someone who is actively involved in maximizing his or her opportunity and ability to learn. This involves not only exerting control over cognitive activity, but also developing strategy skills that enable theregulation of attitudes, environments and behaviours to promote positive learning outcomes (Darr & Fisher, 2004).

2.8.1 Theories of Self – Regulatory Learning

In a discussion of the nature of self-oriented feedback loop, Zimmerman (1990) came up with a classification of theories of self-regulated learning:

- ***Phenomenological Theories***(McCombs, 1986, 1989): These theories delineate self-oriented feedback loop in terms of covert perceptual processes. These theories claim that Self – Regulated Learning is informed by a universal sense of Self – Actualization and Self – Esteem.

- ***Operant Theories***(Mace, Belfiore, & Shea, 1989): These theories depict and favor overt descriptions such as Self – Instruction, Self – Recording, Self – Reinforcement, etc. Operant theories maintain that external reward/punishment (e.g., social approval, enhanced status, material gain, promotion, etc.) determine Self – Regulated Learning responses.
- ***Social Cognitive Theories***(Bandura, 1989): Unlike the previous theories, these focus on the positive aspects of feedback. These theories claim that such factors as Self – Efficacy,achievement success, cognitive equilibrium, and the like are the actual drive behind Self – Regulation.

2.8.2 Models/Phases of SRL

In some of the literatures that i consulted, different models of SRL include elements such as planning, goalsetting, monitoring and controlling the progress towards the learning goal (Zimmerman, 2001; Pintrich, 2000; Winne & Hadwin, 1998; Boekaerts, 1996).

These models describe SRL as a continuum of three to fourlearning phases that lead to students' SRL by building on the previous phases (Pintrich, 2000; Winne & Hadwin, 2008). It is assumed that these phases canoccur multiple times during a single learning situation or across several learningepisodes, but they do not necessarily unfold in order.

Malmberg (2014), opined thatthe models that describe SRLshare a similar architecture in terms of the phases that occur during the SRL cycle, however they may differ in which aspects of SRL. For example, Zimmerman (2011) and Pintrich (2000) focus mainly on the motivational aspectsof SRL, whereas Winne and Hadwin (1998) focus more on the cognitive aspects.

Most of the literatures agree that Self – Regulated Learning is a multi – dimensional process in which there is a set of three or four recurring phases, in a general time – ordered sequence, that materialize with the attainment of Self – Regulation skills (Zimmamann, 2001). This research will look at four (4) models viz:

1. Winne and Hadwin (1998) model,
2. Boekaerts (1996) model,
3. Pintrich (2004) model, and
4. Zimmerman (2009) model.

(i). Winne and Hadwin Model of SRL

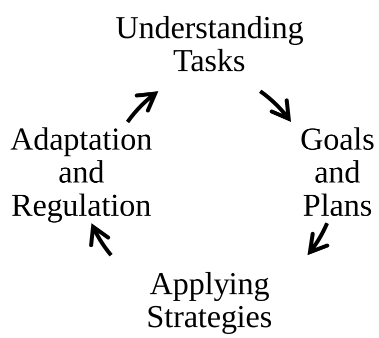

Fig. 2.2: *Winne and Hadwin SRL Model*

Winne and Hdwin (2009) postulated that SRL comprises of four phases:

i. **Defining the task**:Learners gather information about the task at hand and personalize their perception about it. This stage involves determining motivational states, self – efficacy, and information about the environment around them

ii. **Setting goals and planning**: At this stage, learners set goals and plan how to accomplish the task. Several goals may be set concerning explicit behaviours, cognitive engagements, and motivation changes. The goals that are set depend on how the learners perceive the task at hand.

iii. **Enacting tactics/Applying strategies**: Learners carry out the plan they have developed by using study skills and other tactics useful which they have in their repertoire of learning strategies.

iv. **Adaptation**: Here learners evaluate their performance and determine how to modify their strategy in order to achieve higher performance in the future.

(ii). Boekaerts Model of SRL

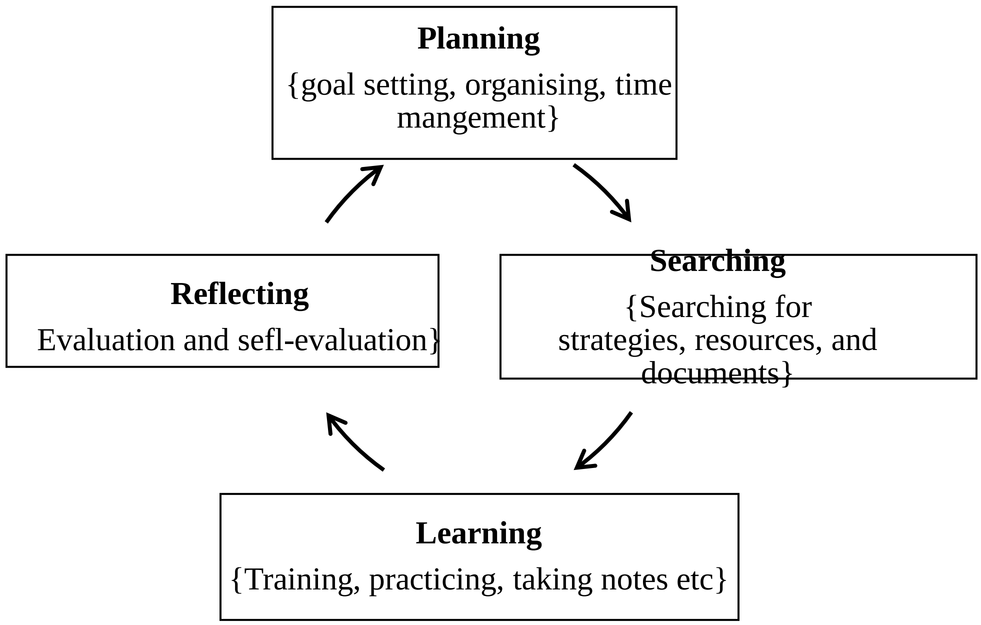

Fig. 2.3: *Boekaerts SRL Model.*

Boekaerts (1996), gave the following phases of SRL:

i. **Planning**: This stage involves goal setting, organizing, and time management.

ii. **Searching**: Searching for strategies to use, resources, and documents which are relevant to the task plan in the planning stage.

iii. **Learning**: This involves training, practices, taking notes, etc

iv. **Reflecting**: It involves evaluation, and self – evaluation.

(iii). Pintrich Model of SRL

Pintrich (2004) model of SRL is given as:

i. F**orethought**: includes planning, goal-setting and activation;

ii. **Monitoring**: includes monitoring of the learning process;

iii. **Management or control:** includes use of regulation and control strategies; and

iv. **Reflection**: includes evaluations, judgments, and attributions (after the learning episode).

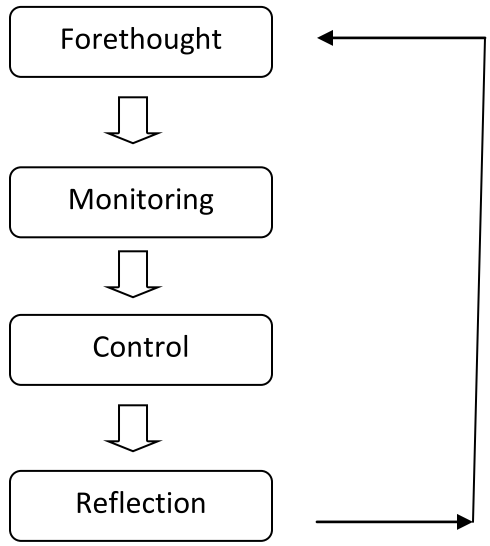

Fig. 2.4: *Pintrich Model of SRL*

(iv). Zimmerman Model of SRL

This model consists of the following:

i. **Forethought/Pre-action**: This phase precedes the actual performance, sets the stage for action, maps out tasks to minimize the unknown, and helps to develop a positive mindset. Realistic expectations can make the task more appealing. Goals must be set as specific outcomes, arranged in order from short to long term. Here, learners consider the following questions;

- when will I start?
- Where will I do the work?
- How will I get there?

- What conditions will help or hinder my learning activities are part of this phase.

ii. **Performance control**: This phase involves processes during learning and the active attempt to utilize specific strategies to help a student/learner become more successful. The following questions becomes relevant at this phase;

- Are the learners accomplishing what they hoped to do?
- Are they being distracted?
- Is the task taking more time than they thought?
- Under what conditions do they accomplish the most?
- What questions can they ask themselves while they are working?
- How can they encouraged themselves to keep working?

iii. **Self – reflection**: This level involves reflection after the performance, a self – evaluation of outcomes compared to the goals set. The following questions should be addressed;

- Did the learners accomplish what they planned to do?
- Where they distracted and how did they get back to work?
- Did they plan enough time or did they need more time than they thought?
- Under what conditions do they accomplish the most work?

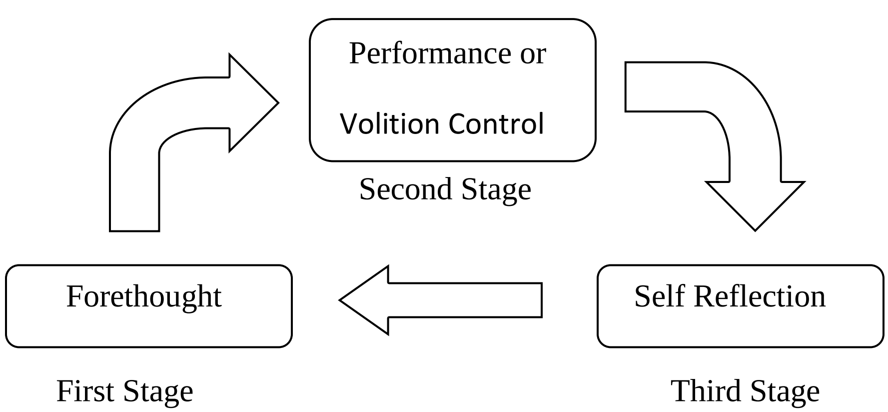

Fig. 2.5:Zimmermann Modelof SRL

2.8.3 Characteristics of Self – Regulated Learners

In general, studies show that the following characteristics differentiate between Self - Regulating and non Self – Regulatingstudents (Sardareh, Saad, & Boroomand, 2012):

- Self - Regulated Learners are familiar and know how to apply a series of cognitive strategies (rehearsal, elaboration, organization) which help them to attend to, transform, organize, elaborate, and recover information (Winne, 1995; Zimmerman, 2001).
- They know how to plan, control, and direct their mental process toward achievement of personal goals, i.e., Metacognition (Corno, 2001).
- Self – Regulated students show motivational beliefs and adaptive emotions such as a sense of academic self efficacy, the adoption learning goals, the development of positive emotion towards tasks (e.g. joy, satisfaction, enthusiasm) and the capability to control and modify them to the requirements of the pre set task and the specific learning situation (Weinstein, Husman & Deirking, 2000; Zimmerman, 2002).
- They plan and control the time and effort to be spent on tasks, and they know how to create and structure favorable environments, such as finding a suitable place to study and seeking help from teachers and classmates when they encounter problems (Corno, 2001; Winne, 1995; Zimmerman, 2001).
- To the extent allowed by the context, Self – Regulated Learners show greater efforts to participate in controlling and regulating academic tasks, classroom climate, and structure(Corno, 2001; Weinstein, 2000; Zimmerman, 2002).
- Self – Regulated Learners are able to effect a series of volitional strategies aimed at avoiding external and internal distractions so that they maintain their concentration,

effort and motivation in performing tasks (Weinstein, Husman, & Deirking, 2000; Zimmerman,2001, 2002).

2.8.4 Encouraging Self – Regulated – Learning

Studies by Yara (2010) on students' self-concept and Mathematics achievement in some secondaryschools in Southwestern Nigeria revealed that students with good Self – Regulated skills perform well in Mathematics.

Thus, creating SRL environments for learnerscan pose challenges to even the most experienced teachers, and a great deal of literature showcases a variety of effective instructional strategies for encouraging Self – Regulation in the classroom (Andreassen & Braten, 2011; Dignath & Buettner, 2008). Some of these strategies include direct instruction, modeling, guided and independent practice, social support and feedback, and reflective practice. (Zumbrunn, Tadlock, & Roberts, 2011).

(i). Direct Instruction and Modeling

Direct instruction involves explicitly explaining different strategies to students, as well as how those strategies are used and what skills are involved in using those strategies (Zimmerman, 2008). The focus of this kind of instruction is modeling and demonstration. When teachers model and explain their own thought processes necessary for completing activities and assignments, students are more apt to understand and begin to use those same processes on their own (Boekaerts & Corno, 2005). Zimmerman (2000), observed that direct instruction may not be necessary for encouraging SRL in all learners, it may be essential for most learners especially younger learners as many fail to independently use SRL strategies effectively. However, research has shown that this type of instruction can be the best initial strategy for encouraging students to be more self-regulative in their learning (Montalvo & Torres,2008).

(ii). Guided and Independent Practice

Guided practice is another way teachers can help improve SRL (Lee, McInerney, & Liem, 2010). During guided practices, the responsibility of implementing the learning strategy shifts from teacher to learners. Student-teacher conferencing is one way teachers can help guide learners in setting goals and monitoring their strategy use and progress, as conferences tend to promote student thinking and learning (Montalvo & Torres, 2008).

Independent practice should naturally follow guided practice. During this process, students are given opportunities to practice the strategy on their own, which can ultimately reinforce autonomy. Although direct and explicit strategy instruction can be powerful on its own, students are less likely to incorporate the SRL strategy into their academic routines without guided and independent practice (Lee e-tal, 2010).

(iii). Social Support and Feedback

Social support from teachers and peers can play an important role as students are learning to be more self-regulative. Findings from a study showed that task engagement and the use of SRL strategies was more prevalent in students that regularly received support from their teacher and peers (Patrick, Ryan, & Kaplan, 2007). Often, social support comes in the form of feedback and research by Labuhn, Zimmerman, and Hasselhorn, (2010), indicates that effective feedback includes information about what students did well, what they need to improve, and steps they can take to improve their work(Labuhn, Zimmerman, and Hasselhorn, 2010). This type of feedback is often referred to as progress feedback, which assist students in improving their academic achievement and it also can promote student motivation and self-Regulation(Duijnhouwer, Prins, & Stokking, 2010).

Labuhn et al., (2010) examined the effects of teacher feedback on the use of SRL strategies to improve mathematics achievement of fifth grade students. Results indicated that students who received feedback from their teachers were more likely to accurately use SRL strategies to improve their Mathematics scores.

(iv). Reflective Practice

Reflective practice, or adapting and revising pedagogical styles to accommodate students might be the most important and effective tool a teacher can use (Gibson, Hauf, & Long, 2011). This practice enables teachers to investigate the possible reasons explaining the effectiveness of a given instructional strategy used in the classroom. Through thoughtful reflection, experimentation, and evaluation, teachers can better create meaningful learning experiences for their students (Gibson, Hauf, & Long, 2011).

2.8.5 Challenges to Promoting Self-Regulated Learning in the Classroom

Though most teachers would agree that teaching students to be more Self – Regulative in the classroom would be ideal, the practice does not come without challenge. Developing lessons that prepare students to engage in SRL practices and provide real support and opportunities for implementation is no small feat (Paris & Winograd, 2003). Many will find that the major obstacle in helping students become Self-Regulative is the time required to teach students how to use specific strategies (Boekaerts & Cascallar, 2006).

Often teachers are pressed to accomplish many tasks in limited time spans, it is important to remember that SRL strategies can help students learn new information and effectively prepare for those very tasks (Paris & Winograd, 2003). Fundamental changes at the school level may need to occur for teachers to be able to allocate the time and resources necessary for preparing students to be self-regulated learners. Most importantly, classroom curriculum and accompanying assessment systems must be organized in ways that support and value autonomous inquiry and strategic problem-solving (Patrick & Ryan, 2007).

Understanding that factors outside of the teacher's control can have a major impact on the development of a student's ability to Self – Regulate also, can prove to be a challenge. For example, how students choose to approach and monitor their learning is usually consistent with their preferred or desired social identity (Cleary, 2006), which can have little to do with a teacher's instruction. Ommundsen, Haugen, and Lund (2005) opined that students with identities consistent with intellectual curiosity may be more apt to engage in SRL learning which is supported by Wang and Holcombe (2010). Ultimately, students' social identities can influence their academic behaviors and educational goals (Montalvo & Torres, 2008).

Another challenge is when teachers of Mathematics encounter the problem of students or learners who had lost concern with understanding of Mathematics and are focused on solely attaining a passing grade in Mathematics, (Hotard, 2009).

2.9 Empirical Review of Related Literatures.

There abound unlimited research literature that has been conducted to examine the relationship among Self – Regulated – Learning Strategy, Mathematics Self – Concept, and Academic Performance (Him, 2006; Zimmermann,1990; Callan, 2014; Ajayi, Lawani, & Adeyanju, 2011; Wang, 2007; Otts, 2010; Battin, 2015; Emmanuel, Adom, Josephine, & Solomon, 2014;

This study is focused on the Effect of Self – Regulated – Learning Strategy on the Self – Concept and Academic Performance among Integrated Science students, thus the researcher consulted the following related literatures.

Maryam, Farideh, and Sadegh (2016) in their research investigated the relationship between Self – Regulation – Learning Strategies and Mathematical Self-Concept on Motivation of Mathematical Achievements among 420 third grade students of secondary school in Tehran. Sample comprised of 420 individuals that were selected by random multistage cluster sampling technique and the Self – Regulation Questionnaire, Mathematical Self-Concept Questionnaire and the Motivation of Mathematical Achievements Questionnaire were all administered to these subjects. Data was analyzed by using correlation coefficient and stepwise regression analysis. The result showed that SRL became the strongest predictable motivation of approach achievements on Mathematics Self – Concept of the students.

In another study carried out by Koshkouei, Shahvarani, and Behzadi (2015) to investigate the influence of Mathematics Self – Concept (MSC), Motivation to learn Mathematics (MTLM) and Self – Regulation- Learning (SRL) on students' Mathematics Academic Performance. This study is a descriptive survey type with 300 female students at the first grade of high school selected by multiple step cluster sampling method and completed MSC, SMOT and SRL questionnaires. Mathematics academic performance was measured by mathematics scores in the first semester of 2013 – 2014 education sessions. Results obtained by data analysis indicated that the primary conceptual model of the research was an appropriate model and possesses good fitness. Therefore, influence of Mathematics Self – Concept, motivation to learn mathematics and self-regulation learning on Mathematics Academic Performance was confirmed. On the other hand, it was revealed that Mathematics Self – Concept had influence on Motivation to learn Mathematics, and Motivation to learn Mathematics had effect on Self – Regulation Learning.

Ajogbeje (2010) in his research, Self – Concept as Predictor of Mathematics achievement among Secondary schools in Ado – Ekiti, Nigeria, investigated the relationship between Self –

Concept and students' academic achievement in Mathematics. The sample consists of 205 girls and 245 boys randomly selected from four girls and four boys schools in Ado – Ekiti state. In order to determine the degree of relationship between students' achievement and Self – Concept, step – wise multiple regression analysis was computed at 0.05 significant levels. The result of the study showed that there is a significant relationship between Self – Concept and Mathematics achievement of secondary schools students', and that mathematics achievement could be predicted moderately by Self – Concept. However, it creates a conflict with the common view that Self – Concept and achievement patterns may be positively and highly correlated. Thus, its implication is that there is need for counseling programmes both at individual and group level focusing on enhancing emotional and social comfort and the holistic Self – Concept of college students.

Onyilo and Onyilo (2010), conducted a research on Academic Performance and Self – Concept of male and female secondary school students in Gwagwalada Area council of the Federal Capital Territory Abuja , Nigeria. Four research questions were raised and four hypotheses were generated and tested to guide the study. The research sampled 400 respondents (200 males and 200 females) who were randomly selected from 12 secondary schools within Gwagwalada Area Council.

Results from the data analysis showed that Academic Performanceand Mathematics Self – Conceptwere discovered to be gender sensitive. Some problems discovered were that male students had greater time to play outside school, while female students were always engaged in domestic work. So, the paper concluded with recommendation for the school and the Government to encourage the development of positive Mathematics Self – Concept in female students.

Dramanu and Balarabe (2013), in a research, investigated the relationship between Academic self – Concept and academic achievement of junior High school students in Ghana. Differences between the academic Self – Concept of male and female students as well as students from Urban and Rural schools were also investigated. Participants were 756 male and 714 female JHS II students randomly selected from 24 Junior High schools through stratified sampling. Two research instruments, namely Achievement test in Mathematics, English language, Social studies, and Integrated Science, and academic Self – Concept scale with a Cronbach alpha reliability coefficient of 0.84 were used to collect data. Statistical analysis was done using the PPMC and*t* – test.

Results showed a positive relationship between Academic Self – Concept and Academic Performance of students. A significant difference was also found between the academic Self – Concept of students in urban and rural schools, with students in urban schools recording higher scores.

The Educational implication of this study supports the view that academic Self – Concept correlates positively with academic performance.. Individuals with high academic Self – Concept are more likely than those with low academic Self – Concept to study hard in order to perform well academically. In addition gender difference in the academic Self – Concept of students was not found in the study, that is, male and female students had the same level of academic Self – Concept.

Ayodele (2011), undertook a study to investigate the relationship between Mathematics Self – Concept and Performance of secondary school students' in Mathematics. Random sampling technique was used to select 320 SSI students (male = 160, female = 160) from 16 secondary schools in 8 LGA's in Ekiti state. Data was collected using a 20 – item Self – Concept questionnaire and a 30 – item multiple choice Mathematics Performance Test with reliability coefficient of 0.74 and 0.83 respectively, and analyzed using PPMC and t – test statistic tested at $p \leq 0.05$level of significance. The result of the study showed that Self – Concept moderately correlated with performance in mathematics, while gender had no significant influence on Self – Concept and Performance in Mathematics. One of the implications on the teaching – learning process is that teachers are encourage to present pleasant teaching experiences to enhance higher and positive Self – Concept in learners that will result in better performance in Mathematics.

Altu and Erden (2013) in a Correlational study aimed at determining whether Mathematics Performance can be explained in terms of Self – Regulation based learning Strategy and Self – Efficacy perceptions, and whether these differ between genders. The sample consists of 473 freshmen (329 male and 473 female) at Yildiz Technical University who were attending the Mathematics course I. The instrument used is the Motivated strategies for learning questionnaires developed by Pintrich et al and students examinations results which were used to collect data for the Correlational study.The findings indicates that Metacognition, Self – Regulation, regulation of time and study environment, help seeking, and Self – Efficacy perceptions were significant factors in explaining mathematics achievement while effort regulation was not. It was also concluded that there was a difference the genders.

Anyichie and Onyedike (2012) conducted a research to determine the effect of Self – Instructional learning strategy on secondary school students' academic achievement in solving mathematical word problems in Nigeria. The study utilized the non – randomized control group pre – test post – test experimental design, while the sample consisted of 131 students randomly selected from four schools. Students of the experimental group were instructed in four units of Mathematics syllabus using Self – Instructional method and on the other hand, the control group was taught the same topics in Mathematics syllabus using the conventional teaching method. Mathematics Achievement test instrument was used to collect data which was analyzed using the two – way ANCOVA at $p \leq 0.05$ level of significance. Major findings of the study indicate that there was significant main effect of the treatment (SRL) on the students' Mathematical word problem achievement, and it was also concluded that there is a significant interactional effect between gender and learning strategy of students trained in Self – Instructional strategy as male subjects achieved higher than females.

One of the educational implication of the study is that it provides empirical evidence that Self – Instructional strategy can affect both Cognitive and Metacognitive domains of students. SRL also increased students' problem solving skills, thus it became imperative for teachers to model and use SRL while instructing or doing their own study.

In yet another research by Loong (2013), he examined any difference in the use of SRL strategies between domestic and international students and mathematics achievement. A sample of 32 (16 male, 16 female) domestic and 38 (21 male, 17 female) international students who are in their first semester for a Pre- University programme in Malaysia were used for the research. All subjects came from classes of mathematics subjects, and were taught by the same instructor. The survey method was conducted with the administration of mathematics achievement test where their score were obtained, and ANOVA was used to examine the difference between domestic and international students while PPMC was used to measure the relationship between SRL and mathematics achievement.Results shows that international students are able to use more SRL strategies than their domestic counterparts, and anxiety subscale is significantly related to Mathematics achievement.

Bozpolat (2016) undertook a study to examine whether SRL can be a predictor of academic achievement, Self – Efficacy, and general Academic Performance. The sample of the study consisted of 826 students in their third year from 11 departments of the Education Faculty of Cumhuriyet University, Turkey. The tool for data collection is the "Academic Self-Efficacy Scale," developed by Kandemir and Özbay (2012), the "Self – Regulated – Learning Strategies Scale" developed by Kadıoğlu et al. (2011). For the data analysis, Cluster analysis of the dependent variable and the three-category ordinal logistic regression analysis was used, and on examining the result of the logistic regression analysis, it could be seen that gender, general academic average, and academic self-efficacy of the students predicted the Self – Regulated Learning strategies to a significant level.

One implication of this study on Education is that, SRL Strategy is evidently established to affect academic achievement. It is therefore recommended that seminars for the students may be organized to ensure that they develop Self – Regulation skills.

2.9.1 Implications of the Reviewed Literatures to the current Study.

After reviewing the above relevant literatures on the effect of SRL strategy on both Mathematics Self – Concept and Academic Performance of learners, the reviewed literatures established that SRL Strategy to a high level affect the Mathematics Self – Concept and Academic Performance of learners in Mathematics (Mega, Ronconi, & Beni, 2013; Mih & Mih, 2011; Kumari, 2013; Trautwein & Ludtke, 2006; Lawani, Adeyanju,& Ajayi 2011).

The teaching – learning process involves activities both within and outside the school setting in relation to the educational practice inherent in the educational system. Thus, the implications of these reviewed literatures to the present study will be summarized as follows: Learners can potentially monitor and regulate their cognition, behavior, and motivation processes. They can actively construct their own goals and meanings derived from both learning context and their prior knowledge, thus learners engage in a constructive process of learning. Also learners' behavior is goal – directed and the process of Self – Regulation includes modifying behavior to achieve goals, and mediating the relationship between the learners' performance and individual characteristics.

The reviewed literatures have confirmed that SRL training among learners can be done effectively at all levels of the educational processes as this present study aims at the Integrated Science students in a teacher training Institution. It presented SRL strategy as a transferable cognitive process to other area of knowledge (Trautwein & Ludtke, 2006).

Teaching is going through innovation and the need for effective and feasible methods of instruction, thus SRL provides a perspective on instruction that is valuable, and can help promote the kinds of classroom norms, which will support the development of powerful learning and learners (Darr & Fisher, 2004).

Several questions emerged out of the literatures reviewed above, and they may well serve as research topics for future discussions in educational work. Some of the questions are: What relations exist between SRL Strategy and Metacognitive regulation?, What physiological factors will explain the development of SRL strategy among learners?, and to what extent educational interventions target the development of SRL strategy that would impact on the other cognitive strategies (Mih & Mih, 2010)

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This study investigated the effect of SRL Strategy on the Mathematics Self – Concept and Academic Performance among Integrated Science students of Kaduna and Nasarawa State Colleges of Education. In this chapter, the procedure for the research methodology was carried out under the following sub – headings:

3.2 Research design

3.3 Population

3.4 Sample and sampling technique

3.5 Instrumentation

3.5.1 Validation of instrument

3.6 Pilot study

3.6.1 Reliability of instrument

3.7 Administration of instrument

3.8 Data collection procedure

3.9 Procedure for Data analysis.

3.2 Research Design

The study was based on Survey and Quasi experimental Pre – Test/ Post – Test control group design.

The Survey design examined the effect of Self – Regulated – LearningStrategy on the Mathematics Self – Concept of students by the administration of the Marsh Mathematics Self – Concept Questionnaire (MSCQ) to test for difference between the Control and Experimental groups using *Mann Whitney u – test,* (Ayodele, 2011). The quasi experimental method investigated the effect of Self – Regulated – Learning Strategy on the learners' Academic Performance in Mathematics and on gender Performance by the administration of the Mathematics for Science Performance test (MSPT) and the Self – Regulation – Strategy Questionnaire (SRLQ). The *t*– test was used to determine if there is any significant difference in their average scores, (Dramanu & Balarabe, 2013).The research design for the Quasi experimental is represented by figure 3.1:

$$\text{Control: } O_1 \rightarrow X_o \rightarrow O_2$$

$$\text{Treatment: } O_1 \rightarrow X_1 \rightarrow O_2$$

Figure 3.1:*Research Design*

Where:

X_1 = Treatment

O_1 = Observation (Pre – Test)

O_2 = Observation (Post – Test)

This research design involved Pre – Test administration of MSCQ and MSPT to both the Control and Experimental groups, and after the six week administration of treatment to the Experimental group, the Post – Test of MSCQ and MSPT was administered to both the control and experimental groups while SRLQ was administered to the treatment group only. The summary is given below:

Control Group: $O_1 \Rightarrow$ Pre – Test MSPT & MSCQ;

$X_o \Rightarrow$ No treatment;

$O_2 \Rightarrow$ Post – Test MSPT & MSCQ

Experimental Group: $O_1 \Rightarrow$ Pre - Test MSPT & MSCQ;

$X_1 \Rightarrow$ Treatment SRL Strategy

$O_2 \Rightarrow$ Post – Test MSPT, SRLQ, & MSCQ

3.3 Population of the Study

The population of the study comprised of all 100 level students of Integrated Science, Kaduna and Nasarawa State Colleges of Education, Gidan Waya and Akwanga respectively. These students come from various socio – economic, religious inclinations, and urban/rural background with varying ages ranging from 17 to 34 years.

In the population there are five Integrated Science course combinations as shown in table 3.1:

Table 3.1 The population of the research

S/NO	Combination	Total	KSCOE Males	Females	Total	COEAKWG Males	Females
1	BIO/ISC	130	61	69	289	71	218
2	CHEM/ISC	89	53	36	=	=	=
3	CSC/ISC	68	47	21	=	=	=
4	MATH/ISC	11	6	5	=	=	=
5	PHY/ISC	86	63	23	=	=	=
	Total	**384**	**230**	**154**	**289**	**71**	**218**

Source: *Research & Statistics Unit, K.S.C.O.E. Gidan Waya (2016) and ISC dept, COEAKWG 2016.*

3.4 Sample and Sampling Technique

The sample size for this research was sixty (60) students who were randomly selected using the Purposive and Stratified sampling technique (Gupta, 2013). The first level involved the drawing of 15 males and 15 females from the population to form the Experimental group while the second level involved the drawing of 15 males and 15 females into the Control group of thirty students by lottery. The reason for equal number of males and females is to remove any bias on gender (Onyilo and Onyilo, 2010; Ayodele, 2011).

3.4.1 Procedure for Selection

The selection for the Experimental Group was done by printing 230 (Males) small squares with 15 having letter Y for yes and 215 squares having letter N for no, similarly 154 (Females) small squares was printed with 15 having Y and 139 having N. Thus, the 15 males and 15 females formed the Experimental group of 30 subjects. Similarly for the Control Group, 71 (Males) small squares was printed with 15 having letter Y and 56 having letter N, while, 218 (Females) small squares were printed with 15 having letter Y and 203 letter N. Thus, the 15 males and 15 females formed the Control Group of 30 subjects. (Tuckman, 1975).

Note that subjects picked a square from a bag which gives a fair representation across the course combinations between the experimental and the control group.

This is in line with the central limit theorem by Tuckman (1975) which recommended that a sample size of thirty (30) subjects is viable for experimental study, and also Gratton and Jones (2004) claimed that for a more detailed inferential statistics 30 subjects per group is suggested as absolute minimum.

Table 3.2 Sample Population

Institution	**Sex**		**Total**	**Group**
	M	**F**		
KSCOE G/W	15	15	30	EG
COEAKWG	15	15	30	CG
Total	30	30	60	

Source: *Research & Statistics Unit, K.S.C.O.E. Gidan Waya (2016) and ISC Dept, COEAKWG 2016.*

3.5 Instrumentation

Three instruments were used for data collection. These are:

a) The Mathematics Self – Concept Questionnaire (MSCQ) constructed by Marsh (1998 In Matic, Marusic, and Baranovic, 2015) have four sub – scales, Mathematics Self Efficacy, Beliefs, Interest, and Anxiety. The questionnaire is based on 5 – point Likert scale and it was selected because the format is clear and easy to complete and the questions highlight a range of critical answers the researcher analyzed, such as viewing oneself as positive, and how they generally view Mathematics as a subject.

b) The second instrument is the Self – Regulated Learner Questionnaire (SRLQ) developed by Callan (2014) is based on a 5 – point Likert scale. The SRLQ measure required that students rate SRL Strategy used in an academic setting an assessed how learners often apply or implement certain SRL Strategies when they study Mathematics for tests, examinations, homework, or assignments and how learners apply SRL techniques during written tests, assessment, or examinations.

c) The Mathematics for Science Performance Test (MSPT) which was sourced and compiled by the researcher from standardized semester examinations test items measured learners' level of Academic Performance in Mathematics for Science. It consists of objective test items (Multiple choice, True/False, and Fill in the blank spaces) which is in line with the National Commission for Colleges of Education (NCCE, 2013) Minimum standard. The MSPT covered some topics extracted from the syllabus for the course Mathematics for Science.

3.6 Validation of the Instrument

The research instrument MSPTwas given to two experienced Mathematics lecturers from the department of Science Education ABU Zaria, with minimum rank of Ph.D who assessed and validated the instrument based on the following:

- They certified that the items considered tested the academic achievement of the subjects
- They also determined that the instrument is appropriate as pertaining to the academic level of the subjects under study
- They eliminated any ambiguity and errors from the instrument

3.6.1 Observation by the Validators

The validators made the following observations with the attendant recommendations:

i. The MSPT items are too many and should be reduced from 60 to 40 items

ii. The initial duration of one hour thirty minutes should be reduced to one hour

3.7 Pilot Testing of Instrument

A trial run of the MSPT instrument was conducted with the 100 level Integrated Science students of College of Education Gindiri, Plateau state. This is to prevent study subjects from interactive contact which may influence the subjects and hence the result of the research. Thirty (30) students were sampled randomly by lottery (Tuckman, 1975). The Pilot test allowed the Reliability Coefficient for MSPT to be calculated using the Split – Half Reliability test which gave a Cronbach Alpha value of $\alpha = 0.61$ (Appendix L 1).

Also, the MSCQ and SRLQ were given to the subjects in the pilot study to indicate if the content was easily comprehensible as indicated by their responses on a 3 – point Likert scale ranging from one indicating low comprehension to a numerical value of three indicating sufficient/high comprehension and understanding.

3.8 Reliability of Instrument

Reliability of a measuring instrument is the degree of consistency with which it measures whatever it is meant to measure (Ary, Jacobs, and Sorensen, 2010).

The Mathematics Self-Concept Questionnaire is made up of four sub – Scales namelyMathematics Self – Efficacy, Belief, Interest, and Anxiety, has reliability Coefficient of $\alpha = 0.88$, and the reliability Coefficient of SRLQ is $\alpha = 0.94$ (Callan, 2014). These two instruments, MSCQ and SRLQ were both adopted. For the reliability of MSPT, the split – half reliability method was used to obtain the coefficient of reliability at $\alpha = 0.61$ (SPSS 20,Appendix L 1).

3.9 Administration of Treatment

Both groups were pretested before the administration of the treatment to ensure that there is no significant difference in the ability of the groups in terms of Academic Performance.

In order to determine the Effect of Self – Regulated – Learning Strategy on Subjects' Mathematics Self – Concept and Academic Performance in Mathematics, the Self – Regulated instruction program (Training guide) which was developed by Zimmerman (1996) was implemented on the Experimental group only. While on the other hand, the Lecture or Traditional method of instruction was implemented on the Controlled group.

The two groups were taught the topics stated in the scope of this research within six weeks after which the Post-Test of MSPT, MSCQ, was administered to the two groups while the SRLQ was administered to the Experimental group only.

3.10 Procedurefor Data Collection

Data were collected from the raw score of the Pre –Test and Post – Test administration of MSPT, MSCQ, and SRLQ. The*Mann Withney U* - test was used to test for difference in the Mathematics Self – Concept of Control and Experimental groups, and *t* – test was used to test for difference in the Academic Performance of the two groups and also for difference in Gender Academic Performance. All tests were conducted at $p \leq 0.05$ level of Significance. Descriptive statistics based on the rating scale of MSCQ and SRLQ was used to answer the research questions.

3.11 Procedurefor Data Analysis

The data analysis was done using the *Mann Withney U – test* at$p \leq 0.05$ level of significance to test for difference in the mean score for Mathematics Self – Concept between the treatment and Controlled groups, and the*t– test* was used to investigate any difference in the Academic Performance of the two groups, and to test for difference in Gender Performance of Integrated Science students in the Experimental group.

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS, AND DISCUSSION

4.1 Introduction

This chapter focused on the data generated and analyzed with respect to the research questions and Null hypotheses which were mentioned in chapter one. All Pre – Test and Post – Test scores were processed using Statistical Package for Social Science (SPSS 20), and descriptive statistics was used to answer the research questions while *U –test* was used to test Null hypothesis one and independent sample *t – test* was used to test Null hypotheses two and three at 0.05 level of significance.

The chapter is presented under the following headings:

4.2 Data analyzed and result presentation

4.3 Summary of findings

4.4 Discussion of the Findings

4.2 Data Analyzed and Result presentation

Research Question One: To what extent does SRL strategy influence the Mathematics Self – Concept of l00 level Integrated Sciences students?

To answer research question one, Descriptive Statistic of mean, Standard and mean deviations were used. The result of the analysis is presented in Table 4.2.1

Table 4.2.1: MSC score of 100 level Integrated Science students taught using SRL strategy and students taught using Lecture method.

Group	Pre-test				Post-test			
	N	Mean	Std. Deviation	S.E	N	Mean	Std. Deviation	S.E

CG	30	60.03	10.97	2.00	30	64.90	9.95	1.81
EG	30	58.70	8.17	1.49	30	83.13	14.41	2.63

Source: *Statistical Package for Social Science (SPSS) contained in appendix L 2*

Table 4.2.1 showed the comparison of the mean score of MSC among students taught using SRL Strategy and those taught using the Lecture method.

Null Hypothesis I: There is no significant difference in the mean score for Mathematics Self – Concept of Integrated Science students taught Mathematics for Sciences using SRL Strategy and those taught using the Lecture method.

To test Null Hypothesis one, the post – test mean score of MSC for both the CG and EG Were analyzed using the Mann – Whitney *u – test* for independent samples (Large sample) at $p \leq 0.05$ level of significance. The result of the test is shown in Table 4.2.2

Table 4.2.2: Table showing the summary of *U*– test on the difference in MSC mean score of students taught using SRL and those using Lecture method.

Source	N	Mean	Std. Deviation	S.E	*z*	*p*	Decision
CG	30	64.90	9.95	1.81	-4.355	.000	Reject H_{o1}
EG	30	83.13	14.41	2.63			

Significant level at 0.05

Source: *Statistical Package for Social Science (SPSS) contained in appendix L 3*

The above table 4.2.2 shows that $p = 0.000 \leq 0.05$ which indicates that the experimental group exhibited a significant difference in their Mathematics Self Concept than subjects in the control group.

Research Question Two

To what extent does SRL strategy mediate Academic Performance of 100 level Integrated Science students in Mathematics foe Science?

To answer research question two, student's post – test scores of MSAT for both CG and EG were used in a Descriptive Statistic analysis with the result given in the Table 4.2.3:

Table 4.2.3: Summary of Descriptive statistic of MSPT for CG and EG.

Source	N	Mean	Std. Deviation	S.E	Mean Difference
CG	30	52.68	10.81	1.97	
					14.15
EG	30	66.83	11.60	2.12	

Source: *Statistical Package for Social Science (SPSS) contained in appendix L 4*

Null Hypothesis Two

There is no significant difference in the mean score in Academic performance of 100 level Integrated Science students taught using SRL strategy and those taught using the Lecture method.

The independent samples *t – test*was used to test the null hypothesis two at 5% level of significance of the post – test scores of MSPT for both CG and EG. The result is given in Table 4.2.4:

Table 4.2.4: Summary of *t – test* Analysis on the mean score of MSPT Post – Test for both CG and EG.

Source	N	Mean	Std. Deviation	*dft-value*	*p-value*	Decision
CG	30	52.68	10.81			
58	1.6715		.000 Reject H_{o2}			
EG	30	66.83	11.60			

Significant level at 0.05 ***Source:*** *Statistical Package for Social Science (SPSS) contained in Appendix L 5*

Table 4.2.4 gives the summary of the *t – test*of the mean score of Integrated Science students' academic performance in Mathematics for Science. Since $p = 0.000 \leq 0.05$, it follows that SRL has a significant effect on the Academic Performance of Integrated Science students taught with Self – Regulated Learning strategy than students taught using Lecture method.

Research Question Three

Does SRL Strategy influence Academic Performance on gender in Mathematics for Science among 100 levelIntegrated Science Students?

To answer research question three, the post – test scores of MSPT of the EG for males and females were used in a descriptive statistic analysis as given by Table 4.2.5

Table 4.2.5 : Descriptive Statistics summary of Post – Test SRL and MSPT showing gender performance in the Experimental Group.

SRL Capacity						**MSPT**			
Source (EG)	**N**	**Mean**	**Std. D.**	**S.E**	**M.Diff.**	**Mean**	**Std. D.**	**S.E**	**M.Diff.**
Male	15	132.33	8.62	2.22	0.26	69.00	10.64	2.75	4.33
Female	15	132.07	11.35	2.29		64.67	12.46	3.22	

Source:*Statistical Package for Social Science (SPSS) contained in appendix L 6*

The result from table 4.2.5 shows there is virtually no difference in the SRL capacity for both males and females as mean difference is 0.26 while the MSPT mean for males is 69.00 which is greater than the mean of the females 64.67 with a mean difference of 4.33. This indicates that SRL Strategy influences better Academic Performance in malespthan in female students of NCE Integrated Science. However, this influence may not be of significant effect until a*t –test*analysis is done on hypothesis three.

Null Hypothesis Three

There is no significant difference in the Academic Performance mean score of male and female ISC students taught Mathematics for Science using SRL strategy.

Table 4.2.6: Summary of *t – test* on MSPT average score of male and female students taught using SRL.

Source (EG)	**N**	**Mean**	**Std. Dev**	***df***	***t-value***	***p-value***	**Decision**
Male	15	69.00	10.64	28	1.7011	.314	Retain H_{o3}
Female	15	64.67	12.46				

Significant level at 0.05***Source:****Statistical Package for Social Science (SPSS) contained in appendix L 7*

Resultof the $t - test$ analysis for null hypothesis three in table 4.2.6 revealed that $p - value$ is 0.314 and is greater than alpha – value = 0.05. Thus, Self – Regulated Learning strategy is not gender bias towards higher Academic Performance in male or in female 100 level ISC students.

4.3 Summary of Findings

The following are major findings of the research:

1. The treatment group tend to exhibit a higher level of Positive MSC than the non – treatment group.
2. ISC students taught Mathematics for Science using SRL exhibited a significantly higher level of MSC than those taught using the Lecture method. There is a significant difference in their mean score for MSC.
3. There is a significant difference in the Academic Performance of ISC students taught Mathematics for Science using SRL and those taught using Lecture method
4. The study revealed that SRL strategy does not result in any significant difference on male and female Academic Performance as both of them exhibited equal SRL capacity, despite the fact that they were taught Mathematics for Science using SRL strategy.

4.4 Discussion of Results

The main purpose of this research work is to investigate the effect of Self – Regulated Learning strategy (SRL) on the MSC and Academic Performance among 100 level ISC students of Kaduna and Nasarawa states Colleges of Education.

This research found that SRL Strategy as a teaching and learning approach for Mathematics is effective to ISC students in improving the MSC of the treatment group positively. This is in agreement with Lee and Kung (2017), who showed that a positive MSC is an important variable for facilitating Academic Performance in Mathematics. The result in Table 4.2.1 shows that the non – treatment group has a mean difference of 4.87 while the treatment group has a mean difference of 24.43. Thus, it can be established that there is a significant difference in the level of MSC for ISC students taught using SRL Strategy (Eklof, 2007), and(Timmerman, Sylke, &Johannes, 2017). This difference may be attributed to the teacher being a role model because teachers play an important role in shaping students MSC, and the implication of this is thatteacher's expectation of students' success is a central influence on students MSC and ability (Goldman and Penner, 2014). Another reason could be the open and informal classroom atmosphere created by the teacher that ensures students freedom to ask questions and explore their own ideas (Smith, 2014)

The study also revealed that the treatment group of100 level ISC students tend to exhibit a higher level of MSC when taught using SRL than the non – treatment group. Assessing the result in Table 4.2.2, it can be accepted that the effect of SRL is statistically significant in favour of the treatment group. This finding agrees with Adegoke (2015), Dramanu and Balarabe (2013), Maryam, Farideh, and Sadegh (2016), who established in their researches that there is a significant difference in the level of Mathematics Self – Concept of ISC students who were administered the treatment as compared with those who were not. The reason which the researcher identified is the beliefs of the students about learning Mathematics as a subject which have a deep impact on their MSC. Goldin (2002) agreed with this statement.

The Descriptive analysis in Table 4.2.3 above exhibits to an extent that there is a noticeable level of mediation of SRL in the Academic performance of students taught Mathematics for Science using SRL than those taught using the Lecture method. However, to find out how significant the level of mediation is, the *t – test*analysis was done on the post – test average scores of the CG and EG.

The *t – tes*t result in Table 4.2.4 conducted on the post – test score of MSPT for the treatment and non –treatment groups showed there is a significant difference in the academic performance of ISC students taught Mathematics for Science using SRL and those taught using the lecture method. This result is in complete agreement with Olaoye (2012), Anyichie and Onyedike (2012), Bozpolat (2016), and Zimmerman (1990). Olaoye (2012) examined the effect of SRL and Conventional strategies on students' performance in Mathematics and found that those on SRL perform better than those in the conventional group. This lends support to the position that SRL mediates higher academic performance in Mathematics (Ekuri & Offiah, 2018)

This research work also found that SRL may be gender biased as Table 4.2.5 indicates that the male subjects have a higher average score of 69.00 in MSPT as against the female's average score of 64.67 even though both male and females exhibit similar level of SRL capacity. However, Table 4.2.6 displays the *t*– test analysis conducted on the MSPT scores of the treatment group and the result shows that there is no significant difference in the mean score of MSPT between male and female ISC students taught Mathematics for Science using SRL strategy. This position is supported by Anyechie and Onyedike (2012), Bozpolat (2016), Medina (2011), Koshkouei, Shavarani, and Behzadi (2016) whose research work proved the fact that SRL is not gender bias in the Academic performance of male and female subjects exposed to the strategy. However, Self – Regulated Learning strategy may be gender friendly according to Maryam, Farideh, and Sadegh(2014).

CHAPTER FIVE

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS.

5.1 Introduction

This chapter highlighted the summary of the study, methodology employed to collect data, recommendations based on findings, and suggestions for further studies are briefly outlined.

5.2 Summary of the research work

This study investigated the Effect of Self – Regulated – Learning Strategy (SRL) on the Mathematics Self Concept and Performance Among Integrated Science (ISC) Students of Kaduna and Nasarawa States Colleges of Education. Three hypotheses were derived and postulated from the research questions. The instrument used to collect data were the Mathematics for Science Performance Test (MSPT), the Mathematics Self Concept Questionnaire (MSCQ) developed by Marsh (1988) having four (4) Sub –Scales namely Mathematics Self – Efficacy, Mathematics Self Concept, Mathematics Anxiety, and Mathematics Interest. The third instrument is the Self – Regulated Learner Questionnaire (SRLQ) developed by Callan (2014).

Two (2) State Colleges of Education, Kaduna State College of Education Gidan Waya and Nasarawa State College of Education, Akwanga were used for the research with KSCOE Gidan Waya being the Experimental College while NSCOE Akwanga being the Controlled College which was drawn by Lottery method. A Pre – Test was administered to both groups followed by a six (6) week teaching session, after which the Post – Test was administered. The data was analyzed using descriptive Statistics, *U – test*, and *t – test* to generate result in chapter four.

The treatment for the study involved:

(i). SRL capacity acquisition workshop for the Experimental Group that took place before the six week teaching sessions using the Zimmerman Self – Regulated training guide.

(ii). Lecture method for the Controlled Group

All data were analyzed by SPSS version 20 at $p \leq 0.05$ level of significance using *U – test*, and *t – test*for mean difference.

5.3 Summary of Major Findings

1. The treatment group tend to exhibit a higher level of Positive MSC than the non – treatment group.
2. ISC students taught Mathematics for Science using SRL exhibited a significantly higher level of MSC than those taught using the Lecture method. There is a significant difference in their mean score for MSC.
3. There is a significant difference in the Academic Performance of ISC students taught Mathematics for Science using SRL and those taught using Lecture method
4. The study revealed that there is no significant difference in the Academic Performance of male and female ISC students taught Mathematics for Science using SRL strategy despite an indication of equal SRL capacity exhibited by both subjects.

5.4 Conclusion

This research work investigated the Effect of SRL Strategy on the Mathematics Self – Concept and Academic Performance among Integrated Science students of Kaduna and Nasarawa States Colleges of Education. The following conclusions were arrived at from the findings of the research work:

Students taught Mathematics for Science through SRL strategy attain a higher and better level of Academic Performance than those taught through the Lecture method. They also exhibited certain Cognitive skills associated with SRL such as Problem Solving capacity, Selfconfidence, Evaluation, Planning skills through enhanced interactive sessions with the researcher during the six weeks teaching experience.

There is a strong indication that students exposed to SRL displayed a higher level of Mathematics Self Concept than those not exposed to SRL. This implies an increase in their Mathematics Self – Efficacy, Mathematics Self Concept, and Mathematics Interest, while a decrease in their Mathematics anxiety.

Male and female students in the treatment group fared differentially in their Mathematics Performance with SRL favouring the male students as having a higher capacity for Self Regulation than the female students.

The study also presented a practical implication for Integrated Science teachers of Mathematics as several instructional practices were described and examined.

5.5 Limitations of the Study

Limitations to the research study are given below:

i. The study focused on two (2) State Colleges of Education, leaving out the Federal and Private Colleges of Education, thus undermining on generalization of findings.

ii. The six (6) week teaching sessions could not be completed within the specified time due to College activities that intruded especially excursion trips in their subject area by some of the students in both the Control and Experimental groups. Thus, a longer period was needed to cover the sessions.

5.6 Recommendations

Based on the findings and conclusions from this research, the following recommendations are made:

i. Teachers of Mathematics (Mathematics for Science inclusive) could use SRL training guide/manual to enhance and improve their instructional skills which encourage students' participation and engagement in becoming Self – Regulated in their learning of Mathematics.

ii. The Mathematics Self Concept of students learning Mathematics, especially females can be influenced by encouraging them to participate more in Mathematics discussions, problem solving activities, and by emphasizing the importance of Mathematics in future professions.

iii. Findings can be used to develop/design course/workshop manuals and or books for the purpose of teaching SRL skills to students for higher performance in Mathematics.

iv. It is also recommended that the school authorities should give attention in developing the student's SRL skills and Performance in Mathematics by conducting training programs/workshop in the school to expose them to a variety of these skills like Survey, Question, Read (SQR), Frayer Model (Concept Mapping), Mnemonic Device, Graphic Organizers, Cooperative Learning, Thinking Aloud, Problem Solving, and Modeling.

v. Teachers of Mathematics should task students with periodical autonomous problem solving activities in Mathematics and encourage them to complete assignments within time lines.

5.7 Contribution to Knowledge

This research study explored the Effect of Self – Regulated – Learning Strategy on the Mathematics Self Concept and Academic Performance of 100 level Integrated Science students. The results were significant for teachers of Mathematics who can apply them to improve learning and academic performance in Mathematics at schools.

The following were contributions to knowledge:

i. The researcher has come up with a Cognitive Skill that helped students to Self – Regulate their learning of Mathematics.

ii. The finding of the study revealed that Students become highly responsible for their own learning of Mathematics when exposed to SRL Cognitive skill

iii. Manuals/model lesson plans that were used on the Experimental Group are sure to encourage teachers towards professional skills in Self – Regulation.

iv. Addition of literature to existing literatures

5.8 Suggestions for Further Research Studies

The following suggestions are presented based on the findings and conclusion for further research studies:

i. Similar research work could be carried out in other Science subject areas like Physics, Biology, Chemistry, Technology, etc to find out if SRL strategy can embrace diverse subjects.

ii. This same research could be done at Regional or National level in order to have a wider basis for generalization.

iii. Studies could be carried out at all levels of Primary, Secondary, and Tertiary institutions to test the effectiveness of SRL in improving students' Academic Performance.

iv. Similar studies should be carried out to determine if there exists a Correlation between Teachers SRL guidelines/instructional skills and their students' SRL capacity.

v. The same study should be replicated at the NCE level to find out how effective SRL strategy is on the Self – Efficacy and Self – Concept in aiding Academic Performance in Mathematics.

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APPENDIX A1

Fig. 1.1: Pre – Test and Post – Test result of 27 high school students.

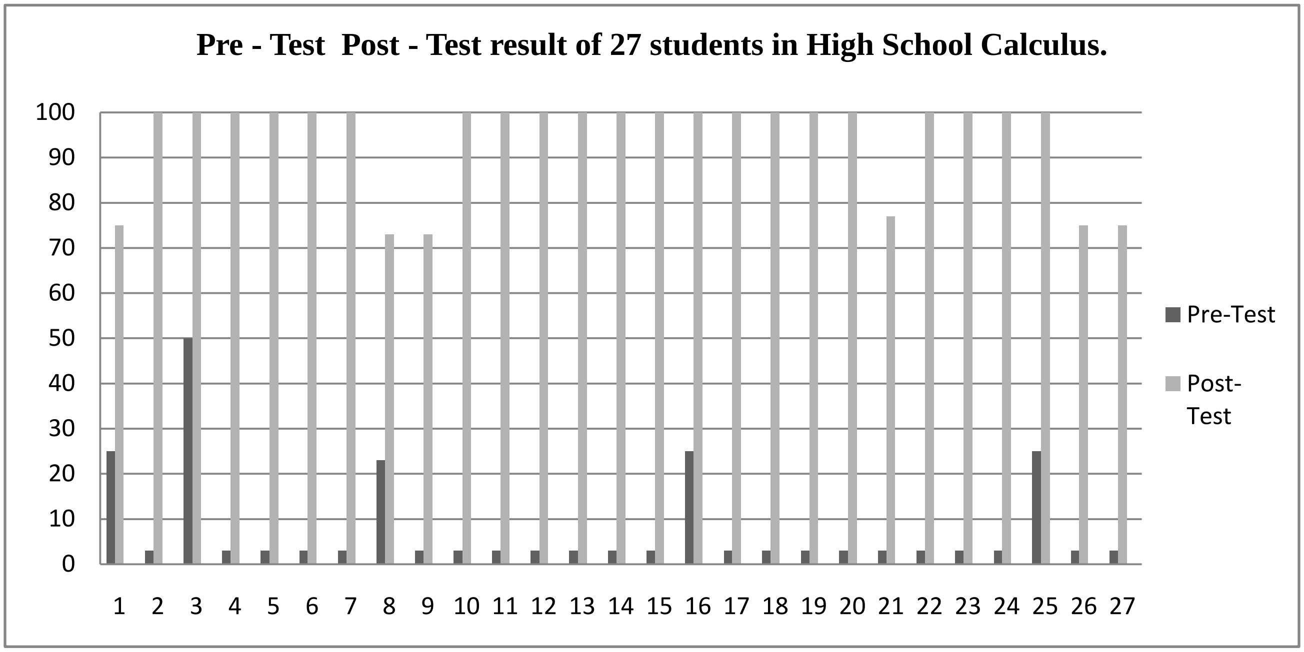
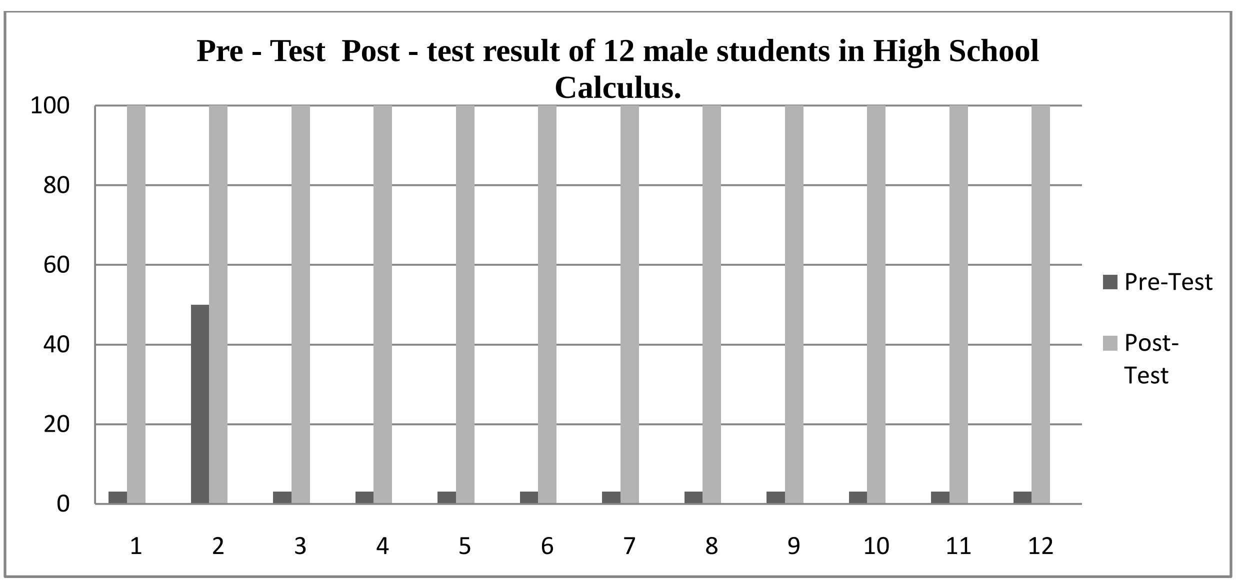
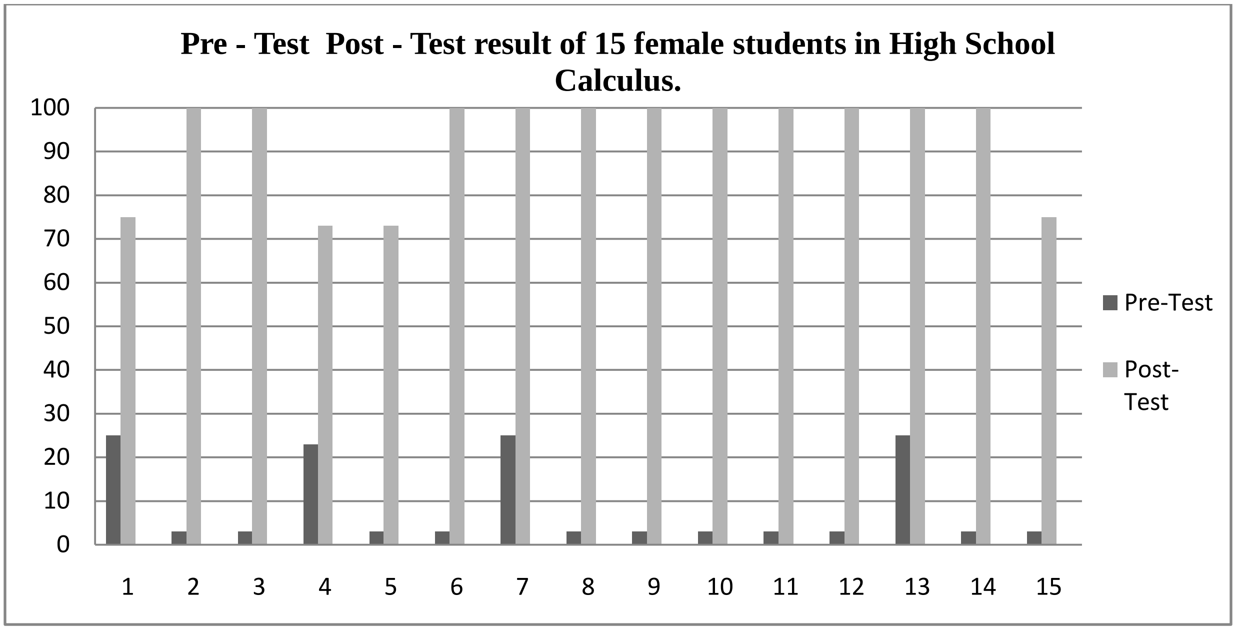


Fig. 1.2: Pre – Test and Post – Test result of 12 male high school students.



APPENDIX A2

Fig. 1.3: Graph showing the Pre – Test and Post – Test result of 15 female high school students.



APPENDIX B

ZIMMERMANN SELF – REGULATED TRAINING GUIDE.

Teacher introduces some of the Cognitive skills for learners to be familiar with.These skills were later collapsed into the three main phases.

1. Planning Strategy
2. Generating questions
3. Choosing Consciously
4. Setting and pursuing goals
5. Evaluating the way of thinking and acting
6. Identifying difficulty
7. Paraphrasing, Elaborating, and Reflecting.
8. Clarifying learner's terminology
9. Problem solving activities
10. Thinking Aloud
11. Journal keeping
12. Cooperative Learning
13. Modelling

Zimmermann model will be operationalised as follows with respect to the Laws of Indices

PHASE 1: Planning before a learning or performance task (task analysis).

The Teacher guides the learners to answer the following questions:

1. What kind of a task is this?
2. What is my goal?
3. How will I know I have reached it?
4. What do I already know about the topic?
5. What additional information, if any, will I need?
6. What strategies should I use? (actively listening, taking notes, outlining, visually representing the material, occasionally self-quizzing, reviewing, or writing a summary)
7. What strengths can I bring to the task?
8. What are my weaknesses and how can I make up for them?
9. How interested and motivated am I to do the task, and how can I increase my interest and motivation if they are low?

10. What's the value or relevance of what I'll be learning?
11. How confident am I in my ability to learn this material? If not very, how can I increase my belief in my ability to learn it, without becoming over-confident?
12. What similar tasks can I recall doing well in the past?

PHASE 2: **Monitoring during a learning or performance task**

1. Am I sure I know what I am doing?
2. Does my approach to the task make sense?
3. Am I making good progress toward my goal?
4. How focused am I? Am I getting tired? If so, how can I keep myself focused and alert?
5. How well are my strategies
6. What changes in approach or strategies should I make, if any?
7. What material is the most important?
8. What material am I having trouble understanding?
9. How does what I am learning relate to what I already know?
10. How is my thinking on the topic changing?
11. If my interest and motivation are sagging, how is what I'm learning relevant to my experience or my future?
12. What material is challenging what I've thought about the subject? Am I resisting it?
13. Am I starting to get discouraged or give up? Am I thinking I'm just no good at this subject? How can I change this negative thinking?
14. What similar tasks can I recall doing well in the past?

PHASE 3: **Evaluating after a learning or performance task**

1. How well did I achieve my goal or master what I set out to learn?
2. What can I recall and what do I need to review?
3. What were the most important points I learned?
4. Can I see and organize the interrelationships among them?

5. What am I still having trouble understanding?
6. What questions do I have to ask my instructor?
7. How does what I learned relate to other things I've been learning or have experienced?
8. How has my thinking on the topic changed?
9. Which approaches and strategies worked well?
10. Which didn't?
11. What do I need to do differently next time I take on a similar task?
12. How am I reacting emotionally to my evaluation of my learning?
13. Being pleased reinforces a learner's motivation and other positive emotions she generated about the material and her ability to learn it.
14. Being disappointed may lead either to improving her learning strategies or her defensively withdrawing her energy from task.
15. This last reaction in turn undermines the positive emotions needed to begin the next learning or performance task.

APPENDIX C1

CONTROL GROUP LESSON PLANS

WEEK ONE

NAME: Ayuba, Jonah Anzah

SCHOOL: K.S.C.O.E. Gidan Waya.

COURSECONBN: Integrated Science

LEVEL: 100 Level

NO. **OFSTUDENTS**: 30 students

TIME: 2 Hours

SUBJECT: Mathematics for Science

TOPIC: Graphs

BEHAVIOURALOBJECTIVE: By the end of the lesson, learners should be able to:

1) Define what a graph is
2) Mention three types of graphs with example
3) Write the general form of a straight line equation
4) Find the slope/gradient between any two given points
5) Determine the straight line equation passing through the given two points in nos 4
6) Plot correctly a simple straight line equation on the x – y axes.

PREVIOUS KNOWLEDGE: It is assumed that students have been taught simple graphs at Senior Secondary School level. Example include linear graph of one or two variable, pie – chart, bar – chart, histogram, and Ogive.

INTRODUCTION: The Teacher asks the following questions to enable him have an idea on the level of entering behaviour the learners have.

1) Mention the types of graphs you know. Teacher writes them as the student respond.
2) Which of the above graphs is easy to plot?
3) How many can plot the graph in 2 above?

PRESENTATION OF LESSON: Lesson is presented in the following steps.

Step I: Teacher defines what a graph is and explains to the students the types available.

Definition of Graphs: Graphs are diagrammatic representation of précised information

Types of graphs: There are three (3) types of graphs viz:

i. Graphical example geometrical figures, pie – chart, bar – chart, histogram.
ii. Numerical. Example table of values
iii. Algebraic. Example line equations, y = mx + c

Step II:Teacher mentions to the students that we will be dealing with the algebraic type of graphs:

i. $y = mx + c$ ii. $y = x^2$iii. $y = \frac{1}{x}$ iv. $y = \sin x$
iv. $y = \cos x$ vi. $y = e^{nx}$

Now, General form of a straight line equation. Any straight line can be represented in the form $y = mx + c$, where m is the slope or gradient of the line and c is the constant or intercept of the line.

Examples are:

i. $2x - y = 6$ ii. $3y + 5x + 3 = 0$iii. $\frac{2x}{3} + \frac{y}{4} = \frac{1}{2}$

These equations can all be written in the standard form, that is

i. $2x - y = 6 \Rightarrow y = 2x - 6$and $m = 2$ *and* $c = -6$.
ii. $3y + 5x + 3 = 0 \Rightarrow y = -\frac{5}{3}x - 1$andm = $-\frac{5}{3}$ and c = -1

iii. $\frac{2x}{3} + \frac{y}{4} = \frac{1}{2} \Rightarrow y = -\frac{8}{3}x + \frac{6}{2}$and $m = -\frac{8}{3}$ *and* $c = 3$.

The slope or gradient between any given two points $P(x_1, y_1)$ and Q(x_2, y_2) is given by the relation

Gradient $m = \frac{y_2 - y_1}{x_2 - x_1}$.

Thus, find the slope m, between the following pairs of points.

(1). A(3,5) and B(-2,7) (2). H(-4,-1) and K(-5,-4) (3). L($\frac{1}{3}$, $\frac{1}{5}$) and M(3,2)

Step III: Finding the equation of a straight line between two given points

The Teacher explains to the learners the procedure for finding the equation of the straight line passing through two points.

Find the equation the straight line passing through the following pairs of points:

i). (3,5) and (8,6) ii). (-1,0) and (4,-2) iii). $\left(\frac{2}{3}, \frac{3}{5}\right)$ *and* $(\frac{1}{3}, \frac{1}{5})$

Step IV: Plotting a straight line equation.

To plot a straight line equation on the x – y axes, do the following:

i. Determine at least three points of the given equation
ii. Tabulate the values of x and y from (i)
iii. Draw axes , scale , and plot the tabulated values.

Evaluation: Teacher evaluates the lesson by asking the following question

i. State with examples three (3) types of graphs
ii. State and write the general form of a straight line equation
iii. Express the equation $3x + 14y + 9 = 0$ in the form $y = mx + c$, and find the value of the slope and constant of the straight line.
iv. Calculate the slope of a line passing through the points (-11, 6) and (-5,8)
v. Determine the equation that passes through the point in iv above

Conclusion: The Teacher gives the learners' assignment to do at home.

Plot the equations below:

i. $y = 2x - 4$ for $-2 \leq x \leq 3$; scale: 2cm =1 unit on x – axis and 2cm = 1 unit on y – axis
ii. $2x + y = 3$for $-2 \leq x \leq 5$: scale: 2cm = I unit on x – axis, and 2cm = 5 units on y – axis

APPENDIX C2

CONTROL GROUP LESSON PLAN **WEEK TWO**

NAME: Ayuba, Jonah Anzah

SCHOOL: K.S.C.O.E. Gidan Waya.

COURSECONBN: Integrated Science

LEVEL: 100 Level

NO. **OFSTUDENTS**: 30 students

TIME: 2 Hours

SUBJECT: Mathematics for Science

TOPIC: Graphs of Common Plots ($y = x^2$; $y = \frac{1}{x}$; $y = \sin x$; $y = \cos x$) and Rate of Change.

BEHAVIOURALOBJECTIVE: By the end of the lesson, learners should be able to:

i. Plot accurately any of the graphs with a maximum of one error
ii. Find the rate of change or differentiate a simple equation.

PREVIOUS KNOWLEDGE: Learners have been taught the following topics:

i. Types of graphs
ii. General form of a straight line equation
iii. Determining the slope and constant of any given straight line equation, and
iv. Finding the equation of a straight line passing through any given two points.

Introduction: The Teacher introduces the lesson by asking the learners' the following

Questions based on their previous Knowledge:

i. Define a graph and mention the types you know.
ii. State the general form of a straight line equation
iii. Explain how to determine the slope and equation of straight line passing through the points (3,1) and (-2,2).

PRESENTATION: Teacher presents his lesson in the following steps:

Step I: The Teacher explains the shape and direction of the graph $= x^2$, i.e

Step II: Also, the Teacher explains to learners' the process of plotting the quadratic graph.

Plot the following graphs with the given information:

i). $y = x^2 - 2x - 2 \quad for \; -4 \leq x \leq +4$

ii). $y = \frac{1}{x} \quad for \; -2 \leq x \leq +2$

iii). $y = \sin x \quad for \; \theta^{\circ} \leq x \leq 360^{\circ}$

iv). $y = \cos x \; for \; \theta^{\circ} \leq x \leq 360^{\circ}$

Step II: Rate of Change

Definition of Rate of Change

The Teacher explains to the learners' the principles in Rate of change of a function.

Given a function, $y = x$ - - - - - -(*)

and P a point $P(x, y)$ moving to $Q(x + \delta x, \; y + \delta y)$

Let δx be a small change in x and δy be a corresponding small change in y.

Then, (*) becomes $y + \delta y = x + \delta x$

Subtract y from both sides, get,

$\delta y = x + \delta x - y$, but $y = x$

Thus, we have $\delta y = x + \delta x - x$

i.e $\delta y = \delta x$

Divide both sides by δx, get $\frac{\delta y}{\delta x} = \frac{\delta x}{\delta x}$

i.e$\frac{\delta y}{\delta x} = 1$ which is a constant.

Now, take limit of both side as $x \rightarrow 0$,$y \rightarrow 0$, $\delta x \rightarrow dx$ and $\delta y \rightarrow dy$

i.e$\lim_{x \rightarrow 0} \frac{\delta y}{\delta x} \rightarrow \frac{dy}{dx}$ which defines the rate of change in x with corresponding change in y.

This is called the Differential of $y = f(x)$ with respect to x which is the tangent or slope of the given equation.

Now, the general form of differentiation is given as

$if\ y = x^n$ where n is a constant, then

$$\frac{dy}{dx} = n\,x^{n-1}$$

Note: The differential coefficient of a constant is zero, i.e

If $y = c$ then $\frac{dy}{dx} = 0$

Example: Find the differential coefficient or tangent/slope of the following equations:

i). $y = 3x - 4$ ii). $y = 7x^2 - 5x + 9$ iii). $2x - y + 11 = 0$iv). $y = x^2 - 2x - 2$at the point$(-1,6)$

Evaluation: The following questions are presented to the learners to solve.

1. Construct the table of values, and hence draw the graph of the function
$$y = -3x + 12x\ for - 2 \le x \le 6$$
2. Determine the differential coefficient of the following equations:
(i). $2x - 4y = -7$ (ii). $y = -9x + 4x - 3$ (iii). $y = 5x^3 + 6x^2 - 14x - 11$

Conclusion: Lesson is concluded by the Teacher giving assignment to the learners.

1. Construct the table of values and draw the graph of the equation
$$y = x^2 - x - 2\ for\ -3 \le x \le +3$$
2. Draw the graph of $\sin\theta\ \ for\ 0^{\circ} \le \theta \le 360^{\circ}$

APPENDIX C3

CONTROL GROUP LESSON PLAN **WEEK THREE**

NAME: Ayuba, Jonah Anzah

SCHOOL: K.S.C.O.E. Gidan Waya.

COURSECONBN: Integrated Science

LEVEL: 100 Level

NO. **OFSTUDENTS**: 30 students

TIME: 2 Hours

SUBJECT: Mathematics for Science

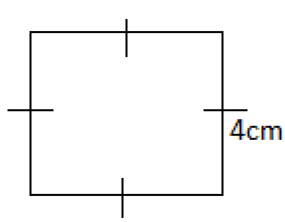
TOPIC: Areas and volume of Cubes, Cuboids, Cylinders, and Spheres..

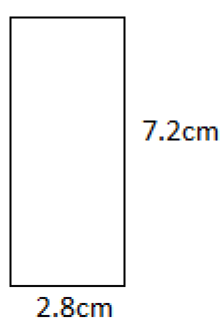
BEHAVIOURALOBJECTIVE: By the end of the lesson, learners should be able to:

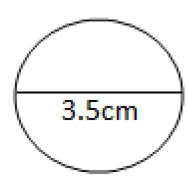
i. Calculate accurately to any given approximation the surface area of Cubes, Cuboids, Cylinders, and Spheres.
ii. Calculate the volume of the solids in I above.
iii. To determine the Surface area and volume of any figure formed by a combination of the above solids.

PREVIOUS KNOWLEDGE: The learners have been taught to find /calculate the area of plain figures/shapes, like Squares, Rectangle, Circles, and Sectors of circles.

Introduction: The Researcher introduces the lesson by asking the learners' to calculate the area of the following figures:

1.


2.


3.


PRESENTATION: Teacher presents his lesson in the following steps:

Step I: Teacher explains to the learners that Solids are 3 – dimensional figures, i.e they have Length, Width, and Height. Examples are drawn for the learners to see.

1. **Cube**: This is a solid three-dimensional geometric figure bounded by six planes; each of the six sides or faces of a cube is a square (see Figure below).

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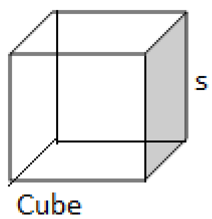
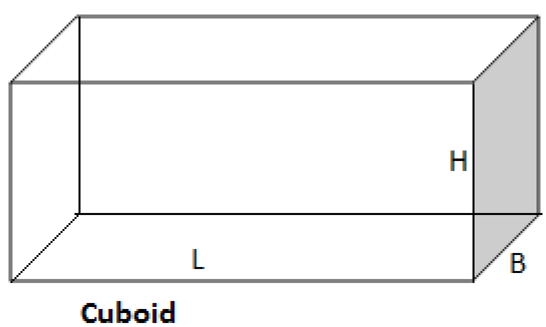
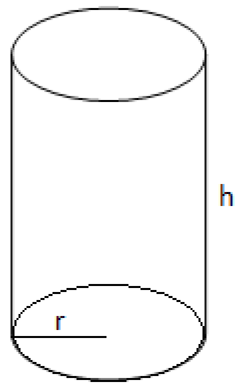


2. **Cuboid**:This is a six-sided three-dimensional prism whose faces are all rectangles. An example of a Cuboid is a brick. See the figure below:



3. **Cylinder**:This is a three-dimensional geometric figure. A *circular cylinder* consists of two circular bases of equal area that are in parallel planes, and are connected by a *lateral surface* that intersects the boundaries of the bases. See the figure below:



Cylinder

The volume of a circular cylinder is $\pi r^2 h$, where r is the radius of the bases, and h is the perpendicular distance between the planes that contain the bases. In a *right circular cylinder*, the lateral surface is perpendicular to the bases. The lateral surface area of a right circular cylinder is $2\pi rh$,, and the total surface area is $2\pi r(r+h)$.

Step II: The Teacher explains to learners how to calculate the area and volume of the given solids.

For Cube

If s is the length of one of the 12 equal edges, then

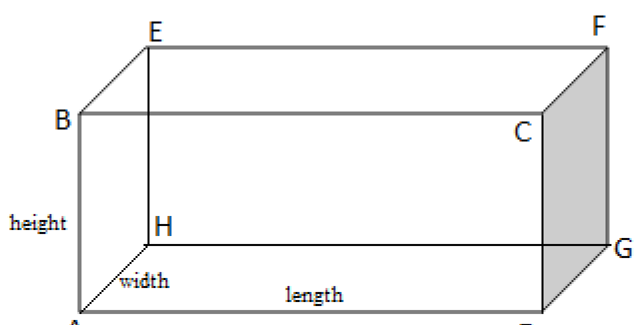
$$Total\ Surface\ Area = 6s^2 square\ units$$

$$Volume = s^3\ cubic\ units$$

Example: i. Calculate the surface area and volume of a cube whose side is 4m.
ii.The perimeter of one face of a cube is 26cm, determine the area and volume of the cube.

For Cuboids

The Teacher uses a diagram and explain to the Learners that Cuboids has three dimensional faces, each with an equal and opposite face. i.e a total of six faces.



Cuboid

Thus, **Surface Area** of the tree dimensional faces = $lb\ sq\ unit + bh\ sq\ unit + lh\ sq\ unit$.

Since each face has an equal opposite face, it follows that

Total Surface Area of the Cuboid = $2lb\ sq\ unit + 2bh\ sq\ unit + 2lh\ sq\ unit$

i.e**Total surface Area of Cuboid** = $2(lb + bh + lh)$ square unit.

Volume of Cuboid= $lbh\ cubic\ unit$.

Example: Calculate the total surface area and volume of a Cuboid with length 2.9cm, breadth 1.6cm, and height 5.2cm

For Sphere

The Surface Area of a Sphere is given by

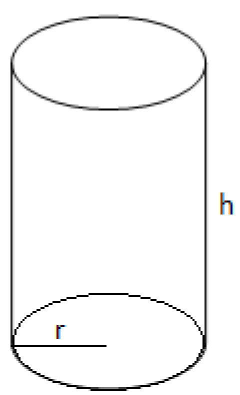
S.A = $4\pi r^2$square unit, where r is the radius of the Sphere.

While Volume of a Sphere is given by

VOL. = $\frac{4}{3}\pi r^3$cubic unit, where r is the radius of the Sphere.

Example: i**)**. Find the surface area and volume of a sphere whose diameter is 16.7cm
ii). Calculate the surface area and volume of a semi – hemisphere with radius 13cm.

For Cylinder



Cylinder

Curved Surface area of a Cylinder = $2\pi rh$ square units

whereπ is a constant approximately equal to 3.13159, r is the radius of the cylinder, and h is the height of the cylinder.

Total surface area of a Cylinder = $2\pi r^2 + 2\pi rh$

= $2\pi r(r + h)$**square units.**

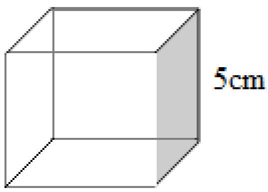
Volume of a Cylinder $=\pi r^2 h$**cubic unit.**

Example: i**).** Calculate the Curved Surface area and Volume of a cylinder having radius as 11.2cm and height 22cm.[Take $\pi = \frac{22}{7}$]

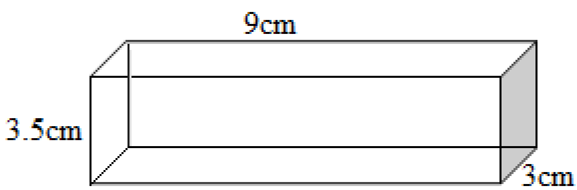
ii). Calculate the Total Surface area and Volume of a cylinder with diameter 8.6m and height 7.2m [Take $\pi = \frac{22}{7}$].

Evaluation: The Teacher evaluates the lesson by presenting the following questions to learners to solve:

(1). Calculate the S.A. and Volume of the figures:



i). ii).



(2). Find the Curved Surface area, Total Surface area, and Volume of a Cylinder with diameter 7.3cm and height 17cm.

(3). Determine the Surface area and Volume of a Sphere whose diameter is 8.4cm

Conclusion: The lesson is concluded by giving the learners homework to do.

APPENDIX C4

CONTROL GROUP LESSON PLAN **WEEK FOUR**

NAME: Ayuba, Jonah Anzah

SCHOOL: K.S.C.O.E. Gidan Waya.

COURSECONBN: Integrated Science

LEVEL: 100 Level

NO. **OFSTUDENTS**: 30 students

TIME: 2 Hours

SUBJECT: Mathematics for Science

TOPIC: Trigonometric Ratios and Special Angles with simple Application.

BEHAVIOURALOBJECTIVE: By the end of the lesson, learners should be able to:

i. Define trigonometric ratios of Sine, Cosine, and Tangents of acute angles using a right – angled triangle.
ii. Apply the definition in a right – angled triangle to solve simple problems on lengths and distances.
iii. Derive at least five (5) trigonometric ratios of Special angles.

PREVIOUS KNOWLEDGE: The learners have been taught Fractions, simple Ratios, Pythagoras theorem and its application, and a little on Surds.

Introduction: The Teacher introduces the lesson by asking the learners to give, or list examples of ratios, and triangles. Also, learners are asked to state the Pythagoras theorem.

Presentation: Teacher presents the lesson in the following steps:

Step I: The Teacher uses a right – angled triangle to defines the trigonometric ratios

for Sine, Cosine, and Tangent of the indicated acute angle.

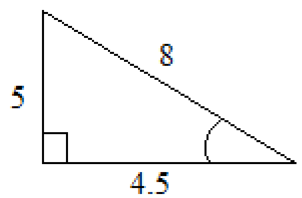
Thus, $Sin\theta = \frac{OPPOSITE}{HYPOTENUSE} = \frac{OPP}{HYP}$ i.e $Sin\theta = \frac{AO}{AB}$

$Cos\theta = \frac{ADJACENT}{HYPOTENUSE} = \frac{ADJ}{HYP}$ i.e $Cos\theta = \frac{OB}{AB}$

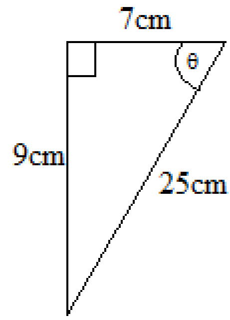
$Tan\theta = \frac{OPPOSITE}{ADJACENT} = \frac{OPP}{ADJ}$ i.e $Tan\theta = \frac{AO}{OB}$

Step II: Examples are given to find the trigonometric ratios.

1. Find the Sine, Cosine, and Tangent of the indicated acute angles in the following diagrams:

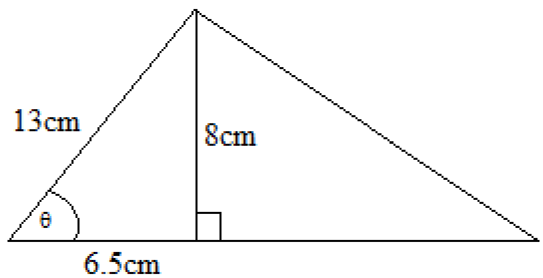


(i).

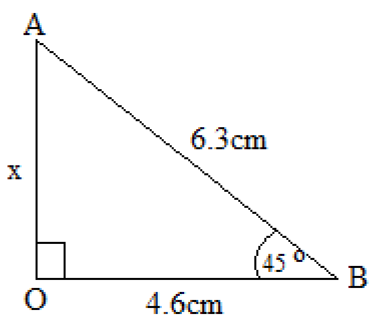


(ii).

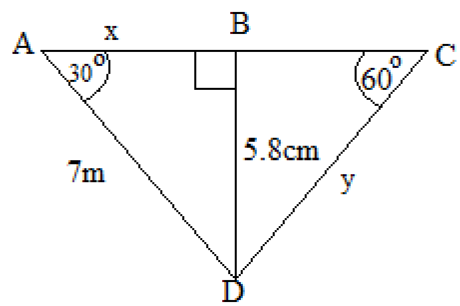
(iii).



2. Find the value of the indicated sides in the figures below:



(i).

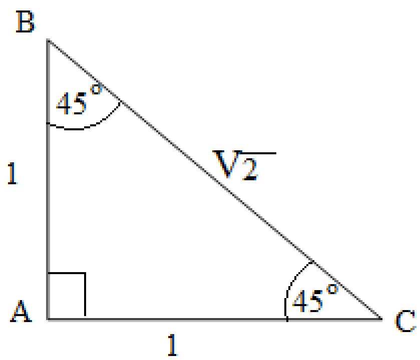


(ii).

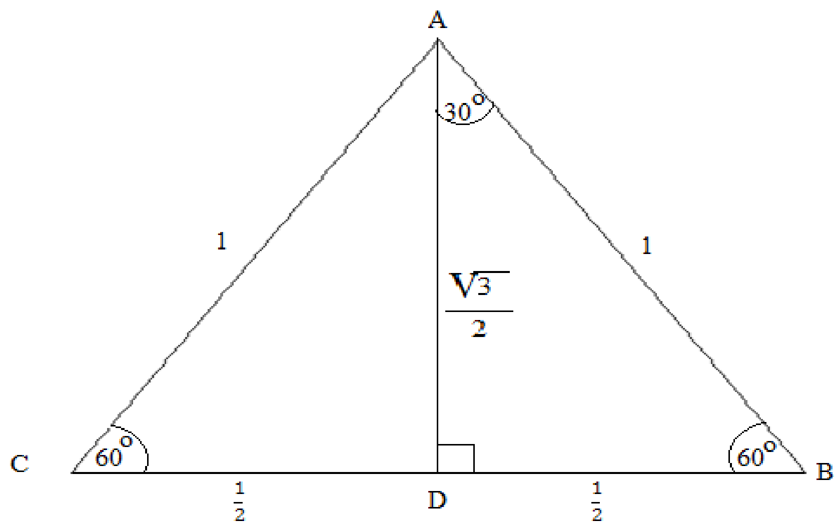
Step III: The Teacher explains to the learners how the Trigonometric ratios of Special

Angles $30^{\circ}, 45^{\circ},\ and\ 60^{\circ}$ can be derived.

Given an Isosceles triangle with unit length below,



Next, given an equilateral triangle of length unity, i.e



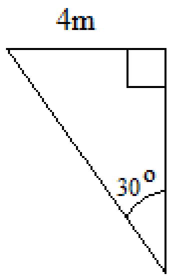
Step IV: The Teacher gives some examples:

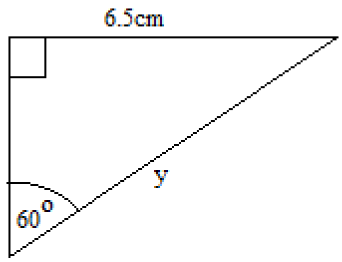
Simplify leaving your answer in Surd form:

(i). $\frac{Sin\,60^{\circ}}{Cos\,60^{\circ}} \times \frac{3\sqrt{3}}{2}$ (ii). $Sin30^{\circ} + Cos30^{\circ}$

Evaluation: The following is presented to the learners to solve:

(1). Find the value of the indicated sides of the figures below:

i. 

ii. 

(2). Simplify using special angle ratio $\frac{x^2+y^2}{y^2-x^2}$, where $x = Cos30^o$ and $y = Sin45^o$

(3). $\frac{Tan\ 60^o\ Sin30^o}{Tan30^o}$.

Conclusion: Exercises/assignment is given to learners.

APPENDIX C5

CONTROL GROUP LESSON PLAN **WEEK FIVE**

NAME: Ayuba, Jonah Anzah

SCHOOL: K.S.C.O.E. Gidan Waya.

COURSECONBN: Integrated Science

LEVEL: 100 Level

NO. **OFSTUDENTS**: 30 students

TIME: 2 Hours

SUBJECT: Mathematics for Science

TOPIC: Expansion and Factorisation of Quadratic Equations.

BEHAVIOURALOBJECTIVE: By the end of the lesson, learners should be able to:

i. Expand at least three (3) different pairs of factors that give rise to a quadratic equation.
ii. Factorise a factorisable quadratic equations and hence solve it.

PREVIOUS KNOWLEDGE: The learners have learnt to expand, factorise, and solve linear equation with one or two variables.

Introduction: The Teacher introduces the lesson by asking the learners to solve the following problems:

(i). $Expand\ \ 3(6-5x)-2(y+4)$
(ii). Factorise the expression $9x^2y+108x=0$
(iii). Solve the simultaneous linear equation $x+3y=5$and $4x-y=2$.

Presentation: Teacher presents the lesson in the following steps:
Step I: Teacher explains and show to learners how to expand quadratic factors using the following examples:

Expansion: This is defined as writing or expressing a two or more factors as a single expression.

Example

Expand the following: (i). $x(x-7)=2$ (ii). $(2x-1)(x+3)$

(iii). $5(4x+3)(x-y)=0$.

Step II: Teacher explains to learners what Factorisation means i.e, it is the writing of a single algebraic expression as a product of two or more factors. Researcher gives examples:

Factorise the following expressions and equations.

(i). $x^2 - 4x$ (ii). $x^2 + 5x + 6 = 0$ (iii). $15 - 2x - x^2$ (iv). $4x - 5x - 6 = 0$
(v). $8a^2 - 14a - 9$.

Step III: Teacher explains that not every quadratic equation is factorisable, hence other Methods (Completing the square, graphical method, and quadratic formular) are needed to solve such problems.

Factorise the equation, $3x^2 - 7x + 4 = 0$.

Evaluation: Teacherevaluates the lesson by giving the following problems to the learners to solve:

1. Expand the following: (i). $(m-5)^2$, (ii). $x(x-4)(x+6)$,
   (iii). $(1-3x)(7-x)$.
2. Factorise the following: (i). $2x^2 - 15x + 27$ (ii). $6x^2 + 13x - 5 = 0$.

Conclusion: Teacher checks learners' solution and makes general observations from their work, and then give the following assignment.

Assignment

Factorise: (1). $\mathrm{x}^2 + 8\mathrm{x} + 15$ (2). $\mathrm{x}^2 + 4\mathrm{x} - 21 = 0$ (3). $\mathrm{m}^2\mathrm{n}^2 + 4\mathrm{mn} - 21 = 0$
(4). $3\mathrm{x}^2 - 11\mathrm{x} + 6$ (5). $10\mathrm{p}^2 - 41\mathrm{p} + 45 = 0$

Expand: (1). $(4x-1)(2x+3) = 0$ (2). $(9+3n)(5-7n) = 0$ (3). $(11 - 4\mathrm{x})^2 = 0$
(4). $3y(2y+9)(5-y) = 0$ (5). $15\mathrm{a}(15 + 4\mathrm{a})^2 = 0$.

APPENDIX C6

CONTROL GROUP LESSON PLAN **WEEK SIX**

NAME: Ayuba, Jonah Anzah

SCHOOL: K.S.C.O.E. Gidan Waya.

COURSECONBN: Integrated Science

LEVEL: 100 Level

NO. **OFSTUDENTS**: 30 students

TIME: 2 Hours

SUBJECT: Mathematics for Science

TOPIC: Solutions of Linear Equations with one or two Variable(s).

BEHAVIOURALOBJECTIVE: By the end of the lesson, learners should be able to:

i. Solve at least three (4) out of five linear equations with one variable accurately.
ii. Solve at least three (4) out of five linear equations with two variable accurately

PREVIOUS KNOWLEDGE: The learners have been taught to expand and factorise algebraic expressions and quadratic equations.

Introduction: The Teacher introduces the lesson by asking the learners to expand the factors

$(x-1)(x-4)=0$and factorise the quadratic equation $5y^2-9y-2=0$.

Presntation: Teacher presents the lesson in the following steps:

Step I: Teacher defines a linear equations and gives examples.

Linear Equations: These are Mathematical equations/relationship between two variables that represents a straight line when plotted on the x – y plane, and the power of the variables is one and only one.

Examples are:

(i). $6x+10=0$ (ii). $4x-8=0$ (iii). $3x-2y=1$.

Step II: Teacher explains the process of solving linear equations with one variable.

Solve the following:

(i). $6x+10=0$ (ii). $4x-8=0$ (iii). $6x+10=4x-8$

Step III: Teacher explains to learners that there are several methods of solving linear equations having two variables, however, we shall be looking at two methods:

i. Substitution method
ii. Elimination method

Substitution Method

Solve the following pairs of simultaneous linear equations by Substitution method.

(i). $3x - 4y = 5$ (ii). $9x - 2y = 8$

$2x + y = 512x + 5y = 7$

Elimination Method

Solve by elimination method:

(i). $2x - y = 5$ (ii). $x + y = 13$

$5x + 3y = -24x + y = -5$

Evaluation: Teacher evaluates the lesson by asking the learners to Solve the following two problems:

1. Find the value of x if $4(x - 7) = 2(1 - 2x)$
2. Solve by substitution method $x + y = 3$; $5x + 2y = 1$
3. Solve the equation in No.2 by elimination method.

Conclusion: The lesson is concluded by revising the steps required to solve linear equations an gives the learners home work.

Assignment

Solve the following:

1. $3x(6 - 5x) + 5x(3x - 2) = 7$
2. $(5x - 3)\frac{4}{3} = \frac{1}{4}(x + 1)$
3. $4x + 2y = 7$; $x + 3y = 7$
4. $2x + 2y = 5$; $2x + 3y - 11 = 0$
5. $8x + 5y = -3$; $33x - 7y = 4$
6. $3x - 4y = 0$; $55x - 2y = 7$.

APPENDIX D1

EXPERIMENTAL GROUP LESSON PLAN **WEEK ONE**

NAME: Ayuba, Jonah Anzah

SCHOOL: K.S.C.O.E. Gidan Waya.

COURSECONBN: Integrated Science

LEVEL: 100 Level

NO. **OFSTUDENTS**: 30 students

TIME: 2 Hours

SUBJECT: Mathematics for Science

TOPIC: Graphs

BEHAVIOURALOBJECTIVE: By the end of the lesson, learners should be able to:

1). Define what a graph is
2). Mention three types of graphs with example
3). Write the general form of a straight line equation
4). Find the slope/gradient between any two given points
5). Determine the straight line equation passing through the given two points in nos 4
6). Plot correctly a simple straight line equation on the x – y axes.

SRL I:

- The Teacher sets the above objectives as the goals for the learners to attain during Self – Regulation learning. Let the learners write down these goals in their note.
- Learners are helped to develop a positive mindset towards the lesson
- Learners are to consider the following questions
  - When will start?
  - Where will I start?
  - How will I get there?
  - What conditions will help or hinder my learning?

PREVIOUS KNOWLEDGE: It is assumed that students have been taught simple graphs at Senior Secondary School level. Example include linear graph of one or two variable, pie – chart, bar – chart, histogram, and Ogive.

INTRODUCTION: The Teacher asks the following questions to enable him have an idea on the level of entering behaviour the learners have.

1). Mention the types of graphs you know. Researcher writes them as the student respond.

2). Which of the above graphs is easy to plot?

3). How many can plot the graph in 2 above?

PRESENTATION OF LESSON: Lesson is presented in the following steps.

Step I: Teacher defines what a graph is and explains to the students the types available.

Definition of Graphs: Graphs are diagrammatic representation of précised information

Types of graphs: There are three (3) types of graphs viz:

i. Graphical example geometrical figures, pie – chart, bar – chart, histogram.
ii. Numerical. Example is table of values
iii. Algebraic. Example is the line equations, y = mx + c

Step II:Teacher mentions to the students that we will be dealing with the algebraic type of graphs:

i. $y = mx + c$ ii. $y = x^2$iii. $y = \frac{1}{x}$ iv. $y = \sin x$

v.$y = \cos x$ vi. $y = e^{nx}$

Now, General form of a straight line equation. Any straight line can be represented in the form $y = mx + c$, where m is the slope or gradient of the line and c is the constant or intercept of the line.

Examples are:

i. $2x - y = 6$ ii. $3y + 5x + 3 = 0$iii. $\frac{2x}{3} + \frac{y}{4} = \frac{1}{2}$

These equations can all be written in the standard form, that is

i. $2x - y = 6 \Rightarrow y = 2x - 6$and $m = 2$ *and* $c = -6$.

ii. $3y + 5x + 3 = 0 \Rightarrow y = -\frac{5}{3}x - 1$andm = $-\frac{5}{3}$ and c = -1

iii. $\frac{2x}{3} + \frac{y}{4} = \frac{1}{2} \Rightarrow y = -\frac{8}{3}x + \frac{6}{2}$and $m = -\frac{8}{3}$ *and* $c = 3$.

The slope or gradient between any given two points $P(x_1, y_1)$ and Q(x_2, y_2) is given by the relation

Gradient $m = \frac{y_2 - y_1}{x_2 - x_1}$.

Thus, find the slope m, between the following pairs of points.

(1). A(3,5) and B(-2,7) (2). H(-4,-1) and K(-5,-4) (3). L($\frac{1}{3}$, $\frac{1}{5}$) and M(3,2)

Step III: Finding the equation of a straight line between two given points

The Teacher explains to the learners the procedure for finding the equation of the straight line passing through two points.

Find the equation the straight line passing through the following pairs of points:

i). (3,5) and (8,6)   ii). (-1,0) and (4,-2)   iii). $\left(\frac{2}{3}, \frac{3}{5}\right)$ and $(\frac{1}{3}, \frac{1}{5})$

Step IV: Plotting a straight line equation.

To plot a straight line equation on the x – y axes, do the following:

1. Determine at least three points of the given equation
2. Tabulate the values of x and y from (i)
3. Draw axes , scale , and plot the tabulated values.

SRL II : The following questions become relevant:

- Are the learners accomplishing what they hoped to do?
- Are they distracted from paying attention to the lesson?
- Is the task taking more time than expected?
- What questions can they ask themselves while they are working?
- How can they encourage themselves to keep working?

Evaluation: Teacher evaluates the lesson by asking the following question

1. State with examples three (3) types of graphs
2. State and write the general form of a straight line equation
3. Express the equation $3x + 14y + 9 = 0$ in the form $y = mx + c$, and find the value of the slope and constant of the straight line.
4. Calculate the slope of a line passing through the points (-11, 6) and (-5,8)
5. Determine the equation that passes through the point in iv above

SRL III : This level involves reflection and the following questions should be addressed:

- Did the learners accomplish what they planned to do?
- Where they distracted and how did they get back to work?
- Did they have enough time or they needed more time than they thought?
- Under what conditions do they accomplish the most work?

Conclusion: The Teacher gives the learners' assignment to do at home.

Plot the equations below:

1. $y = 2x - 4$ for $-2 \leq x \leq 3$; scale: 2cm =1 unit on x – axis and 2cm = 1 unit on y – axis
2. $2x + y = 3$ for $-2 \leq x \leq 5$: scale: 2cm = I unit on x – axis, and 2cm = 5 units on y – axis

APPENDIX D2

EXPERIMENTAL GROUP LESSON PLAN **WEEK TWO**

NAME: Ayuba, Jonah Anzah

SCHOOL: K.S.C.O.E. Gidan Waya.

COURSECONBN: Integrated Science

LEVEL: 100 Level

NO. **OFSTUDENTS**: 30 students

TIME: 2 Hours

SUBJECT: Mathematics for Science

TOPIC: Graphs of Common Plots ($y = x^2$; $y = \frac{1}{x}$; $y = \sin x$; $y = \cos x$) and Rate of Change.

BEHAVIOURALOBJECTIVE: By the end of the lesson, learners should be able to:

i. Plot accurately any of the graphs with a maximum of one error
ii. Find the rate of change or differentiate a simple equation.

SRL I :

- The Teacher sets the above objectives as the goals for the learners to attain during Self – Regulation learning. Let the learners write down these goals in their note.
- Learners are helped to develop a positive mindset towards the lesson
- Learners are to consider the following questions
  - When will start?
  - Where will I start?
  - How will I get there?
  - What conditions will help or hinder my learning?

PREVIOUS KNOWLEDGE: Learners have been taught the following topics:

i. Types of graphs
ii. General form of a straight line equation
iii. Determining the slope and constant of any given straight line equation, and
iv. Finding the equation of a straight line passing through any given two points.

Introduction: The Teacher introduces the lesson by asking the learners' the following Questions based on their previous Knowledge:

Define a graph and mention the types you know.

i. State the general form of a straight line equation

ii. Explain how to determine the slope and equation of straight line passing through the points (3,1) and (-2,2).

PRESENTATION: Teacher presents his lesson in the following steps:

Step I: The Teacher explains the shape and direction of the graph $= x^2$, i.e

Step II: Also, the Teacher explains to learners' the process of plotting the quadratic graph.

Plot the following graphs with the given information:

i). $y = x^2 - 2x - 2 \quad for \; -4 \leq x \leq +4$

ii). $y = \frac{1}{x} \quad for \; -2 \leq x \leq +2$

iii). $y = \sin x \quad for \; \theta^{\circ} \leq x \leq 360^{\circ}$

iv). $y = \cos x \; for \; \theta^{\circ} \leq x \leq 360^{\circ}$

Step II: Rate of Change

Definition of Rate of Change

The Researcher explains to the learners' the principles in Rate of change of a function.

Given a function, $y = x$ - - - - - -(*)

and P a point $P(x, y)$ moving to $Q(x + \delta x, \; y + \delta y)$

Let δx be a small change in x and δy be a corresponding small change in y.

Then, (*) becomes $y + \delta y = x + \delta x$

Subtract y from both sides, get,

$\delta y = x + \delta x - y$, but $y = x$

Thus, we have $\delta y = x + \delta x - x$

i.e $\delta y = \delta x$

Divide both sides by δx, get $\frac{\delta y}{\delta x} = \frac{\delta x}{\delta x}$

i.e$\frac{\delta y}{\delta x} = 1$ which is a constant.

Now, take limit of both side as $x \rightarrow 0$,$y \rightarrow 0$, $\delta x \rightarrow dx$ and $\delta y \rightarrow dy$

i.e$\lim_{x \to 0} \frac{\delta y}{\delta x} \rightarrow \frac{dy}{dx}$ which defines the rate of change in x with corresponding change in y.

This is called the Differential of $y = f(x)$ with respect to x which is the tangent or slope of the given equation.

Now, the general form of differentiation is given as

$if\ y = x^n$ where n is a constant, then

$$\frac{dy}{dx} = n\, x^{n-1}$$

Note: The differential coefficient of a constant is zero, i.e

If $y = c$ then $\frac{dy}{dx} = 0$

Example: Find the differential coefficient or tangent/slope of the following equations:

i). $y = 3x - 4$ ii). $y = 7x^2 - 5x + 9$ iii). $2x - y + 11 = 0$

iv). $y = x^2 - 2x - 2$ at the point $(-1,6)$.

SRL II : The following questions become relevant:

- Are the learners accomplishing what they hoped to do?
- Are they distracted from paying attention to the lesson?
- Is the task taking more time than expected?
- What questions can they ask themselves while they are working?
- How can they encourage themselves to keep working?

Evaluation: The following questions are presented to the learners to solve.

1. Construct the table of values, and hence draw the graph of the function
$$y = -3x + 12x\ for - 2 \leq x \leq 6$$
2. Determine the differential coefficient of the following equations:
(i). $2x - 4y = -7$ (ii). $y = -9x + 4x - 3$ (iii). $y = 5x^3 + 6x^2 - 14x - 11$

SRL III : This level involves reflection and the following questions should be addressed:

- Did the learners accomplish what they planned to do?
- Where they distracted and how did they get back to work?
- Did they have enough time or they needed more time than they thought?
- Under what conditions do they accomplish the most work?

Conclusion: Lesson is concluded by the Teacher giving assignment to the learners.

i. Construct the table of values and draw the graph of the equation
$$y = x^2 - x - 2\ for\ -3 \leq x \leq +3$$
ii. Draw the graph of $\sin\theta\ \ for\ \ 0^\circ \leq \theta \leq 360^\circ$

APPENDIX D3

EXPERIMENTAL GROUPLESSON PLAN **WEEK THREE**

NAME: Ayuba, Jonah Anzah

SCHOOL: K.S.C.O.E. Gidan Waya.

COURSECONBN: Integrated Science

LEVEL: 100 Level

NO. **OFSTUDENTS**: 30 students

TIME: 2 Hours

SUBJECT: Mathematics for Science

TOPIC: Areas and volume of Cubes, Cuboids, Cylinders, and Spheres..

BEHAVIOURALOBJECTIVE: By the end of the lesson, learners should be able to:

i. Calculate accurately to any given approximation the surface area of Cubes, Cuboids, Cylinders, and Spheres.
ii. Calculate the volume of the solids in I above.
iii. To determine the Surface area and volume of any figure formed by a combination of the above solids.

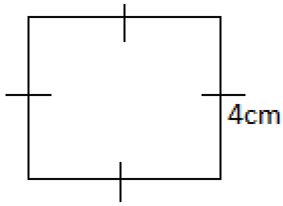
SRL I :

- The Teacher sets the above objectives as the goals for the learners to attain during Self – Regulation learning. Let the learners write down these goals in their note.
- Learners are helped to develop a positive mindset towards the lesson
- Learners are to consider the following questions
  - When will start?
  - Where will I start?
  - How will I get there?
  - What conditions will help or hinder my learning?

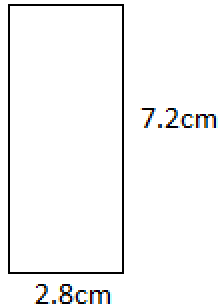
PREVIOUS KNOWLEDGE: The learners have been taught to find /calculate the area of plain figures/shapes, like Squares, Rectangle, Circles, and Sectors of circles.

Introduction: The Teacher introduces the lesson by asking the learners' to calculate the area of the following figures:

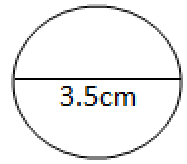
1.



2.



3.



PRESENTATION: Teacher presents his lesson in the following steps:

Step I: Teacher explains to the learners that Solids are 3 – dimensional figures, i.e they have Length, Width, and Height. Examples are drawn for the learners to see.

1. **Cube**: This is a solid three-dimensional geometric figure bounded by six planes;

   each of the six sides or faces of a cube is a square (see Figure below).

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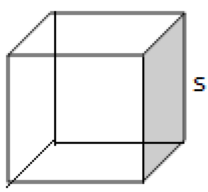
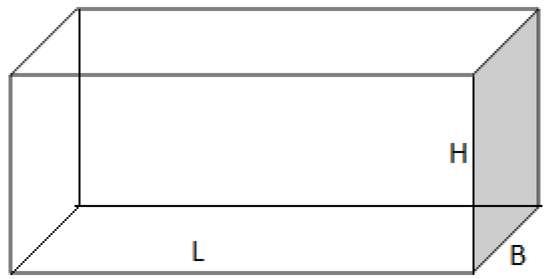


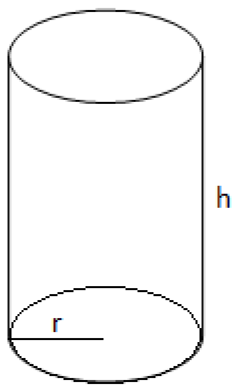
Cube

2. **Cuboid**:This is a six-sided three-dimensional prism whose faces are all rectangles. An example of a Cuboid is a brick. See the figure below:



Cuboid

3. **Cylinder**:This is a three-dimensional geometric figure. A *circular cylinder* consists of two circular bases of equal area that are in parallel planes, and are connected by a *lateral surface* that intersects the boundaries of the bases. See the figure below:



Cylinder

The volume of a circular cylinder is $\pi r^2 h$, where r is the radius of the bases, and h is the perpendicular distance between the planes that contain the bases. In a *right circular cylinder*, the lateral surface is perpendicular to the bases. The lateral surface area of a right circular cylinder is $2\pi rh$,, and the total surface area is $2\pi r(r+h)$.

Step II: The Teacher explains to learners how to calculate the area and volume of the given solids.

For Cube

If s is the length of one of the 12 equal edges, then

$$Total\ Surface\ Area = 6s^2 square\ units$$

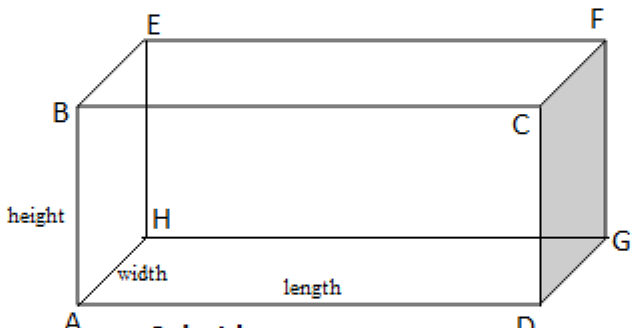
$$Volume = \ s^3\ cubic\ units$$

Example: i. Calculate the surface area and volume of a cube whose side is 4m.
ii.The perimeter of one face of a cube is 26cm, determine the area and volume

of the cube.

For Cuboids

The Teacher uses a diagram and explain to the Learners that Cuboids has three dimensional faces, each with an equal and opposite face. i.e a total of six faces.



Thus, **Surface Area** of the tree dimensional faces = $lb\ sq\ unit + bh\ sq\ unit + lh\ sq\ unit.$

Since each face has an equal opposite face, it follows that

Total Surface Area of the Cuboid = $2lb\ sq\ unit + 2bh\ sq\ unit + 2lh\ sq\ unit$

i.e**Total surface Area of Cuboid** = $2(lb + bh + lh)$ square unit.

Volume of Cuboid= $lbh\ cubic\ unit.$

Example: Calculate the total surface area and volume of a Cuboid with length 2.9cm, breadth 1.6cm, and height 5.2cm

For Sphere

The Surface Area of a Sphere is given by

S.A = $\boldsymbol{4\pi r^2}$square unit, where r is the radius of the Sphere.

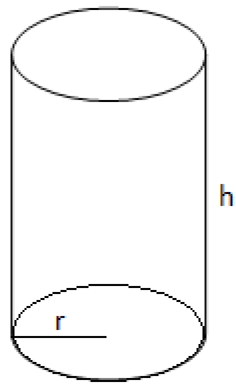
While Volume of a Sphere is given by

VOL. = $\boldsymbol{\frac{4}{3}\pi r^3}$cubic unit, where r is the radius of the Sphere.

Example: i**)**. Find the surface area and volume of a sphere whose diameter is 16.7cm

ii). Calculate the surface area and volume of a semi – hemisphere with radius 13cm.

For Cylinder



Cylinder

Curved Surface area of a Cylinder = $\boldsymbol{2\pi rh}$ square units
whereπ is a constant approximately equal to 3.13159, r is the radius of the cylinder, and h is the height of the cylinder.

Total surface area of a Cylinder = $\boldsymbol{2\pi r^2 + 2\pi rh}$
= $\boldsymbol{2\pi r(r+h)}$**square units.**

Volume of a Cylinder =$\boldsymbol{\pi r^2 h}$**cubic unit.**

Example: i**).** Calculate the Curved Surface area and Volume of a cylinder having radius as 11.2cm and height 22cm.[Take $\pi = \frac{22}{7}$]

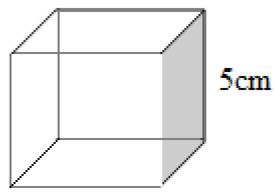
ii). Calculate the Total Surface area and Volume of a cylinder with diameter 8.6m and height 7.2m [Take $\pi = \frac{22}{7}$].

SRL II : The following questions become relevant:

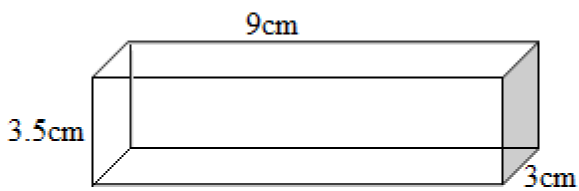
- Are the learners accomplishing what they hoped to do?
- Are they distracted from paying attention to the lesson?
- Is the task taking more time than expected?
- What questions can they ask themselves while they are working?
- How can they encourage themselves to keep working?

Evaluation: The Teacher evaluates the lesson by presenting the following questions to learners to solve:

(1). Calculate the S.A. and Volume of the figures:



i). ii).



(2). Find the Curved Surface area, Total Surface area, and Volume of a Cylinder with diameter 7.3cm and height 17cm.

(3). Determine the Surface area and Volume of a Sphere whose diameter is 8.4cm

SRL III : This level involves reflection and the following questions should be addressed:

- Did the learners accomplish what they planned to do?
- Where they distracted and how did they get back to work?
- Did they have enough time or they needed more time than they thought?
- Under what conditions do they accomplish the most work?

Conclusion: The lesson is concluded by giving the learners homework to do.

APPENDIX D4

EXPERIMENTAL GROUP LESSON PLAN **WEEK FOUR**

NAME: Ayuba, Jonah Anzah

SCHOOL: K.S.C.O.E. Gidan Waya.

COURSECONBN: Integrated Science

LEVEL: 100 Level

NO. **OFSTUDENTS**: 30 students

TIME: 2 Hours

SUBJECT: Mathematics for Science

TOPIC: Trigonometric Ratios and Special Angles with simple Application.

BEHAVIOURALOBJECTIVE: By the end of the lesson, learners should be able to:

i. Define trigonometric ratios of Sine, Cosine, and Tangents of acute angles using a right – angled triangle.
ii. Apply the definition in a right – angled triangle to solve simple problems on lengths and distances.
iii. Derive at least five (5) trigonometric ratios of Special angles.

SRL I :

- The Teacher sets the above objectives as the goals for the learners to attain during Self – Regulation learning. Let the learners write down these goals in their note.
- Learners are helped to develop a positive mindset towards the lesson
- Learners are to consider the following questions
  - When will start?
  - Where will I start?
  - How will I get there?
  - What conditions will help or hinder my learning?

PREVIOUS KNOWLEDGE: The learners have been taught Fractions, simple Ratios, Pythagoras theorem and its application, and a little on Surds.

Introduction: The Teacher introduces the lesson by asking the learners to give, or list examples of ratios, and triangles. Also, learners are asked to state the Pythagoras theorem.

Presentation: Teacher presents the lesson in the following steps:

Step I: The Teacher uses a right – angled triangle to defines the trigonometric ratios for Sine, Cosine, and Tangent of the indicated acute angle.

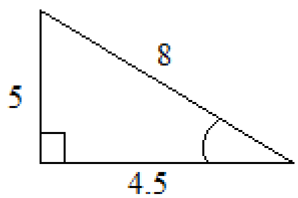
Thus, $Sin\theta = \frac{OPPOSITE}{HYPOTENUSE} = \frac{OPP}{HYP}$ i.e $Sin\theta = \frac{AO}{AB}$

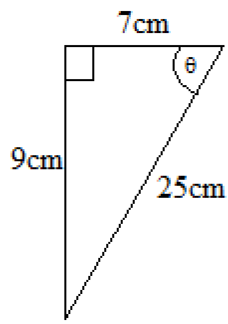
$Cos\theta = \frac{ADJACENT}{HYPOTENUSE} = \frac{ADJ}{HYP}$ i.e $Cos\theta = \frac{OB}{AB}$

$Tan\theta = \frac{OPPOSITE}{ADJACENT} = \frac{OPP}{ADJ}$ i.e $Tan\theta = \frac{AO}{OB}$

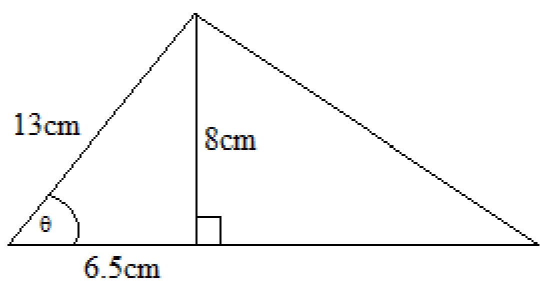
Step II: Examples are given to find the trigonometric ratios.

1. Find the Sine, Cosine, and Tangent of the indicated acute angles in the following diagrams:

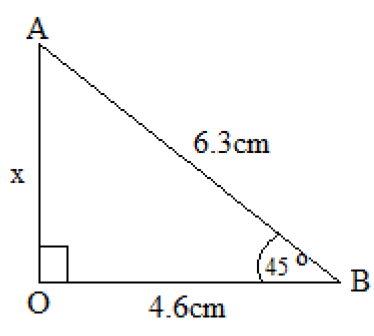


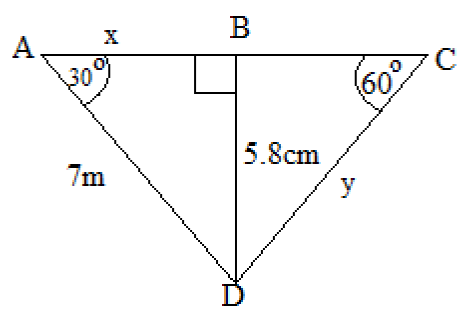


(i). (ii). (iii).



2. Find the value of the indicated sides in the figures below:



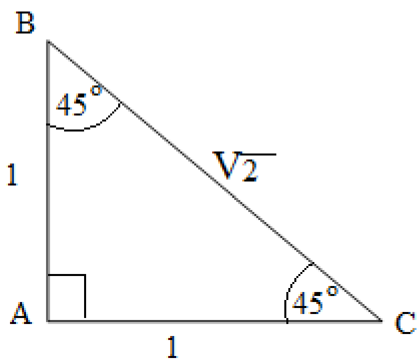


(i). (ii).

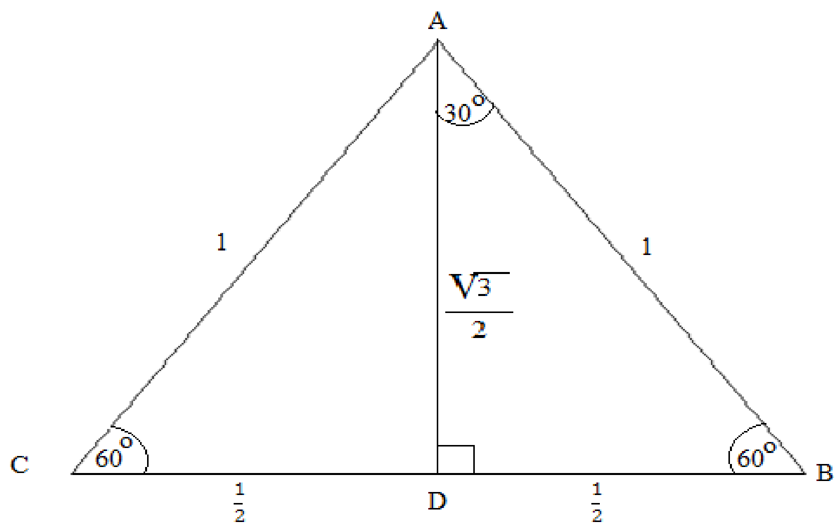
Step III: The Teacher explains to the learners how the Trigonometric ratios of Special

Angles $30^{\circ}, 45^{\circ}$, and 60° can be derived.

Given an Isosceles triangle with unit length below,



Next, given an equilateral triangle of length unity, i.e



Step IV: The Teacher gives some examples:

Simplify leaving your answer in Surd form:

(i). $\frac{Sin\,60^{\circ}}{Cos\,60^{\circ}} \times \frac{3\sqrt{3}}{2}$ (ii). $Sin30^{\circ} + Cos30^{\circ}$

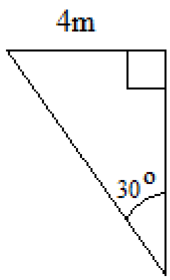
SRL II : The following questions become relevant:

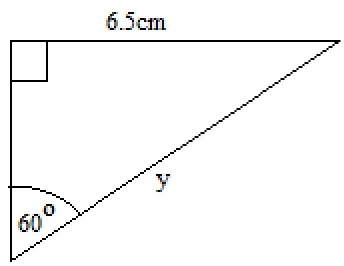
- Are the learners accomplishing what they hoped to do?

– Are they distracted from paying attention to the lesson?
– Is the task taking more time than expected?
– What questions can they ask themselves while they are working?
– How can they encourage themselves to keep working?

Evaluation: The following is presented to the learners to solve:

(1). Find the value of the indicated sides of the figures below:

i. 

ii. 

(2). Simplify using special angle ratio $\frac{x^2+y^2}{y^2-x^2}$, where $x = Cos30^o$ and $y = Sin45^o$

(3). $\frac{Tan\ 60^o\ Sin30^o}{Tan30^o}$.

SRL III : This level involves reflection and the following questions should be addressed:

– Did the learners accomplish what they planned to do?
– Where they distracted and how did they get back to work?
– Did they have enough time or they needed more time than they thought?
– Under what conditions do they accomplish the most work?

Conclusion: Exercises/assignment is given to learners.

APPENDIX D5

EXPERIMENTAL GROUP LESSON PLAN **WEEK FIVE**

NAME: Ayuba, Jonah Anzah

SCHOOL: K.S.C.O.E. Gidan Waya.

COURSECONBN: Integrated Science

LEVEL: 100 Level

NO. **OFSTUDENTS**: 30 students

TIME: 2 Hours

SUBJECT: Mathematics for Science

TOPIC: Expansion and Factorisation of Quadratic Equations.

BEHAVIOURALOBJECTIVE: By the end of the lesson, learners should be able to:

i. Expand at least three (3) different pairs of factors that give rise to a quadratic equation.

ii. Factorise a factorisable quadratic equations and hence solve it.

SRL I :

- The Teacher sets the above objectives as the goals for the learners to attain during Self – Regulation learning. Let the learners write down these goals in their note.
- Learners are helped to develop a positive mindset towards the lesson
- Learners are to consider the following questions
  - When will start?
  - Where will I start?
  - How will I get there?
  - What conditions will help or hinder my learning?

PREVIOUS KNOWLEDGE: The learners have learnt to expand, factorise, and solve linear equation with one or two variables.

Introduction: The Teacher introduces the lesson by asking the learners to solve the following problems:

(i). $Expand\ \ 3(6-5x)-2(y+4)$

(ii). Factorise the expression $9x^2y+108x=0$

(iii). Solve the simultaneous linear equation $x+3y=5$and $4x-y=2$.

Presentation: Teacher presents the lesson in the following steps:

Step I: Teacher explains and show to learners how to expand quadratic factors using the following examples:

Expansion: This is defined as writing or expressing a two or more factors as a single expression.

Example

Expand the following: (i). $x(x-7)=2$ (ii). $(2x-1)(x+3)$

(iii). $5(4x+3)(x-y)=0$.

Step II: Teacher explains to learners what Factorisation means i.e, it is the writing of a single algebraic expression as a product of two or more factors. Researcher gives examples:

Factorise the following expressions and equations.

(i). x^2-4x (ii). $x^2+5x+6=0$ (iii). $15-2x-x^2$ (iv). $4x-5x-6=0$

(v). $8a^2-14a-9$.

Step III: Teacher explains that not every quadratic equation is factorisable, hence other Methods (Completing the square, graphical method, and quadratic formular) are needed to solve such problems.

Factorise the equation, $3x^2-7x+4=0$.

SRL II : The following questions become relevant:

- Are the learners accomplishing what they hoped to do?
- Are they distracted from paying attention to the lesson?
- Is the task taking more time than expected?
- What questions can they ask themselves while they are working?
- How can they encourage themselves to keep working?

Evaluation: Teacherevaluates the lesson by giving the following problems to the learners to solve:

1. Expand the following: (i). $(m-5)^2$, (ii). $x(x-4)(x+6)$,
   (iii). $(1-3x)(7-x)$.
2. Factorise the following: (i). $2x^2-15x+27$ (ii). $6x^2+13x-5=0$.

SRL III : This level involves reflection and the following questions should be addressed:

- Did the learners accomplish what they planned to do?
- Where they distracted and how did they get back to work?
- Did they have enough time or they needed more time than they thought?
- Under what conditions do they accomplish the most work?

Conclusion: Teacher checks learners' solution and makes general observations from their work, and then give the following assignment.

Assignment

Factorise: (1). $x^2 + 8x + 15$ (2). $x^2 + 4x - 21 = 0$ (3). $m^2n^2 + 4mn - 21 = 0$

(4). $3x^2 - 11x + 6$ (5). $10p^2 - 41p + 45 = 0$

Expand: (1). $(4x - 1)(2x + 3) = 0$ (2). $(9 + 3n)(5 - 7n) = 0$ (3). $(11 - 4x)^2 = 0$

(4). $3y(2y + 9)(5 - y) = 0$ (5). $15a(15 + 4a)^2 = 0$.

APPENDIX D6

EXPERIMENTAL GROUPLESSON PLAN **WEEK SIX**

NAME: Ayuba, Jonah Anzah

SCHOOL: K.S.C.O.E. Gidan Waya.

COURSECONBN: Integrated Science

LEVEL: 100 Level

NO. **OFSTUDENTS**: 30 students

TIME: 2 Hours

SUBJECT: Mathematics for Science

TOPIC: Solutions of Linear Equations with one or two Variable(s).

BEHAVIOURALOBJECTIVE: By the end of the lesson, learners should be able to:

i. Solve at least three (4) out of five linear equations with one variable accurately.
ii. Solve at least three (4) out of five linear equations with two variable accurately

SRL I :

- The Teacher sets the above objectives as the goals for the learners to attain during Self – Regulation learning. Let the learners write down these goals in their note.
- Learners are helped to develop a positive mindset towards the lesson
- Learners are to consider the following questions
  - When will start?
  - Where will I start?
  - How will I get there?
  - What conditions will help or hinder my learning?

PREVIOUS KNOWLEDGE: The learners have been taught to expand and factorise algebraic expressions and quadratic equations.

Introduction: The Teacher introduces the lesson by asking the learners to expand the factors $(x-1)(x-4)=0$and factorise the quadratic equation $5y^2-9y-2=0$.
Presntation: Teacher presents the lesson in the following steps:
Step I: Teacher defines a linear equations and gives examples.

Linear Equations: These are Mathematical equations/relationship between two variables that represents a straight line when plotted on the x – y plane, and the power of the variables is one and only one.

Examples are:

(i). $6x + 10 = 0$ (ii). $4x - 8 = 0$ (iii). $3x - 2y = 1$.

Step II: Teacher explains the process of solving linear equations with one variable.

Solve the following:

(i). $6x + 10 = 0$ (ii). $4x - 8 = 0$ (iii). $6x + 10 = 4x - 8$

Step III: Teacher explains to learners that there are several methods of solving linear equations having two
variables, however, we shall be looking at two methods:

iii. Substitution method
iv. Elimination method

Substitution Method

Solve the following pairs of simultaneous linear equations by Substitution method.

(i). $3x - 4y = 5$ (ii). $9x - 2y = 8$

$2x + y = 512x + 5y = 7$

Elimination Method

Solve by elimination method:

(i). $2x - y = 5$ (ii). $x + y = 13$

$5x + 3y = -24x + y = -5$

SRL II : The following questions become relevant:

- Are the learners accomplishing what they hoped to do?
- Are they distracted from paying attention to the lesson?
- Is the task taking more time than expected?
- What questions can they ask themselves while they are working?
- How can they encourage themselves to keep working?

Evaluation: Teacher evaluates the lesson by asking the learners to Solve the following two problems:

1. Find the value of x if $4(x - 7) = 2(1 - 2x)$
2. Solve by substitution method $x + y = 3$; $5x + 2y = 1$
3. Solve the equation in No.2 by elimination method.

SRL III : This level involves reflection and the following questions should be addressed:

- Did the learners accomplish what they planned to do?
- Where they distracted and how did they get back to work?
- Did they have enough time or they needed more time than they thought?

– Under what conditions do they accomplish the most work?

Conclusion: The lesson is concluded by revising the steps required to solve linear equations an gives the learners home work.

Assignment
Solve the following:

1. $3x(6-5x)+5x(3x-2)=7$
2. $(5x-3)\frac{4}{3}=\frac{1}{4}(x+1)$
3. $4x+2y=7$; $x+3y=7$
4. $2x+2y=5$; $2x+3y-11=0$
5. $8x+5y=-3$; $33x-7y=4$
6. $3x-4y=0$; $55x-2y=7$.

APPENDIX E

Mathematics Self-Concept Questionnaire (MSCQ)

Student's No: | | | | | |

Age: ....**Sex**:......................**Date**:....................... Total Score | | | |

This questionnaire deals with Mathematics Self – Efficacy, Beliefs, Interest, and Anxiety which students have about themselves.

Please indicate how much you agree or disagree with each statement by ringing or ticking (√) the single number in each section which represents how you typically feel most of the time.

Since students vary so much in the opinions they hold, there are no right or wrong answers.

KEY:

STRONGLY CONFIDENT	CONFIDENT	UNSURE	NOT CONFIDENT	STRONGLY NOT CONFIDENT
SC	C	U	NC	SNC

Mathematics Self - Efficacy

S/NO	**How confident do you feel about doing any of the following Mathematics task?**	**1 SC**	**2 C**	**3 U**	**4 NC**	**5 SNC**
1	Using a train timetable to work out how long it would take to get from one place to another	1	2	3	4	5
2	Calculating how much cheaper a TV would be after a discount of 30%	1	2	3	4	5
3	Calculating how many square metres of carpet you need to cover a floor	1	2	3	4	5
4	Understanding graphs presented in lecture notes	5	4	3	2	1
5	Solving an equation like 3x + 5 = 17	5	4	3	2	1
6	Finding the actual distance between two places on a map with a 1:10,000 scale	1	2	3	4	5
7	Calculating the petrol consumption rate of a car	5	4	3	2	1

Mathematics Beliefs

STRONGLY CONFIDENT	CONFIDENT	UNSURE	NOT CONFIDENT	STRONGLY NOT CONFIDENT
SC	C	U	NC	SNC

S/NO	**Thinking about studying Mathematics: To what extent do you agree with the following?**	**1 SC**	**2 C**	**3 U**	**4 NC**	**5 SNC**
1	I am not just good at mathematics	1	2	3	4	5
2	I get good marks in Mathematics	1	2	3	4	5
3	I learn Mathematics quickly	1	2	3	4	5
4	I have always believed that Mathematics is one of my best subjects	1	2	3	4	5
5	In my Mathematics class, I understand even the most difficult work	1	2	3	4	5

Mathematics Interest

STRONGLY CONFIDENT	CONFIDENT	UNSURE	NOT CONFIDENT	STRONGLY NOT CONFIDENT
SC	C	U	NC	SNC

S/NO	**Thinking about your views on Mathematics: To what extent do you agree with the following?**	**1 SC**	**2 C**	**3 U**	**4 NC**	**5 SNC**
1	I enjoy reading about Mathematics	1	2	3	4	5
2	I look forward to my Mathematics lessons	1	2	3	4	5
3	I do Mathematics because I enjoy it	1	2	3	4	5
4	I am interested in the things I learn in Mathematics	1	2	3	4	5

Mathematics Anxiety

STRONGLY CONFIDENT	CONFIDENT	UNSURE	NOT CONFIDENT	STRONGLY NOT CONFIDENT
SC	C	U	NC	SNC

S/NO	**Thinking about studying Mathematics: To what extent do you agree with the following?**	**1 SC**	**2 C**	**3 U**	**4 NC**	**5 SNC**
1	I often worry that it will be difficult for me in Mathematics classes	1	2	3	4	5
2	I get very tense when I have to do Mathematics homework	1	2	3	4	5
3	I get very nervous when doing Mathematics problems	1	2	3	4	5
4	I feel helpless when doing a Mathematics problem	1	2	3	4	5
5	I worry that I will get poor marks in Mathematics	1	2	3	4	5

Scores on the MSCQ

Level	Limit of Score	Interpretation
1	121 – 150	High Self – Concept
2	91 – 120	Above average Self – Concept
3	61 – 90	Average Self – Concept
4	31 – 60	Below average Self – Concept
5	0 – 30	Low Self – Concept

APPENDIX F

TABLE OF SPECIFICATION FOR MSCQ

Distribution of MSCQ items Under Bloom's Taxonomy

S/NO	Domain	No. of items	%
1	Cognitive	8	36.36
2	Affective	14	63.64
3	Psychomotor	0	0.00
Total		**22**	**100**

S/NO	SUB – LEVEL	Weight %	Levels for Affective Domain					Total
			REC	RES	VAL	ORG	INT.VAL	
1	Mathematics Self - Efficacy	36.36	0	0	0	0	8	8
2	Mathematics Self – Beliefs	22.73	3	0	0	2	0	5
3	Mathematics Interest	18.18	0	3	0	1	0	4
4	Mathematics Anxiety	22.73	0	1	4	0	0	5
Total		**100%**	**3**	**4**	**4**	**3**	**8**	**22**

Key: REC → Receiving

RES → Responding

VAL → Valuing

ORG → Organization

INT. VAL → Internalizing Values

APPENDIX G

SRL QUESTIONAIRE

Student's No:. | | | | | |

Age: ....**Sex**:......................**Date**:.......................... Total Score: | | | |

Self-Regulation Strategy Inventory – Self-Report

Directions: The purpose of this section is to see how often you do certain things in **MATH**. For each statement, please fill in or tick **ONE** of the five options to indicate the extent or deptyou do each of these things when doing homework for **MATH** or studying for **MATH** tests.

To answer these questions, use the following 5-point scale:

Strongly Disagree S A	**Disagree D**	**Unsure or Uncertain U**	**Agree A**	**Strongly Agree S A**
1	2	3	4	5

S/No	How OFTEN do you do the following things when studying or doing homework for MATH…	S D	D	U	A	S A
1	I make sure no one disturbs me when I study Mathematics	1	2	3	4	5
2	I try to study Mathematics in a quiet place.	1	2	3	4	5
3	I think about the types of questions that mightbe on a Mathematics test.	1	2	3	4	5
4	I ask my Mathematics teacher about the topics that willbe on upcoming tests.	1	2	3	4	5
5	I rely on my math class notes to study.	1	2	3	4	5
6	I study Mathematics hard even when there are more funthings to do at home.	1	2	3	4	5
7	I quiz myself to see how much I am learning during studying of Mathematics.	1	2	3	4	5
8	I make a schedule to help me organize my Mathematics study time.	1	2	3	4	5
9	I use binders or folders to organize my Mathematics study materials.	1	2	3	4	5
10	I lose important Mathematics worksheets, notes, or materials.	5	4	3	2	1
11	I avoid going to extra-help lessons in Mathematics.	5	4	3	2	1

S/No	How OFTEN do you do the following things when studying or doing homework for MATH…	S D	D	U	A	S A
12	I wait to the last minute to study for Mathematics tests.	5	4	3	2	1
13	I try to forget about the Mathematics topics that I havetrouble learning.	5	4	3	2	1
14	I try to see how my notes from Mathematics classrelates to things I already know.	1	2	3	4	5
15	I try to identify the format of upcoming Mathematics tests (e.g., multi-choice, essay, test length).	1	2	3	4	5
16	I try to study Mathematics in a place that has no distractions(e.g., noise, people talking).	1	2	3	4	5
17	I ask my teacher questions when I do not understand something in Mathematics.	1	2	3	4	5
18	I make pictures or drawings to help me learn Mathematical concepts.	1	2	3	4	5
19	I give up or quit when I do not understand Something or the solution of a Mathematical problem	5	4	3	2	1
20	I forget to bring home my Mathematics materialswhen I need to study.	5	4	3	2	1
21	I tell myself exactly what I want to accomplishduring studying Mathematics.	1	2	3	4	5
22	I look over my homework assignments if I don't understand something.	1	2	3	4	5
23	I avoid asking questions in class about things Idon't understand during Mathematics lessons.	5	4	3	2	1
24	I tell myself to keep trying when I can't learn atopic or an idea in Mathematics.	1	2	3	4	5
25	I carefully organize my Mathematics study materials so Idon't lose them.	1	2	3	4	5
26	I let my friends interrupt me when I am Studying Mathematics.	5	4	3	2	1
27	I think about how best to study Mathematics before I beginstudying.	1	2	3	4	5
28	I finish all of my Mathematics studying before I watch movies, play games, or go out with my friends.	1	2	3	4	5
29	I do poorly on Mathematics tests because I find it hard to plan my work within a short period of time.	5	4	3	2	1

S/No	**How OFTEN do you do the following things when studying or doing homework for MATH…**	**S D**	**D**	**U**	**A**	**S A**
30	I have trouble summarizing what I just heard in Mathematics class or read in my Mathematics textbook.	5	4	3	2	1
31	When I study for Mathematics examinations or tests, I havetrouble figuring out just what to do to learn thematerial.	5	4	3	2	1
32	I have trouble understanding what a Mathematics testquestion is asking.	5	4	3	2	1
33	When I take a Mathematics test I often realize I havestudied the wrong material.	5	4	3	2	1
34	I memorize Mathematical formulas withoutunderstanding them.	5	4	3	2	1
35	I have a hard time changing how I study fordifferent types of Mathematical problems.	5	4	3	2	1
36	In taking Mathematics tests, I often do not understandwhat the teacher wants and I lose points because ofit.	5	4	3	2	1

Scores on the SRLQ

Level	SRLQ Score	Interpretation
1	Above 127	High Self – Regulation Capacity
2	114 – 126	Intermediate Self – Regulation capacity
3	Less 113	Low Self – Regulation Capacity.

APPENDIX H

TABLE OF SPECIFICATION FOR SRLQ

Distribution of SRLQ items Under Bloom's Taxonomy

S/NO	Domain	No. of items	%
1	Cognitive	16	44.45
2	Affective	12	33.33
3	Psychomotor	8	22.22
Total		**36**	**100**

S/No	Cognitve		Affective		Psychomotor	
	Level	**No of Items**	**Level**	**No of Items**	**Level**	**No of Items**
1	Knowledge	3	Receiving	1	Perception	0
2	Comprehension	4	Responding	3	Mind Set	2
3	Application	2	Valuing	4	Guided Response	1
4	Analysis	2	Organization	1	Mechanism	1
5	Synthesis	1	Internalizing Value	3	Complex Overt Response	0
6	Evaluation	4			Adaptation	2
7					Origination	1
Total	**16**		**12**			**8**

APPENDIX I

MATHEMATICS FOR SCIENCES PERFORMANCETEST(MSPT) INSTRUMENT.

STUDENT'S NO: | | | | | |

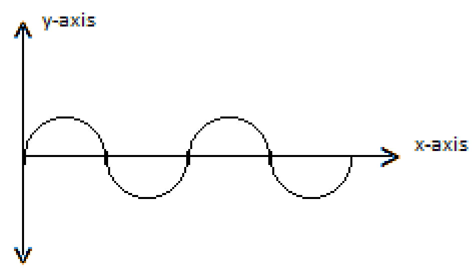
SCORE: | | | |

AGE:……………….. **SEX:……………………** **DATE:………………………**

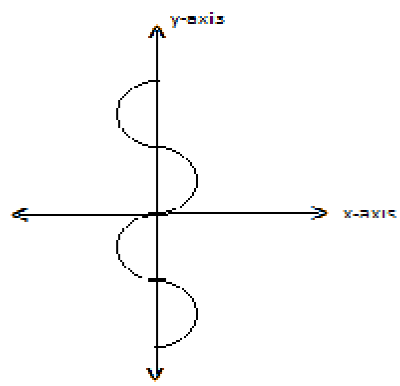
Time Allowed: One Hour (1Hr)

INSTRUCTIONS: Attempt all questions. Each question is followed by four options lettered A to D. Choose the letter that corresponds to the right option and circle the letter.

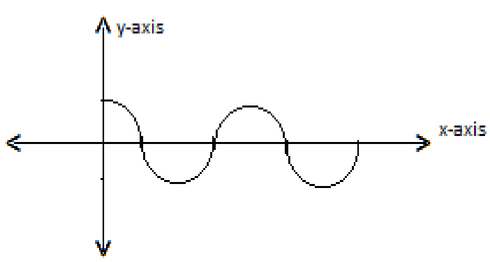
1. Which of the following graphs best describes the function $f(x) = \sin\theta$?



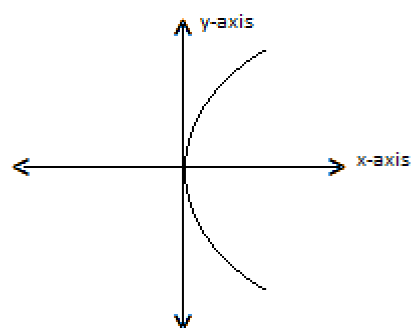
(A)



(B)



(C)



(D)

2. If $2x - 7y + 9 = 0$, determine the value of m and c by writing the given equation in the form $y = mx + c$
(A) $m = \frac{2}{18}, c = \frac{1}{2}$ (B) $m = \frac{7}{9}, c = \frac{7}{2}$ (C) $m = \frac{2}{7}, c = \frac{9}{7}$ (D) $m = \frac{5}{7}, c = \frac{4}{7}$

3. In a right – angled triangle, $tan\theta = \frac{3}{4}$, find the value of $cos\theta$.

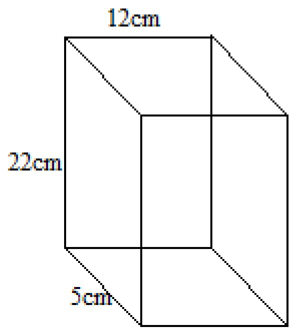
$\frac{3}{5}$ (B) $\frac{4}{3}$ (C) $\frac{4}{5}$ (D)$\frac{5}{3}$

4. Factorise the expression $B^2 - 3B - 10$,

(A) $(B+5)(B+2)$ (B) $(B+2)(B-2)$ (C) $(B-5)(B+2)$

(D) $(B-5)(B-2)$

5. Calculate the surface area of the figure below:



(A)2640cm^2 (B) 868cm^2 (C) 88cm^2 (D) None of the above

6. Determine the value of x in the equation$9x^2 - 108x + 0 = 0$

(A)$x = 0 \ or \ 12$ (B)$x = 3 \ or \ 0$ (C) $x = 3 \ or \ 9$ (D) $x = 3 \ or \ 4$

7. $\frac{dy}{dx}$meansthat for any small change in x there is a corresponding change in y, T/F.

8. Express as a single fraction $\frac{2p}{3} - \frac{p}{q}$,

(A) $\frac{2pq-3p}{3q}$ (B) $\frac{2p+1-p}{3q}$ (C) $\frac{p+1}{3q}$ (D) $\frac{p-q}{3q}$

9. Find the volume of a Cuboid whose top face is a square of sides 6cm and the rectangular side face of length 10.7cm

(A) 22.cm^2 (B) 36.5cm^2 (C) 385.2cm^2 (D) 385.2cm

10. Find the constants $a, b,$ and c in the equation $\frac{x^2}{2} - \frac{x}{5} = -5$ after clearing the fractions are.....................and……………

(A)$a = 1, b = 5, c = 0$ (B) $a = 5, b = -2, c = 50$ (C) $a - 2, b = 5, c = 5$

(D) None of the above.

11. Expand $(x^2 - 2x + 4)(x + 2)$,

(A)$x + 8$ (B) $x^2 + 8x$ (C) $x^3 + 8$(D)$x^2 - 8x$

12. Evaluate without using mathematical tables $cos45^o + tan60^\circ$, leave your answer in surd form:

(A) $\sqrt{45} + \sqrt{60}$ (B) $\frac{\sqrt{3}}{2} + \sqrt{2}$ (C)) $\frac{1}{\sqrt{2}} + \sqrt{3}$ (D)) $\sqrt{2} + \sqrt{3}$

13. Find $\frac{dy}{dx}$ between the points P(3,-4) and Q(9,-5)

(A) $\frac{1}{6}$ (B) $\frac{-1}{6}$ (C) $\frac{-9}{12}$ (D) $\frac{9}{12}$

14. Determine the volume of a Sphere whose diameter is 26.3cm. Approximate the answer to the nearest whole number. [Take = $\frac{22}{7}$].

(A) 9528cm^3 (B) 1110cm^2 (C) 8173cm^3 (D) 5728cm^3

15. The Cosine of angle 60^o is $\sqrt{3}$. T/F

16. Solve the pair of simultaneous linear equations $x + y = 5$ and $2x - 3y = 4$

(A) $x = -\frac{11}{5}$, $y = -\frac{19}{5}$ (B))$x = \frac{11}{5}$, $y = -\frac{14}{5}$ (C)) $x = \frac{6}{5}$, $y = \frac{14}{5}$

(D) None of the above

17. If the radius of a Sphere is 14.3cm, what will be the length of its diameter?

(A) 7.15cm (B) 14.3cm (C) 22.06cm (D) 28.6cm

18. The gradient of a function $f(x)$ is always negative, T/F

19. Solve the equation: $\frac{3}{2(x-2)} - \frac{2}{3(2-x)} = 0$.

(A) 10 (B) 6 (C) 5 (D) 2 or 3

20. The longest side of a right – angled triangle is called……………….

21. Find the rate of change of the function $y = 2x^2 + 1$ at $x = 2$,

(A) 5 (B) 8 (C) 125 (D) – 5

22. The expression $121 - x^2$ is not factorisable, T/F

23. If $y = \frac{1}{x}$ and x increases infinitely, what will be the value of ?

(A) 0 (B) ∞ (C) 1 (D) 0 or 1.

24. The value of $cos45^\circ$ is 0.5, T/F

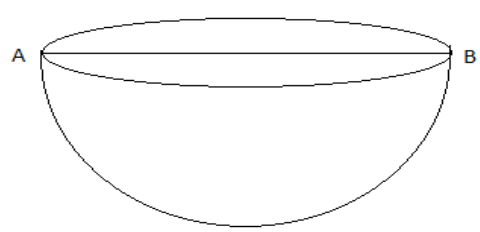
25. In trigonometric ratio, Cosine is defined as …………. side over hypotenuse.

26. Given that $f(x) = -\frac{2}{3}x^{-2}$ find $\frac{dy}{dx}$

(A) $\frac{4}{3}x^{-3}$ (B) $\frac{2}{3}x^{-3}$ (C) $-2x^2$ (D) $-\frac{2}{6}x^{-2}$

27. The Cylinder is formed from which figure?...............................

28. Write out the formular to calculate the surface area of the figure below if AB =$2r$, where $r$is a radius.



(A)πr^2 (B) $2\pi r^2$ (C) $\frac{4}{3}\pi r^2$ (D) $2\pi r$

29. The line that touches a curve at just one point is called…………………..

30. $\pi$is the ratio of the two radius to the circumference, T/F.

31. Find the volume of a Cube with sides 13cm.

(A) 1040cm^3 (B) 196cm^2 (C) 1410cm^3 (D) 2,197cm^3

32. If 5 and -3 are the roots of the equation $0 = ax^2 + bx + c$, find the value of $\frac{-b}{c}$,

(A) $\frac{2}{15}$ (B) $\frac{-2}{15}$ (C) $\frac{1}{15}$ (D) $\frac{-1}{15}$

33. The formular for solving quadratic equations is called…………………

34. The square of x can be written as x raised to the power of $\frac{1}{2}$, T/F

35. Evaluate $\frac{14x-55}{x} = 3$

(A) 5 (B) 3 (C) 4 (D) 11

36. Given the equation $x^2 - x - 6 = -4$, which of the following values satisfies it?

(A) 0 (B) 2 (C) 3 (D) None of the above

37 – 40. Copy and complete the table of values for the function $y = cos\theta$

for$0^\circ \leq \theta \leq 360^\circ$

θ	0°	30	60°	90°	120°	150°	180°	210°	240°	270°	300°	330°	360°
y	1		0.5	0		-0.8	-1	-0.8		0	0.5		1

APPENDIX J

Mathematics for Science Achievement Test Marking Scheme

Question No	Answer (Grade)	Mark	Question No	Answer (Grade)	Mark
1	A	1	21	B	1
2	C	1	22	F (False)	1
3	C	1	23	A	1
4	C	1	24	F (False)	1
5	B	1	25	Adjacent	1
6	A	1	26	A	1
7	T (True)	1	27	Rectangle	1
8	A	1	28	B	1
9	D	1	29	Tangent	1
10	B	1	30	T (True)	1
11	B	1	31	D	1
12	C	1	32	B	1
13	A	1	33	Quadratic Formular	1
14	A	1	34	F (False)	1
15	F (False)	1	35	A	1
16	D	1	36	D	1
17	D	1	37	0.9	1
18	F (False)	1	38	-0.5	1
19	D	1	39	-0.5	1
20	Hypotenuse	1	40	0.9	1

Total Marks = 40 marks.

NOTE: Marks scored by students will be converted to 100%..

APPENDIX K

TABLE OF SPECIFICATION

S/NO	TOPIC/ LEVEL	TIME (Mins)	Wgt %	OBJECTIVES (COGNITIVE)						Total
				KNW	COMP	APP	ANLY	SYN	EVA	
1	Graphs- Types of graphs.	9	15.0%	1	0	0	1	4	0	6
2	Forms of common plots and Rate of change.	10.5	17.5%	0	3	1	2	0	1	7
3	Areas and Volumes of solids.	12	20.0%	2	0	2	3	1	0	8
4	Trigonometric ratios and their Applications	9	15.0%	2	2	0	0	0	2	6
5	Expansion and Factorisation of quadratic equations.	10.5	17.5%	1	2	0	1	3	0	7
6	Solution of linear equations with one or two variables.	9	15.0%	2	2	0	0	1	1	6
Total		**60 Mins**	**100%**	**8**	**9**	**3**	**7**	**9**	**4**	**40**

Key: KNW $\Rightarrow$ Knowledge

COMP $\Rightarrow$ Comprehension

APP $\Rightarrow$ Application

ANA $\Rightarrow$ Analysis

SYN $\Rightarrow$ Synthesis

EVA $\Rightarrow$ Evaluation.

APPENDIX L 1

Reliability of Mathematics for Science Performance Test

```
RELIABILITY
  /VARIABLES=EVENPILOT ODDPILOT
  /SCALE('ALL VARIABLES') ALL
  /MODEL=ALPHA
  /STATISTICS=DESCRIPTIVE.
[DataSet1] C:\Users\Rev. David\Documents\PILOTTEST.sav
```

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	15	50.0
	Excluded[a]	15	50.0
	Total	30	100.0

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

Reliability Statistics

Cronbach's Alpha	N of Items
.610	2

Item Statistics

	Mean	Std. Deviation	N
EVENPILOT	56.8333	12.19143	15
ODDPILOT	61.7333	11.25336	15

APPENDIX L 2

Descriptive Analysis for Mathematics Self - Concept

```
GET
  FILE='C:\Users\Rev. David\Documents\MSCSRLMSAT PRET POT EG AND CG.sav'.
DATASET NAME DataSet1 WINDOW=FRONT.
DESCRIPTIVES VARIABLES=MSCPRETEG MSCPOTEG
  /STATISTICS=MEAN STDDEV MIN MAX.
```

Descriptives for MSC Pre/Post Experimental Group

```
[DataSet1] C:\Users\Rev. David\Documents\MSCSRLMSAT PRET POT EG AND CG.sav
```

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
MSCPRETEG	30	38.00	74.00	58.7000	8.17123
MSCPOTEG	30	58.00	109.00	83.1333	14.40721
Valid N (listwise)	30				

Descriptives for MSC Pre/Post Control Group

```
[DataSet1] C:\Users\Rev. David\Documents\MSCSRLMSAT PRET POT EG AND CG.sav
```

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
MSCPRETCG	30	25.00	79.00	60.0333	10.96541
MSCPOTCG	30	34.00	80.00	64.9000	9.94935
Valid N (listwise)	30				

APPENDIX L 3

Mann-Whitney *U* – Test for MSC Post – Test Control and Experimental Groups

```
GET
  FILE='C:\Users\Rev. David\Documents\MSCSRLMSAT PRET POT EG AND CG.sav'.
DATASET NAME DataSet1 WINDOW=FRONT.
NPAR TESTS
  /M-W= MSCPOTCG BY GRPVAR(0 1)
  /MISSING ANALYSIS.

 [DataSet1] C:\Users\Rev. David\Documents\MSCSRLMSAT PRET POT EG AND CG.sav
```

Ranks

	GRPVAR	N	Mean Rank	Sum of Ranks
MSCPOTCG EG	.00	30	20.68	620.50
	1.00	30	40.32	1209.50
	Total	60		

Test Statistics[a]

	MSCPOTCG
Mann-Whitney U	155.500
Wilcoxon W	620.500
Z	-4.355
Asymp. Sig. (2-tailed)	.000

a. Grouping Variable: GRPVAR

APPENDIX L 4

Descriptive Analysis for MSPT Post – Test for CG and EG

```
DESCRIPTIVES VARIABLES=MSPTPOTCG MSPTPOTEG
  /STATISTICS=MEAN STDDEV MIN MAX SEMEAN.

[DataSet4] C:\Users\Rev. David\Documents\MSCSRLMSPT PRET POT EG AND CG.sav
```

Descriptive Statistics

	N	Minimum	Maximum	Mean		Std. Deviation
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic
MSPTPOTCG	30	35.00	72.50	52.6833	1.97302	10.80667
MSPTPOTEG	30	42.50	87.50	66.8333	2.11703	11.59543
Valid N (listwise)	30					

APPENDIX L 5

t -Test Analysis for MSPT on Control and Experimental groups

```
GET
  FILE='C:\Users\Rev. David\Documents\MSCSRLMSPT PRET POT EG AND CG.sav'.
DATASET NAME DataSet1 WINDOW=FRONT.
T-TEST GROUPS=GRPVAR(0 1)
  /MISSING=ANALYSIS
  /VARIABLES=CGEG
  /CRITERIA=CI(.95).
```

```
[DataSet1] C:\Users\Rev. David\Documents\MSCSRLMSPT PRET POT EG AND CG.sav
```

Group Statistics

	GRPVAR	N	Mean	Std. Deviation	Std. Error Mean
CGEG	.00	30	52.6833	10.80667	1.97302
	1.00	30	66.8333	11.59543	2.11703

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
CGEG	Equal variances assumed	.036	.850	-4.890	58	.000	-14.15000	2.89389	-19.94275	-8.35725
	Equal variances not assumed			-4.890	57.715	.000	-14.15000	2.89389	-19.94336	-8.35664

APPENDIX L 6

Descriptive Analysis on SRL and MSPT Post – Test for Gender Experimental Group

```
GET
  FILE='C:\Users\Rev. David\Documents\MSCSRLMSPT PRET POT EG AND CG.sav'.
DATASET NAME DataSet1 WINDOW=FRONT.
DATASET ACTIVATE DataSet1.
SAVE OUTFILE='C:\Users\Rev. David\Documents\MSCSRLMSPT PRET POT EG AND
CG.sav'
 /COMPRESSED.
DESCRIPTIVES VARIABLES=SRLPOTMALE SRLPOTFEMALE
  /STATISTICS=MEAN STDDEV MIN MAX.

[DataSet1] C:\Users\Rev. David\Documents\MSCSRLMSPT PRET POT EG AND CG.sav
```

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
SRL POT MALE	15	118.00	151.00	132.3333	8.61615
SRLPOT FEMALE	15	112.00	151.00	132.0667	11.34817
Valid N (listwise)	15				

```
[DataSet4] C:\Users\Rev. David\Documents\MSCSRLMSPT PRET POT EG AND CG.sav
```

Descriptive Statistics

	N	Minimum	Maximum	Mean		Std. Deviation
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic
MSAT POT MALE	15	52.50	87.50	69.0000	2.74729	10.64022
MSAT POT FEMALE	15	42.50	77.50	64.6667	3.21702	12.45946
Valid N (listwise)	15					

APPENDIX L 7

t – Test Analysis of Mean Score of MSPT Post – Test for Gender

```
T-TEST GROUPS=GRPVARGEN(0 1)
  /MISSING=ANALYSIS
  /VARIABLES=MSATMF
  /CRITERIA=CI(.95).
```

[DataSet1] C:\Users\Rev. David\Documents\MSCSRLMSAT PRET POT EG AND CG.sav

Group Statistics

	GRPVARGEN	N	Mean	Std. Deviation	Std. Error Mean
MSPT Male/Female	.00	15	69.0000	10.64022	2.74729
	1.00	15	64.6667	12.45946	3.21702

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	T	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
MSPT Male/ Female	Equal variances assumed	1.099	.304	1.024	28	.314	4.33333	4.23046	-4.33238	12.99905
	Equal variances not assumed			1.024	27.330	.315	4.33333	4.23046	-4.34196	13.00862

APPENDIX M

ABBREVIATIONS

1. **NPE**: National Policy on Education
2. **FME**: Federal Ministry of Education
3. **NCE**: National Certificate in Education
4. **NCCE**: National Commission on Colleges of Education
5. **NERDC**: Nigerian Educational Research and Development Council
6. **SRL**: Self – Regulated Learning
7. **MSAT** Mathematics for Science Achievement Test
8. **RSCQ**: Robson Self – Concept Questionnaire
9. **SRLQ**: Self – Regulated Learner Questionnaire
10. **CSI**: Cognitive Strategy Instructions
11. **NOUN**: National Open University of Nigeria
12. **RSE**: Rossier School of Education, University of Southern California
13. **NCTM**: National Council of Teachers of Mathematics
14. **SCQ**: Self –Concept Questionnaire
15. **BEESS**: Bureau for Exceptional and Students Services,
16. **CG**: Control Group
17. **EG**: Experimental Group
18. **KSCOE**: Kaduna State College of Education
19. **COEAKWG**: College of Education Akwanga, Nasarawa State.
20. **Ph.D**: Doctor of Philosophy.
21. **ANOVA**: Analysis of variance
22. **ANCOVA**: Analysis of covariance

23. **PPMC**: Pearson product moment coefficient

Appendix O

OPERATIONL DEFINITIONS OF TERMS

Self – Concept: The individual's belief about himself, including the person's attributes and who and what the self is, which is formed through their experience and interaction with the environment.

Metacognition: Metacognition refers among other things, to the active monitoring and consequent regulation and orchestration of these processes in relation to the cognitive objects on which they bear, usually in the service of some concrete goal or object

Cognitive Strategies: Theseare mental routines or processes for accomplishing cognitive goals like problem solving, studying for test or exams or understanding what is being learnt or studied.

Cognitive strategy instructions: These refer toinstructional approach which emphasizes the development of thinking skills and processes as a means to enhance learning. It enables learners to become more strategic, self – reliant, flexible, and productive in their learning endeavors.

SRL strategy: Learning that occurs largely from the influence of students' self generated thoughts, feelings, strategies, and behaviours, which are systematically oriented towards the attainment of goals.

Teaching: Process by which the learner is made to learn a given subject in accordance with the pre-determined goals and objectives", and again he said it is a Process of imparting knowledge, skills, and professional attitudes in order for people to gain idea, information, concepts, and experiences.

Thus, Teaching can then refer to the general principles, pedagogy, and

Management strategies used for classroom interactions.

Method: Teaching Methodology means the Techniques and procedures that arises from deliberate choice and practical experience of the teacher/instructor which governs the instructional process. It facilitates the acquisition of knowledge, skills, and values by the learners.

Quasi Experiment: This refers to an empirical study used to estimate the causal effect of an intervention on its target population without random assignment. This involves selecting groups, upon which a variable is tested without any randomization.