IMPACT OF INQUIRY AND PROBLEM - SOLVING STRATEGIES ON ATTITUDE, RETENTION, AND PERFORMANCE IN TRIGONOMETRY AMONG SENIOR SECONDARY SCHOOL STUDENTS' IN ZAMFARA STATE, NIGERIA

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DECLARATION

I Ganiyatu ALIYU hereby declared that the work in this thesis titled ‘‘Impact of Inquiry and Problem Solving Strategies on Attitude, Retention and Performance in Trigonometry among Senior Secondary School Students in Zamfara State, Nigeria’’ was presented by me in the Science Education Department, under the Supervision of Prof. Y.K Kajuru, Prof. C. Bolaji and Prof. M. Musa. The information derived from the literature has been duly acknowledged in the text and a list of references provided. No part of this work has been presented for another degree or diploma at any institution.

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CERTIFICATION

This thesis ‘‘Impact of Inquiry and Problem Solving Strategies on Attitude, Retention and Performance in Trigonometry among Senior Secondary School Students in Zamfara State, Nigeria’’ meets the regulations governing the award of the Doctor of Philosophy Degree (PhD) in Mathematics Education of the Ahmadu Bello University, Zaria and is approved for its contribution to knowledge and literacy presentation.

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DEDICATION

This thesis is dedicated to my late Parents ALHAJI S.A. ALIYU and HAJIYA MUSILIMAT ALIYU

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ABSTRACT

This study investigated the impact of inquiry and problem-solving Strategies on Attitude, Retention and Performance in Trigonometry among Senior Secondary School Students in Zamfara State, Nigeria. A Quasi-experimental research design with pretest-posttest control group design was adopted. The study used senior secondary school two (SSII) students with population of 23,910 admitted during 2015/2016 academic session in Zamfara state. A Multi-stage sampling procedure was used for the study. A simple random technique was used to select the classes that participated in the study. A total of 381students in the six randomly selected intact classes were used as sample size. Three research instruments were developed and used: Trigonometry Attitude Scale Questionnaire (TASQ) targeted at the change in attitude. Trigonometry Performance Test (TPT) was used to measure the academic performance of the students, and Trigonometry Retention Test (TRT) was used to measure the retention ability of the students. The test instruments were validated by three experts and Test-rest reliability was observed. Pearson Product Moment Correlation Coefficient (PPMCC) was used to estimate the reliability coefficients and was found to be 0.68 and 0.83 respectively. The Trigonometry Attitude Scale Questionnaire was also validated by three experts and had a reliability of 0.78 using Cronbach-alpha method of estimating reliability. Six research questions were raised and six hypotheses were formulated to guide the study. The research questions were answered using mean and standard deviation. While Null hypotheses were tested using Kruskal –Wallis test, Mann-Whitney U-test and one andtwo-way (ANOVA). Statistics analyses at $\propto = 0.05$ level of significance.The results of the study indicated that Senior Secondary School Students in Zamfara state showed no significance difference in their attitude towards the learning of trigonometry due to the use of inquiry and problem solving Strategies. The inquiry and problem-solving Strategies improved on students' academic performance in trigonometric concepts taught than the lecture method.The inquiry and problem-solving methods improved on students' retention in trigonometric concepts taught than the lecture method. The finding showed that there was no difference in the performance of Male and Female students in the trigonometric concepts taught using inquiry and problem-solving Strategies.The male students retained better than their female counterpart in the trigonometric concepts taught using inquiry and problem-solving Strategies. Based on the findings from the study, it was recommended that Inquiry and problem-solving Strategies should be used by mathematics teachers to teach senior secondary school students to enhance positive performance, and aids retention.

ABBREVIATIONS

TASQ: Trigonometry Attitude Scale Questionnaire

TPT: Trigonometry Performance Test.

TRT: Trigonometry Retention Test.

SSS ; Senior Secondary School

OPERATIONAL DEFINATION OF TERMS

Attitude: The degree of likeness, or dislikeness towards Trigonometry.

Inquiry Strategy: The processes where students are involved in their learning, formulate questions investigate widely and then build new understanding of knowledge.

Problem solving Strategy: Is a teaching strategy that comprises action steps to be taken by the learner to reach anticipated goal when faced with a problem.

Retention test: Is a test designed to measure student's retention ability in Trigonometry.

Trigonometry: The branch of Mathematics that deals with the relations between the sides and angles of plane or spherical triangles and the calculation based on them.

Performance: Is an individual's academic attainment after a specified course of instruction.

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CHAPTER ONE

THE PROBLEM

1.1 Introduction

Trigonometry is the study of triangles in relation to their sides and angles. It is widely applied in many disciplines; in particular, trigonometric functions have come to play great roles in science. For example, in physics, it is used to analyze different kinds of waves, such as radio waves, sound waves, light waves, etc the study of trigonometric has made great significance in engineering, navigation and surveying.If proper mathematical foundations are not laid during the formative years of childhood and adolescence it becomes increasing difficult to address this weakness in later life. Among all the subjects studied at school, mathematics has distinctly contributed more to the objective of general education of man than any other subject (Odeyemi, 2004). It is in realization, of this that almost all nations of the world make compulsory the study of mathematics, and trigonometry in particularAccording to Ojim and Nyim (2012) defined education as the processes of giving intellectual, moral and social instructions or a process involving training or giving information on a particular subject. Therefore, secondary education is an important sub-sector of the entire education system. On one hand, it provides middle level workers for the economy and on the other; it acts as a feeder for higher levelsof education.

A sound education in mathematics is important for any modern knowledge based economy, this because Mathematics has become the central intellectual discipline of all technological societies and it is indispensable in helping the individual to think more clearly about the values involved in this fast changing world.(Gambari, Falode, andAdegbenro, 2014).. The quality of higher education, which is expected to produce high qualify professionals in different field of social, economic, and political life of the country depends upon on secondary education. Secondary education, therefore, needs to be organized in such a way

that it should prepare young men and women for the pursuit of higher education, as well as makingthem able to adjust their practical lives to be fullyproductive. In this study trigonometry was considered, because it is one of the difficult topic in mathematics at secondary school level.

Today, lack of basic mathematical knowledge and skills in any society has isolated such society from the global scientific trend. According to Olorundare (2007), the development of any nation is usually characterised by the degree or extent of the impact of science, technology and mathematics in such nation. In order to train the required highly skilled personnel needed for science, technology and the industry, Mathematical competence is essential, the important role which mathematics plays made it a compulsory subject at both primary and secondary school levels, so that every school child will acquire appropriate scientific and mathematical knowledge. The Government of Nigeria recognised this, hence its inclusion in the National Policy on Education (FRN, 2013) as one of the core subjects being studied at both primary and secondary levels of education.Studies have shown that Nigerian students' achievement in Secondary School mathematics has been relatively low over the years,(WAEC, 2011; Gimba, 2013).

Inquiry Strategy of learning is a students' centred learning process where the teacher acts as a facilitator or coach rather than an instructor. In this method, the teacher allows the students to raise questions and seek solutions through guided instruction. The method gives the opportunity to the students to use their own initiative.According to (Abrams,Southerland, and Silva, 2008) inquiry is a "building" process that moves learners along a continuum when they are encultured in the practice of inquiry. Students come to the classroom expecting "one right answer" and need exposure to inquiry incrementally. By gradually structuring inquiry experiences, students are able to exhibit greater independence and feel less risk from the absence of the dreaded "just tell me what I need to

know" (Hsu, Kysh, Ramage, and Resek.,2009) found a lower Mathematics failure rate in inquiry classroom as opposed to traditional maths classes. .This ability to find solutions to problems rather than memorize them is often cited as a better way to understand mathematics and is linked to better retention, because if your memory fails you, your logic will not. In this study inquiry strategy which was students-centred approach was use to teach the experimental group the concepts of trigonometry to see if the strategy would be the best in teaching trigonometry at SSSII level

Polya(1973) established four stages of solving problems in mathematics as follows: Understanding the problem, Devising a plan, Carrying out a plan, andLooking back. According to Inekwe (2002), to teach problem solving skill successfully, mathematics teachers must provide a more conducive learning atmosphere that will allow students to think, analyse, experiment and be willing to entertain and answer questions to improve students' performance in the concept While Problem solving is an aspect of the mathematics curriculum which begins with initial contact with the problem and ends when solution is reviewed in the light of the given information (Suleiman, 2010). Problem-Solving performance seems to be enhanced through regular experiences and systematic instruction that aim to assist the development of problem scheme and increase students' awareness of problem solving strategies. Problem –solving strategy was used in this study as students- centred learning to teach the experimental group 2 to see if the strategy can improve the performance and enhance retention of students in trigonometry concepts.

The role attitude play in the teaching and learning of trigonometry cannot be over emphasized.Attitude is the degree of likeness associated with an objectAdedeji, (2007) stated that interest in activities tends to increase the like hood that Individual formulate goals relating to that activity and invest more time and effort to achieve them. According toEffendi and Normah, (2009), a student needs to think and make decisions using

appropriate strategies to solve mathematical problems. They add that student's success in achieving their goals encourage to develop positive attitudes towards mathematics and other problem solving activities. Positive attitude are assumed to have significant relationship with students' achievement. Hence students' attitude towards mathematics is a major factor that might influence the performance of the students. It is therefore pertinent to search for ways to encourage positive attitude in the learner towards learning, in order to improve the trigonometry concept at SSII level

Retention is the ability to remember things, for the purpose of this study, retention is defined as the ability to keep or retain the knowledge of trigonometry learnt and be able to recall it when requires..One problem asserted by Ezeamenyi(2004) is that failure to provide enough applications to real life activity and social usage cum poor teaching techniques are strong Limiting factors to student's retention in mathematics..Therefore the achievement and retention of students in mathematics depend solely on teaching methods used by the teachers.

Moreover, Emaikwu (2012), refers to academic performance as an individual's academic attainment after a specified course of instruction.From this definition, trigonometry performance can be defined as the quality of results produced by students in trigonometry as reflected in their examination scores.

Gender is a psychological terms used to describing behaviours and attributes expected of individual on the basis of being born as either male or female. Gender based studies revealed that boys performed better than girls in Mathematics achievement (Asante, 2010)Also Iwendi (2012) found no gender difference in the performance of male and female students in school mathematics. However, some literature research reported that female students performed better than male students when exposed to mathematics test

(Unodiaka, 2015). Furthermore, no significant differences in mathematics achievement test between males and females students were also reported (Jane and Janet 2016).These inconsistency reports on males and females' students' superiority in mathematics achievement test appear inconclusive. With these inconsistencies more empirical researches are needed to investigate the existence of gender differences in the classrooms. In this study, the researcher wants to see if the two strategies are gender bias or not. It is based on this background that the researcher carried out the study to investigate the impact of inquiry and problem-solving, strategieson Attitude, Retention and Performance in trigonometry among senior secondary schools students in Zamfara State, Nigeria

1.2 Statement of the Problem

The methods and strategies employed to teach difficult component of secondary school Mathematicscurriculum like trigonometry need to be given serious attention. Despite the importance of trigonometry in Science and technology, its teaching is being faced with a lot of challenges and it is sad to note that the achievements of secondary school students in trigonometry are not encouraging. Students express difficulty in understanding and retaining concepts being taught by their teachers. According to WAEC Chief Examiners report (2015) reported that questions on trigonometry were poorly attempted by candidates which lead to the poor performance in mathematics in general. The Reports cited above revealed that students have difficulty to accurately measure, draw, and construct and prove identities or use of formulae in trigonometry. This by implication means the students did not retain any knowledge while learning trigonometry or have negative attitude towards trigonometry concepts. This led the students to poor performance in Mathematics and trigonometry in particular which may be due to poor method of teaching by some teachers that resulted to negative attitude by some students, or lack of good instructional materials that will stimulate and sustain the interest of the students, which may lead to good

understanding of the subject and enhance retention of the material learned. It is based on these problems that the researcher carried out the study onthe impact of the inquiry and problem solving strategies on attitudes, retention and performance, among Senior Secondary Schools students in Zamfara state, Nigeria.

1.3 Objectives of the Study

The objectives of the study investigated the impact of inquiry and problem solving strategies on students' Attitude, Retention and Performance in Trigonometry among Senior Secondary School in Zamfara State. The study specifically stated the following objectives:

1. Investigate the impact of inquiry and Problem solving strategies on student'sAttitude towards trigonometry among senior secondary schools in Zamfara State
2. Determine the impact of inquiry and Problem solving strategies on students' academic performance in trigonometry among senior secondary schools in Zamfara state.
3. Examine the impact of inquiry and Problem solving strategies on students' retention ability in trigonometry among senior secondary schools in Zamfara state.
4. Determine the impact of inquiry and Problem solving strategies on gender andattitude changetowards trigonometry among senior secondary schools students in Zamfara state.
5. Determine the impact of inquiry and Problem solving strategies on gender and academic performance in trigonometry among senior secondary schools students in Zamfara state.

6. Find out the impact of inquiry and Problem solving strategies on gender and retention ability in trigonometry among senior secondary schools students in Zamfara state.

1.4 Research Questions

This study investigatedthe impact of Inquiry and Problem Solving Strategies on attitude, retention and performance in trigonometry among Senior Secondary School Students in Zamfara State base on the followingresearch questions:

1 What is the effects of inquiry,problem solving strategiesand lecture method on attitude towards trigonometry among Senior Secondary School Students' in Zamfara State?

2 What is the impacts of inquiryproblem solving strategies and lecture methodonacademic performance in trigonometry among Senior Secondary School Students' in Zamfara State?

3 To what extent does inquiry,problem solving strategiesand lecture method affect retention ability in trigonometry among Senior Secondary School Students in Zamfara State?

4 What are the impacts of inquiry, problem solving strategies on gender and attitude towards trigonometry among SeniorSecondary School Studentsin Zamfara State?

5 To what extent does inquiry, problem solving strategies affect gender and academic performances in trigonometry amongSenior Secondary School Students'in Zamfara State?

6 What are the impacts of inquiry, problem solving strategieson gender and retention ability in trigonometry among Senior Secondary School Students' in Zamfara State?

1.5 Null Hypotheses

This study investigated the impact of Inquiry and Problem Solving Strategies on attitude, retention and performance in trigonometry among Senior Secondary School Students in Zamfara State based on the following nullhypotheses that were formulated atp≤0.05 level of significance:

Ho_1: There is no significant difference inthe attitudinal level of students taught trigonometry using inquiry,problem solving strategies and those taught usinglecture methodin Senior Secondary Schools in Zamfara State.

Ho_2: There is no significant difference inthe mean academic performance scores of students taught trigonometry using inquiry,problem solving strategies and those taught using lecture methodsin senior secondary schoolin Zamfara State.

Ho_3: There is no significant difference in themean retention scores of students taught trigonometry using inquiry,problem solving strategiesand those taught using lecturemethods in Senior Secondary School in Zamfara State.

Ho_4: There is no significant difference inthe attitudinal level of male and female students taught trigonometry using inquiry and problem-solving strategiesin Senior Secondary School in Zamfara State.

Ho_5: There is no significant difference in themean academic performance scores of male and female students taught trigonometry using inquiry and problem-solving strategies in Senior Secondary School in Zamfara State.

Ho_6: There is no significant difference in the mean retention score of male and female students taught trigonometry using inquiry and problem-solving strategies in Senior Secondary School in Zamfara State.

1.6 Significance of Study

This study determined the impact of inquiry and problem-solving Strategies onattitude, retention, and performance, in trigonometry among senior secondary school students' in Zamfara state of Nigeria. It is hoped that: The findings of the study would improve the teachingand learning of mathematics and trigonometry in particular. It is similarly anticipated that the findings of the study would benefit the following: Mathematics students, Mathematics teachers, curriculum developers/textbook writers, Universities and colleges of education and also professional bodies

This research work should provide opportunities for students to ask questions on their mathematical understanding and reduces trigonometry phobia in teaching/learning of mathematics. The finding would also help to improve their low performance in Mathematics in general and trigonometry in particular. In addition, it is hoped that the study would encourage students to be actively involved in the construction of knowledge and to take charge of their own learning. Active participation of students might help them to develop self confidence and improve their retention abilities.

When Inquiry and problem solving strategies were used effectively by mathematics teachers. It should promote both performance and retention abilities of students, this is because students get full participation, and engagement in the hand-on and mind–on activities that related to real life situation.

The study revealed that students exposed to inquiry and problem solving methods performed significantly better in learning trigonometry concepts, hence, the findings should provide necessary information to curriculum planners in making good policies in relation to the outcomes of the study. For example when the findings of the researchwork is eventually published, curriculum planning/development agencies such as those at Nigerian

Educational Research and Development Council (NERDC) should emphasize the use of these methods in the teaching ofmathematics and trigonometry in particular.

Again, the study shouldencourage textbook writers/publishers for writing trigonometry textbooks in line with the principle of constructivist teaching strategy. This should facilitate teachers and students to use the new teaching strategy to solve mathematical problems. It would also enhance students' motivation and interest which may lead to independent learning and good mastery of the subject.

The three basic training grounds for mathematics teachers which are universities through Faculty of Education, Colleges of Education and National Teachers' Institute should integrated/incorporatedthe constructivist strategies in the mathematics curriculum for the pre-service teachers program. This would help them to learn and use the inquiry and problem solving strategies in their trigonometry concepts.

The findings of the study should be an eye opener for futureresearchers' as it adds new information to the existing literatures; hence the researchers can use the findings of the study for further studies. As for the researchers, the teaching strategies that were covered in this study could be used to conduct research of this kind on other aspect of mathematics such as statistics, algebra andGeometry. Finally, the role of a guide which the teacher should play and the type of curriculum materials to be developed and used in teaching and learning of trigonometry effectively may be revealed through the results obtained from the finding of the study.

1.7 Scope / Delimitation of the study

This study examines the impact of inquiry and problem solving strategies on attitude, retention and performance in trigonometry. The study was conducted in Zamfara State withSenior Secondary School two students' (SS II) with a population of 23,910 admitted in the year 2015/2016 academic session. Two schools in Maru and Bungudu Local Government were used in the pilot study. The study used a sample of 381 SSII students as the sample size of the study. The variables covered two independent variables (Inquiry and Problem solving Strategies) and three dependent variables (Attitude, Retention and Performance), and gender was used as moderating variable. The instruments used were Trigonometry Performance Test (TPT) aimed at measuring students performance, Trigonometry Retention Test (TRT) alsoaimed at measuring students' retention ability and Trigonometry Attitude Scale Questionnaire (TASQ) aimed at measuring students' attitude change in trigonometric concept. In addition SSII students' was chosen because the students have already acquired substantial knowledge at SS1, and also they were not an examination class.

The geographical scope of the study was Zamfara state. It was created from the former Sokoto State and one of the 36 states in the Federal Republic of Nigeria with Gusau as its Capital. Zamfara State shares boundaries with Niger republic on the North, Kaduna state, on the South, Katsina state on the east, and Sokoto and Niger states on the west. The state has a land mass of 38,418 square Kilometres and a population of 3.278,873 million people(Federal Republic of Nigeria, 2006). This area was chosen for the study because of poor performance recorded by the students in mathematics at Senior School Certificate Examination and National Examination Council.

Thescope was also delimited to trigonometric content areas; (a) Pythagoras' Theorem (b) Trigonometry ratio(c) special angles (30^0,45^0,60^0) (d) Angle of elevation and depression (e)

Sine and Cosine formulae (f) Bearing and Distance. These areas were considered because they are being taught in SSSII, and are part of the fundamental concepts of Mathematics in SSS II Syllabus, and also students recorded poor performance in the area according to WAEC Chief Examiner's Reports (2015). Therefore, this study was delimited to investigate the impact of inquiry and problem solving strategies on Attitude Retention and Performance in Trigonometry among Senior Secondary School Students' in Zamfara State.

1.8 Basic Assumptions

The Following are the basic assumptions of the study:

1. The Students in the study sample have acquired basic SSSII Trigonometry concepts through lecture method but not exposed to inquiry and problem solving strategies
2. The selected concepts for the study are appropriate for the levels of the students targeted for the study.
3. That the topics for the study have been covered by the experimental and control groups.

CHAPTER TWO

REVIEW OF RELATEDLITERATURE

2.1 Introduction

This study investigated the impact of inquiry and problem-Solving strategies on Attitude, Retention and Performance inTrigonometry among Senior Secondary School Students in Zamfara state, Nigeria. In this chapter the literature reviewed is presented, as follows:

2.2 Theoretical framework

2.2.1 BehaviourismTheory/Conventional Lecture Method

2.2.2 Cognitive Development/Social Learning Theory

2.2.3 Constructivist Learning Theory

2.3 Conceptual Framework

2.3.1 The 7Es Learning Cycle Model of Inquiry Strategy

2.3.2 Polya four stage Model

2.4 Trigonometry as a Teaching subject

2.5 Trigonometry Teaching Methods

2.5.1 Inquiry Strategy of Teaching Trigonometry

2.6 Polya's Problem Solving strategy

2.6.1 Polya's Problem Solving Strategy in Trigonometry

2.7 Lecture Method of Teaching Trigonometry

2.8 Concept of Attitude of Students in Trigonometry

2.9 Retention of learned Concept in trigonometry

2.10 Academic Performance in Trigonometry

2.11 Gender and Academic Performance in Trigonometry

2.12 Overview of Related Studies

2.13 Implication of Reviewed Literature to the study

2.2 Theoretical Framework

According to Gay, Geoffrey, and Peter (2009), a theoretical framework identifies the predominant theory and concepts of the study. According to them it also provides information about, what are being studies and how it is studied. The theoretical perspective that made up the variables in the topic for the research included the three different learning theories which provide the foundation for a viable framework.Therefore the concept that formed the theoretical framework for this study was:

2.2.1 Behaviourism Theory/conventional/ Lecture method

The behaviourism learning theory focuses on modifying behaviours that will eventually lead to learning. The behaviourist theory, and is the approach used in many traditional classroom, the approach stresses practices that emphasised in rote memorization, cramming of formulas, single solutions, and adherence to procedures and drills. Behaviourists believethat learning is considered to have occurred when the correct solution is reached consistently. .

2.2.2 Cognitive Development /Social Learning Theory

Cognitive theory define learning as a permanent change in understanding as result of experience, perceptions or reorganization of knowledge (Augie, 2015), while social learning theoryLearning can occur without a change in behaviour. The theory focuses on teaching that occurs within a social context. It considers that people learning from observing, imitating and modelling the behaviours, attitudes and emotional reactions of others a famous behavioural psychologist such as Piaget, Bruner, Ausubel are co-partners in this school of thought. In their theories each considers maturation and readiness and both in biological and mental development as a vital to learning. The important of maturation and readiness in the learning of mathematics and trigonometry in particular cannot be

overemphasis, so it is necessary to consider teaching methods that can effectively yield positive effect.

a. Jean Piaget's learning theory of Cognitive Development

According to Piaget (1966) child's mental development follows through four stages. These stages are sensory motor stages, preoperational stage, concrete operational stage and the formal operational stage. Piaget believed that child's cognitive development depends on each successive stage and the interaction of maturation at a particular stage and environmental factors. According to Piaget schemata, which are physical and mental skills when used in new situations, help one to acquire new schemata. In the development of this theory, Piaget identified two intellectual processes involved in learning and these are adaption and accommodation. Adaption here refers to elaborate conditional responses which enable the child to maintain dynamic equilibrium with his environment. While accommodation means accepting the environment in part, and organizing behaviour making allowances for its occasional intractability. The most widely used method of teaching mathematics at secondary schools which is lecture method does not permit ample opportunity for adaptation and accommodation to take place in mathematics classroom, hence this leads to seek for more convenient methods of teaching mathematics and trigonometry in particular.

2.2.3 Constructivist Learning Theory

Constructivists believe that learners actively construct their own understanding rather than passively absorb or copy the understandings of others. The term constructivism can be referring to one of many different but related concepts more specially; constructivist perspective can focus on epistemological theory, and pedagogy (D' Angelo, Touchman and Clark, 2009). As an epistemological theory they say, constructivism focuses on how bodies of knowledge come to be. This perspective is important to note even though thus view of

constructivism is not discussed in educational literature as frequency as other views (D'Angelo, Touchman and Clark, 2009).

From the perspective of constructivism, learners construct knowledge based on what they already understand as they make connection between new information. This knowledge evolves from the learner's previous experience combined with active engagement in new activities.

According to vygotsky (2005) as cited in Kajuru and Kauru (2014) constructivism as its name emphasizes the building (i.e. construction) of knowledge that occurs in students' mind when they learn. Constructivism represent a paradigm shift from education based on behaviourism to education based on cognitive theory constructivism continues to be part of the discourse and practice of the instructional designers. In a way its generality (or fuzziness) works to its advantage. It stands for a whole family of strategies and model aiming to make instruction more meaningful and authentic (Ryder, 2010). The main concept of constructivism that is important to remember is the teaching with constructivist Method in mind involves the learner being an active participant in the classroom (Desiree, 2009).

Sambo (2005) said that the most important nature of constructivist approach is interesting, attractive, student centred, activity based, retentive and lead the students to have mathematics power.Instructional design depends on good theories of knowledge; learning and instruction constructivism in its many faces and forms contributes that theory. At the same time, the field depends on skilled professionals who know what to do with a good theory, to use it in combination with local knowledge and ideas for making good instruction. Moreover, instructional designers need the moral grounding to ensure that right people benefit from their efforts, particularly those who may not be in positions of power

or influence (Wilson, 2005)Also the constructive learning environment makes the activities in which the learner is the centre of the learning process, take place, where learners work together, support each other, use different tools and learning resources in order to achieve the learning objectives and solve problems. This study adopted the constructivist approached.

Therefore a constructivist is a problem solving technique that concern how people learn (Shaffer, 2006) as cited in Kajuru &Kauru (2014) Constructivist approach is typically student centred discovery learning instead of teacher centred "facts" dissemination. This study adopted Piaget theory of constructivism argues that people produce knowledge and form meaning based upon their experiences, two of the key components which create the construction of an individual's new knowledge are accommodation and assimilation. Assimilation causes an individual to incorporate new experiences into old ones. This causes the individual to develop new outlooks, rethink what were once misunderstandings, and evaluate what is important, ultimately altering their perceptions while accommodation is reframing the world and new experiences into mental capacity already present. This theory addresses how learning actually occurs, teachers in this theory should function as facilitators whose role is to aid the students when it comes to their own understanding. This learning theory take a very different approach away from the traditional learning, instead of telling, the teacher must begin asking, instead of answering questions that only align with their curriculum, the facilitator must make it so that the student comes to conclusion on their own instead of being told (Kauru & Sodangi,2016).

Learning is an active process; direct experience, making errors, and looking for solutions are vital for the assimilation and accommodation of information. How information is presented is important. When information is introduced as an aid to problem solving, it functions as a tool rather than an isolated arbitrary fact. Students are more interest when

they learn by doing, as opposed to sitting and listening. Therefore, the study investigated the impact of Inquiry and problem solving strategies on attitude, retention and performance in trigonometry among senior secondary school student' in Zamfara state.

2.3 Conceptual Framework

The conceptual framework that guided this study was based on the 7ESinquiry learning cycle model and Polya four stages model were adapted.

2.3.1 The 7E Learning Cycle Model of inquiry strategy

The study adopted 7E learning cycle model as an inquiry based learning strategy which its roots on constructivist perspective. The learning cycle represents a general philosophy of teaching and learning with strong constructivist underpinnings. Central to this methodology is the idea that a hand-on exploration or activity is to be done prior to the formation of concepts. It allows teachers to present lessons that incorporate inquiry activities into their curriculum in a cycle that promotes a student-centered classroom.

The goal of 7E learning cycle model is to emphasize the increasing importance of eliciting prior understandings and the extending, or transfer of concepts. The 7E learning cycle model requires instruction to include the following discrete element: Elicit Engage, Explore, Explain, Elaborate, Evaluate and Extend. (Eisenkraft, 2003)

Elicit

The importance of eliciting prior understandings in ascertaining what students know prior to a lesson is very important. Recognizing that students construct knowledge from existing knowledge, teachers need to find out what existing knowledge their students' process. Failure to do so may result in students developing concepts very different from the ones the teacher intends (Kajuru&Kauru, 2014).

Engage

In the engagement phase the teacher captures student's interest and makes them curious about to topics and concepts to be learnt. This phase provides an opportunity for the teacher to find out what students already know or think they know about the topic and concepts to be developed (Bybee, 2002). The engage component includes both accessing prior knowledge and generating enthusiasm for the subject matter.

Explore

In the exploration phase students interact with the materials and ideas through classroom and small group discussion (Liewelyn, 2005). This helps the students to acquire a common set of experiences so they can compare results and ideas with their classmates.

Explain

In the explanation phase students are provided the opportunity to connect their prior experiences with current learning and make conceptual sense of the main ideas. Liewelyn, (2005) Teachers may frame questions, suggest approaches, provide feedback, and assess understandings (Kajuru &kauru 2014)

Elaborate

In elaboration phase students' are provided with opportunity to apply introduced concepts to new experience Liewelyn, (2005).It also helps students to make conceptual connections between new and prior experience connect ideas and deepen their understanding of concepts and processes.

Evaluate

In evaluation phase that is centrally placed in the model that take place virtually in every phase of the 7E learning cycle model provides a formative and summative assessment of what students know (Bybee, 2002).Formative evaluation should not be limited to a particular phase of the cycle. The cycle should not be a linear.

Extend

Teachers need to make sure that knowledge is applied in a new context and is not limited to simple elaboration. Students are challenged to explore, compare, and contrast ideas, theories, concepts with knowledge gained (Eisenkraft, 2003).Since 7Es learning cycle of inquiry strategy is based on constructivist learning theory. The major ideas of this learning cycle its emphasis on active learning. The implication of this learning cycle to this study is that learner is an information constructor. New information is linked to prior knowledge, which is the engagement of students in meaningful experience as the essence of learning. Teacher have to make good instructional strategies and learning objects to possible make a shift from passive transfer of information to active problem solving. Therefore in order to understand the learning that has taken place within an individual, the actual experience must be examined. This would help in promoting positive performance in the learning of trigonometry.

2.3.2 Polya four stages Model

Polya four stage methods which emphasised the entire process of problem- solving teaching method rather than a narrow focus on how to obtain a solution, it will help the students to develop a sense of independent thinking. The four stages involved understanding the problem, devising a plan, carrying out a plan and looking back or checking the result

Understanding the Problem

In First stage, it involved critical reading, thinking and extracting all provided information from the problem; student must see clearly what is required. Questions that the student should ask are: what is the unknown? What are data? What is the condition? The student should also consider drawing a figure and introducing a suitable notation.

Devising a Plan

In the second stage, the students and the teacher made a general plan and select relevant methods for problem solving. It involved relating the problem and its information to ones problem solved for instance; Questions that the student should consider are; have you seen it before? Do you know a related problem? The student should look at the unknown and think of a familiar problem having or similar unknown.

Carrying out the plan

In the third stage, Student should carry out their plan and check each step. The questions the student should ask are; can you see clearly that the step is correct? Can you prove that is correct? The student has to convince himself that the detail is fit into the devised plan. Each detail has to be examined until everything is clear.

Looking back and checking

In the fourth stage, Questions that the student should ask include, can you check the result, and can you derive the result differently? Can you use the result, or the method for some other problem? The student should examine the solution obtained very carefully. He should reconsider and re-examine the result and the path that led to the result.

The stages are dynamic and cyclic in nature. The problem solving process in mathematics cannot be depicted as one-directional. There are times when the first stage may reoccur during the second, and third stages .For example, a student may begin with a problem and engage in thought to understand it, the student may than develop a plan attempt to solve the problem but become unable to do so. Thus, the student makes a new plan or goes back to develop a new understanding of the problem. The following model shows the dynamic and cyclic nature of problem solving.

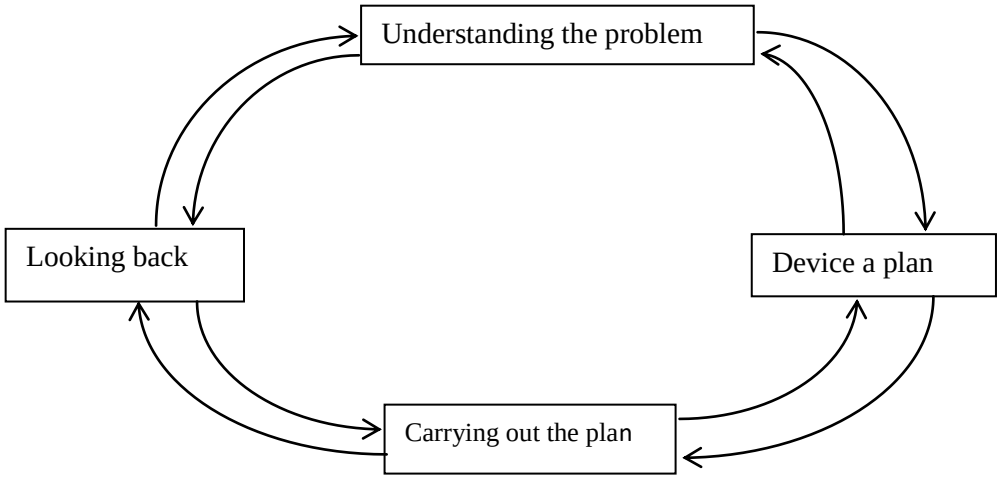


Figure 2.1: The dynamic and cyclic nature of problem solving. Source Adopted from Wilson (2005)

Polya problem solving strategy is deeply rooted in constructivism teaching practices. It is student-centred and offers students opportunities to be actively involved in teaching/learning process. In this study polya problem solving strategy would spells out steps of approaches to given problems to enhance better performance of students and retention ability.

2.4 Trigonometry as a Teaching Subject

Trigonometry as a branch of mathematics involves the study of angles, attitudes, length of size and area of triangle. It is indispensable in various areas of mathematics and science. According to Adetula (2005) trigonometry has applications in both pure mathematics and in applied mathematics, and it is essential in many branches of science and technology. Trigonometry is taught in secondary schools either as a separate course oras part of pre-calculus course. Trigonometry can be studied by constructions, observations and description. The angles of arbitrary triangles cannot be connected with its sides by means of algebraic relations but only trigonometric functions. The value of trigonometric functions varies with the angle of which it corresponds.

The changes in the nature of trigonometry made mathematics teachers still continue traditional methodology. The trend of paying attention to teachers' knowledge of mathematics topics and nature of mathematics has been triggered in part by the need to improve the quality of teacher education, in several countries, the need to improve mathematics teacher education is also made more urgent by introduction of new trigonometry (JongandBrinkman,2002).This is particularly important because teacher education programmes can not only prepare teachers to teach all students but also continue to push the boundaries on what might look like (Bay,2001)Trigonometry is a unit in which algebraic techniques, geometrical realities and trigonometric relations come together. Developments of trigonometric functions are based on some concept in analysis (Gillman, 2001).Meanings of ratios between the edges of right triangle, ratios of sine, cosine and tangent in trigonometry are taught in secondary schools, but the teaching of trigonometry in secondary is limited to obtain these ratios for any special angle. Trigonometry brings together algebra, functions ideas, domain, range inverse, algebra of functions, and recursive reasoning in terms of periodicity. Trigonometry is rich in visual representations of phenomena. It is application in navigation, elevations, and bearings, to name a few of the areas in which trigonometry is indispensable. Trigonometry has rich problem solving opportunities and involves acute reasoning and proof capacities.

The National Assessment of Education Progress (NAEP) and the National Council of Teachers of Mathematics (NCTM) acknowledge that more students are taking more advanced school mathematics courses such as trigonometry or courses that include trigonometry. The teaching of trigonometry in high schools needs more detail.

2.5 TrigonometryTeaching Methods

The nature of mathematics teaching and trigonometry in general in our schools today has be dominated by teacher centredapproach. This approach as opined by. Alieme and Monica

(2015) stated that the method of teaching could be regarded as the vehicle through which a message is delivered to the students. For proper effectiveness in the delivery of topic in the classroom and to enhance achievement of students, it is important for teachers to adopt different strategies of teaching in ensuring the permanent change expected of students at the end of the lesson. Teachers should be able to develop pedagogical skills that will make learning more interesting and acceptable to the students. Other reasons have made science and mathematics educators to go for instructional procedures such as project method, discussion method, problem-solving method, inquiry method among others, (OkaforandOkeke, 2006).The purpose of all teaching is to make the students to learn what they are taught. Thatis teachers teach to impact knowledge and skill to the students. Trigonometry need to be taught using an activity based method of teaching such as problem solving and inquiry strategies which are student-centred learning. This study investigated the impact of inquiry and problem solving strategies on attitude, retention and performance in trigonometry among Senior Secondary School Students in Zamfara State.

2.5.1 Inquiry Strategy of Teaching Trigonometry

"Tell me and I forget, Show me and I remember, Involve me and I understand, this is buttressed by the famous Chinese saying as outlined by Odili (2006).This well known adage signifies the values of engaging the learner in a task as a more meaningful way to learn one such teaching approach is learning through inquiry. The inquiry mode of learning is a student centered learning process where the teacher acts as facilitators or coach rather than an instructor. The method is not about memorizing facts; it is about formulating questions and finding appropriate solutions to questions and issues. Inquiry based teaching is a pedagogical approach that invites students to explore academic content by posing, investigating and answering questions according to Lee (2004) inquiry learning begins when students are presented with questions to be answered, problems to be solved, or a set

of observations to be explained. If the method is implemented effectively, the students should learn to "formulate good questions, identify and collect appropriate evidence, present results systematically, analyzed and interpret results, formulate conclusions, and evaluate the worth and importance of those conclusions .

According to Abrams, Southerland, and Silva (2008) describe inquiry as a "building" process that moves learners along a continuum when they are uncultured in the practice of inquiry. Student come to the class room expecting "one right answer" and need exposure to inquiry incrementally by gradually structuring inquiry experiences, students are able to exhibit the absence of the dreaded "just tell me what I need to know'. According Dang and Jwan (2000), the inquiry method is an approach that seeks to find out more about nature, about how things come by. In this method the teacher allows the students to raise questions and seeks solutions through guided instruction. This method gives the opportunity to the students to use their own initiative.

Inquiry is a process by which children actively investigate their world through questioning and seeking answers to their questions. This process is characterized by actions such a probing, searching, exploring and investigating (Martinello and Cook, 2000). Inquiry as a way of learning the world should be taught in the context of real-life scientific problems involves real science knowledge. Inquiry based teaching (IBT) approach is used to descript teaching. Strategies that are driven by approach is deeply rooted in constructivism teaching practices. It is student centred rather than teacher centred and offers students opportunities to the actively involved in experimenting, questioning and investigating. The approach has been considered as being capable of promoting motivation among secondary schools students since it creates interest in the process of acquiring scientific knowledge and skills (Gibson and Chase, 2002). Inquiry based learning is a process where students are involved in their learning, formulate questions, investigate widely and then knowledge that

knowledge is meaning and knowledge that knowledge is new to the students and may be used to answer a question, to develop a solution or to support a position or point of view to knowledge is usually presented to others and may result in some sort of action.

According to (Galilio Educational Network, 2004) describe “inquiry is the dynamic process of being open to wonder and puzzlements and coming to know and understand the work” research suggest that using inquiry based learning with students can help them become more creative, more positive and more independent .The inquiry based learning provides opportunities for student to:

(i) Develop skills they will need

(ii) Learn to cope with problems that may not have clear solution.

(iii) Deal with changes and challenges to understanding.

(iv) Shape their search for the solutions, now and in the future.

A systematic approach to the development of these skills is essential to prepare students for problem solving and lifelong learning. A systematic approach ensures that students have the opportunity is engage in inquiry, to learn an overall process and to understand that this general inquiry process can be transferred to other inquiry situation. If most people were asked to recall how they were taught mathematics, they would most likely recall engaging in role memorization of mathematical concept as the teacher demonstrated the procedures to solve certain problems on the board. Following the lesson, the teacher would give a’’ drill and kill’ homework assignment over the same concepts that were covered in the class. The next day would consist of the same procedures but over a different concept. This method of mathematics instruction build continue on day after day over the past several years, Students today find it difficult to understand what it is they need to know and many times why they need to know it. A common question asked in a mathematics classroom is’’ why do I need to know this?’’ or when will I ever use this’’. Answering this need to know’’

question has coined the term inquiry.In inquiry method, teachers and learners play a crucial role in asking questions, developing answers and structuring of materials and cases. The application of inquiry method is very important in transition from lecturing method to other teaching methods, which are less and more clearly structured for alternative solutions. Inquiry method activities help students to develop their individual responsibility, cognitive methods, report making, problem solving and understanding skills.

A teacher using inquiry method wills establish the problem in which the students are going to be working. Once students understand what the problem is, they begin working on coming up with a solution while working with partners or small groups. Inquiry method of teaching mathematics allows students more opportunity to think about and explain their mathematical thinking. In this case the teacher confronts student with a perplexing problem, raises open ended questions that lead students to address the problem, repeats the first two phases of the lesson with two or three more problems exemplifying the usefulness of the mathematical content, engages students in a question and discussion session designed to make mathematical generalizations from their experiences in problem solving, engages students in writing and discussing activities designed to stimulate them to formulate a general method for solving any problem of this type in the future inquiry method allows the learners to seek for necessary information that stimulate teaching. With this, the teacher should assist the learners to develop positive attitude towards learning. He must select his teaching methods in such a way that students will be encouraged to participate in learning.

The inquiry approach is often referred to as “guided discovery”. Teacher guide students. It helps students develop deeper understanding of mathematics concepts and also develop critical thinking skills. When students are engaged in meaningful inquiry, their attitudes about learning improve. The use of inquiry based instruction also improves student’s level

of engagement,(Chang and Mao, 2001). In addition about their preferred role as learners, students choose concept cartoons depicting teacher-student's dialogue in a traditional classroom or a progressive classroom to express their favoured means of learning .Out of the 369 students in the study, 88.8% of the students preferred an inquiry- based teaching.

Also, Miller (2003) studies the use of inquiry based reading and writing assignments with students. The assignments lasted longer than a day and included topics chosen by the students. There were opportunities for students to work cooperatively and receives feedback from their peers. Miller, found that students in three out of the four classes in this study performed higher on tests and all students in the study preferred this type of learning as compared to a traditional approach. Dewey(2001) addressed the structure of schools and the need to integrate subjects. According to Dewey, subject taught in isolation do not necessarily make sense to children. Further memorizing of meaningless facts does not constitute genuine learning. Learning should focus on inquiry, not on imparting knowledge. Children can learn to become deep thinkers, if teacher provides the opportunity.

According to Dewey theory of inquiry, learning is social and communicates. Children learn through interactions with people and their environment. Children are constantly exploring their environment, trying to figure out how things connect to their world, social inquiry provides connection to their world. Social inquiry provides cooperative reflection, which in turn allows children to try out possible solution before making final judgments.(Hickman,2007). They watch, immediate, and learn through social connection inside and learn through social connection inside and outside of the school building. Inquiry is experimental children should be active participants in their learning through experiencing an emotional connection (Hickman, 2007).

If children engage in only routine work and they do not connect emotionally to the lesson they are only getting work done. Dewey's idea of an experience is one that reveals new meaning and begins values to learning. Students learn to communicate their knowledge and take action beyond the classroom or school building. (Dewitt,2003), Also, according (Goodlad,2008), schools teach the beliefs, attitudes, skills, passions, knowledge and sensibilities that make the whole of an individual's unique being when students engage in inquiry, they analyze and discuss possible solution to problems. (Dewitt, 2003). Through inquiry students learn to ask better questions which help them comprehend topics they are studying. (Goodbey, Barmett, and Webster,2005) asserted that in an inquiry class, students have interest in what they are learning. Not only do they remain interested, but there is more on task behaviour in an inquiry based classroom. (HeafnerandZembal Saul, 2004) Inquiry based curriculum provide opportunities for students to ask questions about something of interest and included time to explore answers (Chang and Mao, 2001). An inquiry- base curriculum involves reasoning and reflection where students consider answers to their questions and make decisions about what to do or what to believe. Students explore new ideas and solve problems with more than one possible solution.

Inquiry method involves learning through experiences instead of teachers importing knowledge. They create experience for students to achieve understandings. In an inquiry based curriculum, teachers are no longer like technicians following a manual; instead, they are creators of meaningful learning experience (Smyth,2000). The experiences begin with students actively solving an authentic problem by testing hypothesis, draw conclusions to arrive at possible solutions. Upon entering a science and Mathematics classroom, one should be able to observe an exciting learning environment in which students are wondering why and finding out.

Hernandez-Ramos and De la Paz(2009)Complied an analysis which compared inquiry based instruction with teacher directed instruction in a group of over 700 learners in a given middle school and a similar number of learners in a geographically close middle school with similar educators credentials and student demographics. During the study, they found support for higher efficacy for learning that was student oriented. They found that learners that had inquiry based material presentation achieved better results as contrasted with students in controlled group in both internal motivation and overall material knowledge. Also they reported the students had increased critical thinking abilities within the content area. It may be declared that it is necessary to form the intellection of comprehending and retaining science education to be exclusive relationship of life experiences along with organised experiences in an educational environment structured to facilitate learners to construct on their learned conceptual comprehensions in significant methods to obtain a complete understanding of a given scientific concepts. Student should be asking questions resolving discrepancies figuring out patterns, representing ideas, discussing information and solving problems this vision of teaching is associated with the term inquiry. Hence the researcher is interested to study the impact of inquiry and problem solving strategies on attitude, retention and performance in trigonometry among senior secondary school students' in Zamfara State.the researcher want to find out whether students' who had be taught trigonometry using inquiry strategy performed better than lecture method. If the results of the findings can be compared with the results.

2.6 Polya's Problem Solving Strategy

Problem- Solving models are research- based rules, steps or stages that could guarantee success in problem solving tasks.Okereke (2006) said that problem solving based learning was on model which centred on students. However problem solving teaching strategy comprises of identifying choosing mathematical problems which grow out of experiences

of individual students, placing these problems before the students and guiding them in their solution (Obodo, 2004)

In the same line of thought, Scheonfield (2008) said that to be solving a problem, there must be a goal, a blocking of that goal for the individual. Problem- solving according to the principles and standards for schools mathematics published by the National Council of Teachers of Mathematics (NCTM, 2000). Means "getting involved in a task for which there is no immediate answer" that is the solution is not known in advance. As we solve problems every time we achieve something without having known before hand how to do so, in order to solve a problem, we need to coordinate over knowledge, previous experience, intuition, various analytical abilities" and mathematical reasoning".

Problem-solving is a principal component of mathematics –Education from time of its emergence as a self-sufficient method of finding solution to a problem in science.Paul, Hwa and Lau, (2007) defined problem solving in mathematics as a process of finding solution to a problem when the method is not known to the problem solver, and the problem solver has to use strategic skills to select the appropriate techniques for the solution.

According to Galadima (2002), mathematics problem solving is the process which begins with the initial contact with the problem and ends when they obtained answer is reviewed in the light of a given information or a complex process which consists of series of tasks and thought processes that are loosely linked together to form what is called heuristic pattern. Hence, this study investigated the impact of inquiry and problem solving strategies on attitude, retention and performance in trigonometry among senior secondary school students' in Zamfara State, Nigeria.

2.6.1 Polya'sProblem Solving Strategy in Trigonometry

In mathematics, the most well known and taught model of problem solving is Polya's model of problem solving. According to (Polya, 1973) in order to solve a problem one should follow the steps in the same order. In the first step which is understand the problem several questions are asked such as what is the unknown? What are you asked such as what are the data? What is the condition? Is it possible to satisfy the condition? Is the condition sufficient to determine the unknown? During the next which is called as devise a plan, possible connection between the data and the unknown are found to develop a plan for the solution (Polya, 1973). In the third step, that is Carrying out the plan, the prepared plan is followed to come up with a solution of the problem. In the last step called look back, the solution obtained are examined and the problem is extended by using the result obtained or the method used, for generating another problem Polya has been given credit for making these steps essential in mathematics education while solving problem (Brown, 2003).

Polya also emphasised a numberof heuristics, also called as strategies, to use in devising and carrying out plans in solving problem. Some of thesestrategies include draw a picture, try and adjust, look for a pattern, make a table or chart, make an organized, try a simpler problem, and write an equation or open sentence. Problem solving is a basic skill needed by learners and this is perhaps because problem solving is higher order cognitive process needed to solve mathematics problems. When students are included in learning and participated fully. They tend to understand better and repeat the success recorded whenever they are confronted with similar or related challenges. hence, when students are taught about problem solving. They are expected to solve problems by following the same procedures their teacher exhibited. Once a problem a rising from a new situation is solved, the individual transfers that learning experiences his everyday thinking.thinking.it will

never again be a problem of the same magnitude as it was at the time it occurred. It is therefore, an integral part of the teaching process.

There are many factors that influence problem-solving that teachers must do to facilitate teaching –learning process.

1. We must help students recognize when are various strategies appropriate and where and how to use them.
2. We must help students become capable of inventing and adapting to strategies.
3. We must also help students see the structure of a given problem.

Similarly, teachers as instructional technicians, have tools that are available to assist students become better skilled and more cognizant problem solvers. Solving problems is not only a goal of learning mathematics but also a major means of doing so. Student should have frequent opportunities to formulate, grapple with and solve complex problems that require a significant amount of effort and be encouraged to reflect on their thinking. Teaching for problem solving involves applying the gained during the lesson in order to solve a problem that is the purpose of learning mathematics to solve problems.

2.7 Lecture Method of Teaching Trigonometry

Lecture method is an instructional method in which students' are passively receiving all information from the teacher and the textbook. According to Inah (2014) describe lecture method as one of the teaching methods which allows the teacher to deliver a large amount of information in short time.Lecture method of teaching that emphasizes "talk –chalk" method. In traditional teaching, teacher is authority's person and students are passive recipients of information. Students are expected blindly accept the information they are given without questioning the instructor. The teacher seeks to transfer thought and meanings to passive students leaving little room for students initiated questions,

independents thought or interaction between students (Farooq, chaudhry, and mohmood, 2005).

The lecture method pays more attention on teachers which in turn helps to decrease students learning interest to a greater extent. Also Sadi (2014) has stated that the traditional talk and chalk methods have failed to produce good results over years especially in developing countries like Nigeria, he opined that, for teachers to meaningfully learn and improve interest in mathematics, they should tap heavily from devices which have direct sensory appeal and exhibit mathematical concept clearly. This convectional strategy of teaching is often boring for students because of their job in classroom is to passively sit and watch the teacher work mathematics problems on the board and then copy what the teacher did. The lecture method is teacher – cantered. During the lecture session, the teacher needs to involve the student by asking questions that can provoke central thinking (Kankia, 2008). The lecture method should not be used in primary and secondary schools or typical trigonometry and science class Barakatas, (2005), and because of the overcrowded native of mathematics classes in our class (Bakar, Jensen, and Kolb 2002), observed that the lecture method adopted by teachers in secondary schools is ineffective, unsuitable and unproductive to teaching and learning at secondary school level. However, lecture method leads to easy coverage of the syllabus, gives room for easy handling of large classes and saves time and effort. It may be effective for advanced students.

According to Adeyemi (2008) notes that lecture, which is the most common method, does not stimulate students' innovation, inquiry and scientific thinking but rather encourages students to cram facts, which are easily forgotten. Also Tella, Indoshi, and Othuon (2010) noted that teacher-centred methods often result to students not enjoying lesson and missing the benefits of intellectual discovery. In teacher centered class, students remain passive and does not participate and discover anything for themselves. The majority of work involves

teacher-talk using a lecture technique or a simple question and answer that demand basic recall of knowledge from the learner. Generally, only correct answers are accepted by the teacher and incorrect answers are simply ignored. (Nazir, 2003) describe that the teacher in secondary school commonly use lecture method. In this method, the teacher is usually the only active participant while the students are recipients of information. In such situation, little responsibility for learning may be assumed by pupils.

Also Ali (2004) explains that lecture is neither altitude changing, nor achieves the higher mental ability. The lecture method is largely a one-way process; there is not much interaction between the students and teachers. It ignores individual differences; it does not take into consideration the interest, abilities, and needs of the students. This study adopted lecturemethod as the control group.

2.8 Concept of Attitude of Students in Trigonometry

Attitude can alter every aspect of a person's life. Attitude in this content referred to the way senior secondary school students react to the teaching of trigonometry using inquiry, problem solving strategies and also lecture method. The benefit of having a positive attitude towards mathematics cannot be over emphasized, because an individual's attitudes influence not only how he/she lives in the world around them, but also how situations, circumstances, and the actions of others are interpreted by individuals (Fritz,2008). Attitude is important in teaching and learning process. Odogwu, (2002) opined that effective teaching methods improve the students' attitude towards a subject. Student's negative attitude towards mathematics affects the teaching and learning of the subject. Most students believe that mathematics is an abstract subject and difficult to understand. That is why most of the students normally say that mathematics is reserved for intelligent and gifted students. Student's attitude towards mathematics is a major factor that can influence students' choice of achievement in the subject. Due to this, several studies have

been conducted in different countries in order to find out the students attitude towards mathematics (Tahar, Isma'il, Zamani, and Adnan, 2010). According to Odili, (2006) mathematics has been one of the subjects which Nigeria students especially at secondary school level develop dislike for and likewise achieve poorly. Research works have shown that the attitude of students towards a particular method of teaching will determine their performance in that particular subject. Also Eluwa (2005) defined attitude as a state influences changes the individual choices of personal action. Such influences can sometimes be observed in actual choice exhibited in overt behaviour. Society is faced with an enormous question: why do people feel so negatively about mathematics? The literature indicates that adverse attitudes may be created by a variety of factors, the most common being the method of instruction used by mathematics instructors.

Similarly, Howard (2005) in his study determines the effects of using cooperative learning strategies on performance assessments and attitudes of journalism 1 students. There is a difference in the attitude towards both student rights' and responsibilities and cooperative learning in the attitudinal survey given. In another study by Meriam (2000) examined the effects of Teams-Games-Tournament (TGT) on the attitude towards mathematics of year 4 students. The study involved a quasi-experimental non –randomized pre-test post-test design and the duration of treatment was three and a half weeks the results showed that the attitude of year 4 students using TGT method did not produce a statistically difference attitude of 4 year students in the control class from another school.Klin and Noor (2009) found that students' attitude towards mathematics were not significantly different in the pre-test and post-test scores within each group, except in the Enjoyment scale that the control group showed a statistically significant increase in the mean score. This shows that the traditional method had produced some improvement in the student's attitude towards enjoyment of mathematics in this case. Many teachers in secondary school are only

teaching mathematics without engaging the students in practical activities which will motivate them to learn mathematics and allow them to understand the concepts being taught. There are many researches that had beenconducted on attitude/interest towards trigonometry among senior secondary schools students and their findings may not be conclusive. In this light, the present study investigated the impact of attitudinal change among students of senior secondary schools in Zamfara state when exposed to inquiry and Polya's problem solving methods.

2.9 Retention of learned concept inTrigonometry

The ultimate target of our educational endeavour is permanent and meaningful learning. Understanding and retention of learned items are products of meaningful learning when teaching is effective and meaningful to the students Bichi(2002).Retention or memory can be categorized into two that are short-term and long –term. This study was concern with short term, which is how a student can recall material immediately or after a very short time in examinations. It required a student to reproduce correctly what has been previously learned. A study by Roher et al (2005) Performed an experiment using 2 groups of subjects to learn either 20 words definition pairs or 10 words definition pairs in the same study time (2 minutes).They were then given a test to establish initial learning followed by retention 1 or4 weeks later. Their findings showed that the individuals learning the 10 word-definition pairs, who had twice the study time, recalled a far greater proportion of their words after 1 week. This difference disappeared after 4 weeks and the number of words recalled by the 20 words group was greater than those recalled by the 10 words group. By implication of this finding is that quantity is important in retention, an individual would be better studying 50words in 5 minutes and recall 20 than studying 20 words in the same tie and recalled 15 that are increase retention.

According to Kurumeh, Onah, and Mohammad (2012), resourcefulness in mathematics teaching demands mathematics teacher to focus attention on method, of teaching that stimulates learner's enthusiasm, interest and higher retention rate, taking into cognizance the learner individual differences.Obeka(2010) investigated the effect of inquiry and demonstration method on student's achievement and retention in some environmental education concept of Geography. It implies that there was a significant effect due to instructional method on student's retention. However one of the objectives of this study is to investigate the effect of field trip teaching strategy on academic achievement and retention ability among Urban and Rural Senior Secondary Schools Students taught Ecology concept in Biology. However, mathematics is not a subject that be learnt by rote memorization, but for one to remember and recall information demand passing through one's experience. This goes to mean that the task before a teacher is how to help learners improve on their ability to assimilate information towards effective recalling/retrieving when the need arises. Azuka (2012) observed that one of the challenges in the school system is how to teach and ensure that students comprehend the mathematics concepts to facilitate effective retrieval when required. Thus, there are different teaching methods that mathematics teachers can use to ensure effective learning and sustain the attention of the learners to have positive attitude and interest towards the subject.

Again, Henderson and Davis (2005) tested medical studies, compared knowledge and retention after a one year interval between groups assigned to attend either lectures or self-study classes. On both the original final examination and retention examination, there were no statistically significant differences between the two group performances similarly Seyhan and Morgil(2007) examined differences in retention of learning material using lecture based and small group based teaching methods in methods in a continuing medical education course. The result demonstrate that although both groups had a significant

decline on a three month fellow –up exams, the group who attend lecture classes retained information better than the group who attend small group classes. The above information with regard to retention of material taught indicates that certain instructional strategies enhance retention of knowledge over time when effectively utilized. Though many researchers have been conducted on knowledge retention among secondary school students but their findings may not be conclusive .in light of this the present study investigated the impact of inquiry and problem solving strategies on attitude, retention and performance in trigonometry among senior secondary school students in Zamfara state with hope of marking great contribution to mathematics education. Another significant area that this study talked about is the academic performance in trigonometry.

2.10 Academic Performance in Trigonometry

The term academic performance can be described as the successful outcome of accomplished activities or tasks in educational measurement in relation to accepted standards According to Emaikwu(2012) academic performance refers to an individual's academic attainment after a specified course of instruction. Also Tenty and Awe (2011) defined academic achievement as the gain in knowledge of students as a result of taking part in a learning activity or program..Despite the relevance of mathematics in general and trigonometry in particular, the persistent high rates of failure by secondary school students is an issue of great concern to Nigeria. This failure is reported by the chief examiner of West African Examination Council (WAEC, 2011) and National Examination Council (NECO, 2009& 2010).this indicate that mathematics education in Nigeria is not producing students whose mathematical knowledge and skills are good enough for individuals effective living. Mathematics educators and researchers have tried to find out the root causes of this worrisome solution of student's mass failure in mathematics. Researcher's reports indicate various factors as inappropriate teaching and learning methods.

(Azuka,2003) teachers' inability to help students to learn mathematics effectively, the Chief Examiners' Reports(WAEC,2011) indicate that students scores in mathematics at senior secondary examinations range from zero percent with failure representing 60 percent and only 10 percent recorded distinctions. Thus, teachers are being instructed to use inspiring methods of teaching that will ameliorate this ugly trend.

The researchers also pointed to the fact that, teachers use mostly conventional methods of teaching which invariably responsible for mass failure (Azuka,2003) Challenged by the problem of improving students' achievement in mathematics knowledge.Researchers, mathematics educators have suggested various teaching methodsOgunyemi (2010) suggestedproblem solving models as effective teaching and learning strategies. A study conducted by Maduabum andOdili, (2007) indicated a low achievement in mathematics. According to the study, student sat for West Africa Examination Council (WAEC) Mathematics between 1991 and 2002 did not attain 38% pass at credit level in Nigeria. The WAEC Chief Examiner's Report (2011) also confirmed the poor achievement and went on to lament that this poor achievement has resulted in students' low interest in the subject. The problem may be connected to the fact that mathematics teaching in Nigeria still follows the traditional pattern even when the traditional is neither promoting student interest nor achievement in the subject. In order to address this issue mathematics educators such as Iji (2012) and Obodo (2007) explored different strategies to ensure that mathematics is properly taught and learn in the school.

In addition Steen (2003) stressed that teacher can stimulate students to learn mathematics through the process of constructing, patterns, devising strategy for solving the problem and discovering the beauty and application of mathematics. This method of teaching is in agreement with inquiry based method of teaching in which students use inquiry methods to ask questions, investigate a topic and use a variety of resources to find solutions and

answers. Also, problem- solving skills enable the students to apply their skills to both familiar and unfamiliar situations, thereby giving them the ability to use tested theory and also create their own before applying them. By developing problem solving strategy, students learn to understand problem, devise plan, carryout plan, analyse and review the accuracy of their solutions.

According to Stein (2001), Mathematics teachers were more concerned with students role use of procedures rather than with their understanding of concepts and development of higher order thinking skills". This mode of learning makes students to feel that mathematics is boring, static, and repetitive, and it discourages them from developing interest in the subject. Kuremeh (2006) observed that students have great difficulty in understanding, comprehending and assimilating Mathematics taught to them in the classroom, so they resort to learn by role memorization, resulting in consistent mass failure. Teachers of mathematics in particular should see the problem of poor performance as a challenge which should be squarely faced. Strategies plans must be evolved by teachers for making mathematics friendly to all students so that in no time, mathematics would be the subject Nigerian students perform best in. Also, Stein (2001) opined that mathematics teachers should choose problem that can be solved in more than one way to improve "student flexibility of thinking", Mathematics teachers should try to do their best to create a friendly classroom atmosphere where teaching is easier and learning is easy even enjoyable. It is base on this the researcher investigated the impact of inquiry and problem solving strategies on attitude, retention and performance in trigonometry among senior secondary school students in Zamfara state, Nigeria. There is the need to compare gender and academic performance in trigonometry.

2.11 Gender and Academic Performance in Trigonometry

This section investigated the mathematical gender difference of students. The word gender has attracted the attention of many scientist (biologists, psychologists, and researchers) as a result of which a lot of literature exists on different aspects of the concept. Gender according to Okeke (2008) is the social or cultural characteristics, roles or behaviours which male and female are known for by the society. (Okeke, 2008) further described the menas bold, tactful, intelligent, aggressive, and so, women as dull, passive, submissive, talkative and so on..Stanley (2008) define gender as the amount of masculinity and feminity found in a person and obviously while there are mixtures of both in human beings, the normal male has a preponderance of masculinity and the normal female has a preponderance. Could these attributes being reasons that affect students performance in mathematics, and science related courses, the issue of gender disparity is currently a world trend and it has remained an annual problem in mathematics achievement. Achievement varies across gender.Studies on gender and achievement in mathematics exist with different views and findings. Why some studies have shown that male students performed better than female counterparts other studies show the other way round. Still othershas shown no significant difference in the achievement of male and female students in mathematics. (Usman and Musa,2015) in their studies on effect of inquiry teaching method on students'achievement in algebra in Bauchi L.G.A of Bauchi State found out that there is significant difference in the mean achievement scores of male and female students taught using inquiry method in favour of male group. Also another study conducted by Abdullah. (2016) on the Impact of students'teams' achievement divisions strategy on secondary school students in trigonometric performance and retention in Katsina found that male students performed better than the female students taught using STAD strategy. Other

studies earlier conducted reported that boys performed better than grits in mathematics test(Asante, 2010; Olasunde and Olaleye 2010)

According to Asim, Kalu, Idaka and Bassey (2007). Consistently found out that male student are superior in geometry and visualization, while the female students show superiority in computation in the science and mathematics. The issue of school socialization were girls are made aware that they are unequal to the boy interaction in class tends to make confident in mathematic that girls, Kaino (2012) reported that boy's increase interaction with teacher in class than girls tend to influence better development of mathematics concepts among male students.

Adeleke and Amoo (2007) had pointed out on school influence assessment, procedures, teacher expectation and behaviour believed to contribute to gender inequality in science and are stereotyped as male dominates, sometimes even teachers tend to stereotype mathematics as a male domain. They overate boys' ability relative to girls in mathematics stereotypes about female inferiority in mathematics are prominent among students males seem to be more inclined to mathematics than females from observation, at secondary school level most of the girls don't actively participate in mathematics classes due to their poor perceptions about the subject. Negative attitude towards mathematics in women deprived from a large number of profession because they see such professions as masculine in nature.

Oteze (2011) maintained that gender differences may be decreasing, but that the difference still exist in the learning of complex mathematics, personal beliefs in mathematics, and career choices that involves mathematics. However some literature research reported that female students performed better than male students when exposed to mathematics test (Nworgu2004; Unodiaka, 2015) stated that presently in our schools, there exist gender

differences in mathematics and science achievement and these have attracted some debates.For example, (Yusuf,2009) in his study on the strategy for effective teaching and learning of calculus in secondary schools which showed non-significant difference in the mean achievement score of male and female students.. Other researcher such as(Eriba andSesugh, 2006) has reported differently on this issue. They found that boys outperformed in science and mathematics achievement. (Ifeakor,2003) conducted a research on Effect of Peer Assessment on Students Academic Achievement in Mathematics'. One of the specific purposes of the study was to find out the influence ofsex on students' academic achievement in mathematics, the researcher administered a mathematics achievement test (MAT) to 187 SS2 Students. After analyze the data for the study revealed that gender had no statistical significant effect on the Students academic performance.Also (Attah and Guwan,2015) reported that gender has no effect on achievement of students in their studies on the effect of remediation on students' achievement in mathematics in Government Secondary School, kuwiri, Jos – North LGA of plateau State. Whereas According to Nahuche (2001) finds significant difference between male and female students in their academic achievement in mathematics in secondary schools. Theresult shows that males obtained mean higher scores than females in mathematics.

In another development, Aiyendun (2000) also finds no significant difference between male and female students in mathematics achievement. Also Salman and Ameen (2014) in their study reported that there is no significant difference in the achievement of male and female students in mathematics word problems when exposed to various strategies that allow them to participate actively. (Ebisine, 2013) observed that girls outshine boy on the level of understanding non-technical words in mathematics. While (Adeniyi,2012) opined that the scores of both groups on the test achievement in indices and logarithms are the

same which implies that achievement is not attributable to gender. According to (Maduambum andOdili, 2007) in their studies found out that a significant difference exists between the performance of male and females in further mathematics. It is important to carry out a research on gender differences and achievements in Trigonometry, gender differences and achievements in Trigonometry may attract a number of researchers nationally and internationally. Some Studies in mathematics education showed that female performed lower than the male counterpart, while some studies reported significant differences in favour of boys by indicating that boys have higher mathematics reasoning ability and others studies reported no significant difference in mathematics achievements of boys and girls. Thus the present study explored the use of inquiry and problem solving strategies to measure gender difference in trigonometry performance.

2.12 Overview of Related Studies

Several studies have been conducted on various aspects of trigonometry by other researchers in various parts of the world. In this section, the review related studies in this work have been summarised and possible critiques have been offered. Popoola and Fijuyigbe (2010) investigated effect of activity base and inquiry methods on the performance and attitude of junior secondary school students towards computer science. The main purpose of the study was to determine the effects of two instructional methods on students' performance and attitude towards computer science.Four hypotheses guided the study. A quasi-experimental pre test post test control group design was adopted for the study. The sample of the study consisted of one hundred and fifty (150) JSS 2 students selected randomly from three local government area of Ekiti State.Two instruments were used to collect the data were; computer science achievement test (CSAT) and student attitude towards computer science Questionnaire (SATCSQ). The instruments were validated by experts, and the reliability coefficient of 0.94 was obtained. The data collected

were analyzed using Frequency count, standard deviation, Analysis of Covariance (ANCOVA) and Multiple Classification Analysis (MCA). The findings showed that students taught using actively based method performance significantly better and developed positive attitude than those taught with inquiry method and the control groups.

Theabove reviewed study was similar with the present study in terms of design they are similar in the sense that both of them are rooted to relatively new approaches of teaching. Also in comparing the gender of the students in both studies, gender of students does not influence their performance and attitude when subjected to equal amount of activities. However, the study differs from previous one in many ways because it has tried to take in cognizance of the shortcomings of the study mentioned above. Terms of subject, SSSII students was used unlike the previous study that used JSSII.In term of scope, the present study was conducted in Zamfara State, while the previous was conducted in Ekiti State, and content area;they also differ in terms of method of data analysis. The researchers did their research on the effects of academic performance and attitude. While the present study was on the impact of inquiry and problem solving strategies on attitude, retention, and performance in trigonometry among senior secondary school students in Zamfara State. Nigeria.

In another study, Gok and Silay (2010) explored the effects of problem solving strategies on students' achievement,attitude and motivation..The main purpose of the study was to determine the effects of teaching of the problem solving strategies on the students' physic achievement, strategy level, attitude, and achievement motivation. The study was conducted on the tenth grade students in turkey. The research design was experimental research in nature. Data were collected with physics Achievement Test (PAT), Problem Solving Strategies Survey (PSSS), Problem Solving Attitude, Survey (PSAS) Achievement Motivation Survey (AMS) and Problem Solving Worksheet. The instruments were

validated by experts and the reliability coefficient of PAT was 0.70, Data collected were analyzed using mean, Standard Deviation and t-test. The results of the study revealed that the experimental group's achievement, motivation, strategy level and attitude were found to be higher than the control group also gender did not affect the physics achievement of students'. It was recommended that problem solving strategies should be adopted in teaching physic concepts. The two studies are similar in terms of new approaches, but however they differ in terms of design, scope, a goodsample size was used unlike the previous study that used small size and also method of data analysis .and content area were differed. The researchers did their research on the students' achievement, attitude and motivation. While the present study was on the impact of inquiry and problem solving strategies on attitude, retention, and performance in trigonometry among senior secondary school students' in Zamfara State.

In other study, Samuelson (2010) conducted a study on the impact of teaching approaches on students' mathematical proficiency in Sweden to examine the effect of traditional and problem solving methods of teaching children mathematics in the first five years in school, as well as differences between boys' and girls' achievement depending on the teaching approaches. The research employed a longitudinal study of the impact of different learning contexts on students' mathematical proficiency. The sample of the study was 105 students in four different classes were used. The study was conducted in two different schools in Sweden (.46 students in school A and 59 students' in school B). The tests employed in this study were developed by expert group contracted by the National Council of Education in Sweden. The researcher used t-tests for independent samples to analyse the data. The result shows that there is no significant difference between teaching methods when assessing procedural fluency. Students' progress in conceptual understanding, strategic competence and adaptive reasoning is significantly better when teachers teach with problem –based

curriculum. Also to develop aspect of self-efficacy, the result shows that pupils would benefit from a traditional curriculum. Boys and Girls who have been taught with similar methods perform equivalent in both traditional and the problem solving group. It was recommended that an eclectic approach to instruction may be the best to develop all dimensions of learning outcomes. The two studies are similar in terms of comparing traditional teaching method and problem solving. However, the two studies differ in terms of design, scope, sample, and also instruments used for the study. The researcher did his research on the impact of teaching approaches on students' mathematical proficiency and self-efficacy. While the present study was on the impact of inquiry and problem solving strategies on attitude, retention, and performance in trigonometry among senior secondary school students' in Zamfara State.

On the other hand, Moses (2010) explored the effect of Polya's problem solving technique on Secondary School Students' achievement in physic. The study took place in Zaria local Government Area of Kaduna State. The main purpose of the study was to compare the effect of Polya's problem solving technique on secondary school student's achievement in physics. One hypothesis guided the study the design of the study was quasi-experimental in nature. The sample of the study consisted of two hundred and four. (204) Senior Secondary Schooltwo (SSSII) students were drawn from six secondary schools in Zaria local Government Area of Kaduna State. The instrument employed for the study was a researcher developed and validated by experts with the lesson plan. The reliability coefficient of 0.79 was obtainedData analysis techniques employed for the study was mean, standard deviation and t-test. The result showed that students' taught with Polya's problem solving technique performed better than the students' with conventional problem solving, technique. It was recommended that students should be taught with Polya's problem solving technique rather than convectional problem solving technique to enhance

their learning of physic. The two studies are similar in the sense that both of them are rooted to relatively new approaches. Again, they are also similar in terms of design, subject, and method of sampling technique. However, they differ in terms of content area and sample Size.The present researcher therefore investigated the impact of inquiry and problem solving strategies on attitude, retention, and performance in trigonometry among senior secondary school students' in Zamfara state, Nigeria

In another study, Chianson, Kurumeh andObida (2011) conducted a research on the effect of cooperative learning method on students' retention in circle geometry in secondary schools in Benue State, Nigeria..The main purpose of the study was to investigate the effect of the cooperative learning strategy in enhancing the retention of circle geometry being taught to secondary school students. The research design for the study was quasi-experimental. One hypothesis guided the study. The sample for the study was made up of 358 Senior Secondary School II Students randomly selected from three educational zones in Benue state. The instruments for the study were Geometry Achievement Test, andRetention Geometry Achievement Test. The reliability coefficient of 0.73 was obtained. Data analysis employed for the study were mean, standard deviation and t-test The result of the study confirmed that students who were subjected to cooperative learning strategy were able to retain the concepts of circle geometry more those Students who were taught using the conventional learning approach. It was recommended that, students would be able to retain, taught and learnt concept in mathematics for a longer period of time if mathematics teachers applied the cooperative learning strategy in teaching. The two studies were similar in terms of design, sampling procedure and subject used in the study. The difference between the study of Chianson et al and the present study is that the study was conducted on circle geometry in Benue state. While the present study conducted on trigonometry concepts. Also attitude was considered in the present study. The studies differ in terms of

content area and statistical analysis procedure.The researchers did their research on the effect of cooperative learning method on students'retention. While the present study was on the impact of inquiry and problem solving strategies on attitude ,retention and performance in trigonometry among senior secondary school students' in Zamfara State

In another study, Fazahur, Nabi, Jumam, andNazoora (2011) investigated the impact of

project based method on performance of students. The main purpose of the study was to investigate the effectiveness of project method in teaching mathematics at secondary school level in Pakistanthe study was aimed to secondary school level in Pakistan. One hypothesis guided the study.The study used a pre-test-post-test control group design, The sample of the study consisted of 40 students of secondary level classes of Islamabad model College for Girls. Two test and lesson plan were developed for two Methods of Teaching. Data collected were analyzed using mean and chart. The results of post-test revealed that student taught with project method performed better than students taught by lecture method. It was recommended that for the effective teaching of mathematics project based method must be followed in order to increase the learning level of students. Also it should be included in the training curriculum. The two studies are similar in terms of research design. However, the two differ in terms of scope, sample and content area. They also differ in terms of method of data analysis. The present researcher therefore investigated the impact of inquiry and problemsolving strategies on attitude, retention, and performance intrigonometry among senior secondary school students in Zamfara state, Nigeria

In another study, Kassim, Abisola and Adeyanju (2011) explored the effects of attitude and self-concepts on achievement in secondary school Mathematics. The study took place in Ogun State. The study is a non –experimental type and an ex-post facto research design was adopted. It took a sample of 2400 students from 60 selected schools in nine local

government areas within Ogun State. Three instruments wereused for the study: Attitude to Mathematics Questionnaire, Self-concept Scale, and Mathematics Achievement Test. The computed reliability value was r =0.73, r =0.71 r = 0.84 respectively. Data collected were analyzed using multiple regressions, the findings show that students' attitude to mathematics and self- concept have significant joint effect in mathematics achievement. The two studies are similar in comparing attitude of the students', however the two studies differ in terms of research design, scope and also method of data analysis. The researchers did their research on the effect of attitude and self concept on achievement. While the present study was on the impact of inquiry and problem solving strategies on attitude ,retention and performance in trigonometry among senior secondary school students' in Zamfara State.

In other study, Tekerek, Yeniterzi and Ercan (2011) conducted a research to study mathematics attitudes on computer education and instructional technology students in Turkey. A descriptive model research method was used in order to determine the attitude of CEIT students towards maths. The population of the study was faculty of education which have CEIT Departments in Turkey. The sample of the consisted of 122 CEIT students, how have take Math 1 course at the CEIT Departments in four universities in Turkey. The data were collected through Math Attitude Scale. The Cronbach's Alpha reliability coefficient of the scale was found to be 0.96. The data were analyzed and interpreted by means of PASW Statistics 18.in the analysis of data, independent sample t-test was used in other to determine whether there is significant difference among students' attitude towards math as regards their gender and their mothers 'education levels. One way ANOVA was used in order to determine whether there is significant difference among students' attitude towards math as regards their type of graduated high school, grade of high school diploma, YGS-1 score which they received, their fathers' education level, grade of IT in Education 1 course

and lastly grade of math1 course, in conclusion, some differences were found in terms of math attitudes of CEIT''s students. The two studies are similar in comparing the attitude of students, also in statistical analysis procedure where one way ANOVA was also used in the present study. However, thestudies differ, in terms of scope,level of students involved in the study.The present researcher therefore investigated the impact of inquiry and problem solving strategies on attitude, retention, and performance in trigonometry among senior secondary school students in Zamfara state, Nigeria.

In other study, Fajemidagba and Suleiman (2012) explore the effects of Polya's and Bransford and Stein problem solving models on students' performance in mathematics. The experiment was conducted to examine the effects of two school II students' performance in statistics in mathematics. The students of senior secondary school student (150 students) were sampled for the study. For the data, three tests were administered to the experimental group as well as control group. These were (i) mathematics performance test (MPT) (ii) statistics performance I (SPTII) (iii) the statistics performance and Stein groups on the statistics was significantly higher than that of the lecture group. The study is similar to the present study in terms of design, and sample of the study. They however differ in data analysis. While the present study involved the concept of attitude and retention was considered.

In another study, Kurumeh, Jimin and Mohammed (2012) investigated the effectiveness of inquiry teaching method in Senior Secondary School Students' achievement in algebra the main purpose of this study was to investigate the effect of inquiry teaching method on Senior Secondary School (SSI) students' the study took place in Onitsha Education Zone of Anambra State. The design used was quasi-experimental research design. Two research questions and two hypotheses guided the study.123 SSI students' was drawn from four schools based on gender. The instrument employed for the study was Algebraic

Mathematics Achievement Test (AMAT). The internal consistency of the instrument was computed to be 0.83 using kuder-Richardson 21. Data collected were analyzed using Mean, Standard deviation and analysis of variance (ANOVA). The result of the study showed that students in the experimental group taught algebra using inquiry method performed significantly higher than those students in the control group. Also male students in the experimental group were found to benefit more than their female counterparts. It was recommended among other things that Mathematics teacher should adopt inquiry teaching method in teaching Mathematics in senior Secondary Schools. The above reviewed study is similar to the present study in terms of design, sampling procedure and method of data analysis.The two are also related in comparing achievement of male and female students. However the two studies differ in terms of subject, content area and scope.The researchers did their research on the effect of inquiry teaching method on students' achievement in algebra. While the present study was on the impact of inquiry and problem solving strategies on attitude ,retention and performance in trigonometry among senior secondary school students' in Zamfara State, Nigeria.

More recently, Alhassan, Victoria, and Dantani (2013) investigated the effects of Computer Assisted Instructional package on Junior Secondary School Students Achievement and Retention in Geometry in Minna Niger state, Nigeria. Two hypotheses guided the study, thestudy adopted the pre-test, post-test control group design. The sample consisted of eighty (80) junior Secondary Schools (JSSII) Students.Theinstruments employed for the study were Geometry Achievement Test (GAT) and Computer Assisted Instructional Package (CAIP) and Lesson notes were validated by experts. The reliability coefficient of 0.75 was found using Pearson's Product Moment Correlation. Date collected was analyzed using t-test. The results of the study indicated that students taught geometry using computer assisted instructional (CAI) performed better than lecture method Also students

taught geometry using computer assisted instructional (CAI) retained more than the lecture method. It was recommended that government should organized seminars, workshops and symposium for teachers on the development of computer assisted instructional package to enhance learning among students. The two studies are similar in terms of design.However; they differ in terms of scope, subject and sample. The two studies also differ in terms of method of data analysis. Therefore the present study investigated the impact of inquiry and problem solving strategies on attitude, retention and performance in trigonometry among senior secondary school students in Zamfara state, Nigeria

On the other hand, Nfon (2013) a investigated the effect of Rubbult's problem solving strategy (RUPSS) on secondary school student's achievement in trigonometry. The study took place at Fako Division in Cameroon. The study was quasi-experimental research in nature, three. Hypotheses guided the study, the sample for the study consisted three hundred and sixty six (366) forms fourstudents consisted of 186 males and 180 females were drawn from three colleges out of eight colleges by simple random sampling technique.The trigonometry Achievement test (TAT) and was validated by experts with the lesson plan. The reliability index was found to be 0.91 Data collected were analyzed using meanscores, standard deviation, and two-ways (2x2) Analysis of covariance (ANCOVA) the results revealed that students exposed to the RUPSS achieved higher than those exposed to conventional problem solving strategy (CPSS).Also RUPSS was not gender friendly. It was recommended that the teaching and learning via Rusbult's problem-solving strategies. Also problem-solving should be incorporated into the curriculum in all institutions including teacher-training colleges. The above reviewed study was similar to the present study in terms of design, and content area they also related in comparing the achievement of male and female students. Furthermore, the two studies are similar in the sense that both of them are rooted to relatively new approach.However, the study differs

from previous one in many ways because it has tried to take in cognizance of the shortcomings of the study mentioned above. Terms of subject, SSSII students was used unlike the previous study that used SSSI. In terms of scope, the present study was conducted in Zamfara State, while the previous was conducted in Fako Division in Cameroon, and they also differ in terms of method of data analysis. The researcher did the research on the effects on students' achievement in trigonometry. While the present study was on the impact of inquiry and problem solving strategies on attitude, retention, and performance in trigonometry among senior secondary school students in Zamfara State. Nigeria.

On the other hand, KesanandCaliskan(2013) investigated the effect of leaning Geometry topics of 7^{th}grade in primary education with dynamic geometer's sketchpad geometry software to Students success and retention. The sample consisted of 42 students from classes in Sehit Kurmoy Binbasi Yaavuz Primary School. The experimental research design with the post test Control Group was used in the study. Two hypotheses guided the study.Two instruments were used for the study: Geometry Achievement Test and Worksheets Interview Form. The instruments were validated and the reliability was found to be 0.91 Data were analyze using Mann-Whitney U Test. In the experimental group, dynamic geometer's Sketchpad geometry Software adapted to Computer assisted instruction, and in the control group traditional teaching method was used. The result of the study found that there was a significant difference between achievement test scores of experimental group learning geometry with GSP dynamic geometry software and control group learning through traditional method in favour of experimental group. The two studies were similar in the sense that they are rooted to relatively new approaches. However differ in terms of sample, content area,and Scope and data analysis. Therefore the present study investigated the impact of inquiry and problem solving strategies on attitude, retention and

performance in trigonometry among senior secondary school students in Zamfara state, Nigeria

More recently, Adaramola and Adolphus (2013) investigated the teaching of Further Mathematics in Nigeria Secondary Schools for Technological Development through Polya Model. The study took place in Port- Harcourt.The main purpose of the study was to determine the effect of Polya's model on students' attitude in further mathematics in secondary schools. Polya's model and Algorithm was considered. Two hypotheses guided the study. The study was quasi-experimental study with pre-test post test control group experimental research design with factorial arrangement was adopted for the study. The sample of the study consisted of seventy (70) students comprising of thirty five (35) boys and twenty five (25) girls, randomly selected from two public schools in port-Harcourt metropolis. Gender was also considered. Two validated instruments were used in collecting data.The reliability coefficient was found to be 0.81.Data were analyzed using Mean, Standard deviation, and 2x2 Factorial Analysis of Variance. The result indicated the Polya's technique was better in improving student's attitude than the conventional method of teaching. It was recommended that teacher should update their teaching method, which will ultimately enhance students' attitude to Further Mathematics.the two studies are similar in term of comparing the attitude of male and female students. However, the two studies differ in terms of scope, sample and content area. They also differ in terms of method of data analysis. While the present study investigated the impact of inquiry and problem solving strategies on attitude, retention and performance in trigonometry among senior secondary schoolstudents' in Zamfara State, Nigeria.

In another study, Nneji (2013) examined the effect of Polya George's problem solving model on students' Achievement and Retention in Algebraic. Quasi experimental design was adopted in the study. Pre-test post-test non equivalent control groups were used. Eight

intact classes four of which were randomly assigned to experimental and other four to control groups are used for the study. Simple of the study consisted of 220 SS II students. The finding of study revealed that students taught Algebraic with POGROSMO achieved higher and retained more than those taught with expository method. The difference between the study of Nnaji and the present study was that the study was conducted on Algebra conceptsin Ebonyi state. While the present research study was conducted on trigonometry concepts in Zamfara state. Also the concept of attitude was considered in the present study. The two studies are similar in the sense that both of them are rooted to relatively new approaches Again, they are similar in terms of design .the two are also related in comparing achievement and retention of male and female students, and the sample for the study was made of SSII students.While the present study investigated the impact of inquiry and problem solving strategies on attitude, retention and performance in trigonometry among senior secondary school students' in Zamfara State, Nigeria.

In another study, SalmanandAmeen,(2014).explored the comparative effects of two problem-solving models on Senior Secondary School Students Performance in Mathematics word problems. The study was conducted in Ilorin metropolis of kwara State. The study adopted pre-test, post-test quasi experimental design. The sample of the study consisted of one hundred and eighty (180) SSSII students drawn from six equivalent co-educational secondary schools in Ilorin metropolis of Kwara state. The instrument used for data gathering in the study was Mathematics performance Test (MPT) designed by the researchers. The reliability value was 0.67.Data collected were analyse using Analysis of Covariance (ANCOVA).the result revealed that students exposed to Polya's problem solving model better than their counterpart exposed to Bransford and Stein Model. Also gender of the students' in all the groups had no influence on their performance in mathematics word problems involving bearing. It was recommended that mathematics

teachers and mathematics textbook authors should incorporated Polya and Bransford and Stein problem solving model in mathematics textbooks to enhance meaningful learning and teaching. The two studies are similar in the sense that both of them are rooted to relatively new approaches. Again they are also related in comparing performance of male and female students. They are however differs in scope, sample, and method of data analysis.The researchers did their research on the effect of two problem solving models on students' performance in Mathematics word problem . While the present study was on the impact of inquiry and problem solving strategies on attitude ,retention and performance in trigonometry among senior secondary school students' in Zamfara State, Nigeria.

More recently, Obi, Agwagah andAgah (2014) explored the study effects of origamion Students' Retention in Geometry. The main purpose of the study was to determine the effect of origami on students' retention in geometry. Three hypotheses guided the study. The study was a quasi-experimentalresearch in nature. The study took place at Nsukka education zone of Enugu state, Nigeria.The sample of the study consisted of One hundred and one (101) JSSI students purposive sample from two co-educational schools out of twenty three (23) co-educational secondary schools The instrument for the collection was Geometry Retention Test (GRT).The reliability coefficient of GRT was found to be 0.82 . Data analysis techniques employed for the study were means, standard deviation and analysis of covariance (ANCOVA)The result of the study revealed that use of origami in teaching Geometry in Junior Secondary School Students enhanced their retention in geometry. The study also revealed that the use of origami had no statistically differential effect on male and female student's retention. The study also revealed that there was a significant interaction effect between gender and instructional materials on retention of the concept taught during the study. It was recommended that the use of Origami should be adopted in the teaching of geometry in primary, secondary and tertiary levels of education

system. It was also recommended that seminars, workshops and conferences should be mounted by professional bodies, federal and state ministries of education on the use of Origami for mathematics teachers, students and others. This will enable mathematics educators, serving teachers, students and all to benefit from such an approach. The above reviewed study issimilar to the present study in terms of design. They are also related in comparing achievement and retention of male and female students. However, the two studies differ in terms of subject, content area, scope and sample. Again while obi, Agwagah and Agah (2014) concentrated on new instructional material, the present study was on relatively new instructional strategies.The researchers did their research on the effect of Origami on Students' Retention in Geometry. While the present study was on the impact of inquiry and problem solving strategies on attitude ,retention and performance in trigonometry among senior secondary school students' in Zamfara State, Nigeria.

In another study, Kajuru and kauru (2014) investigated the effects of the 7E'S constructivist approach to teaching Trigonometry on polytechnic student's achievement and retention. The main purpose of the study was to determine the effect of the 7E'S Constructivist approach to teaching Trigonometry on achievement and retention of polytechnic students. Three hypotheses guided the study. The study was quasi-experimental research in nature.The sample for the study consisted of two hundred (200) HNDI students in science and Engineering programmes selected randomly from two (2) polytechnics (Nuhu Bamali and Kaduna polytechnic). The instrument employed for the researcher developed and validity by experts with the lesson plan, the reliability value was found to be 0.83. Data collected were analyzed using mean scores, standard deviation and t-test.the result of the study indicated that students who were taught trigonometry using 7E'S constructivist approach achieved higher and retained more of content taught, it was recommended that students should be in engaged in an active process of learning such as

minds –on, hands- on, authentic learning. The above reviewed study was similar to the present study in terms of design, content area; they are also related in comparing achievement and retention of male and female students. However, the two studies differ in terms of subject, scope and sample they also differ in method of data analysis.. Therefore the present study investigated the impact of inquiry and problem solving strategies on attitude, retention and performance in trigonometry among senior secondary school students' in Zamfara state, Nigeria.

On the other hand, Gambari, Falode and Adegbenro (2014) explored the effectiveness of Computer animation and geometrical instructional model on mathematics Achievement and retention among Junior Secondary School Students in Minna, Nigeria. It also examined the influence of gender and students' achievement and retention. The research was a pre-test, post test experimental and control group design. Stratified random Sampling was use to select 40junior secondary school students within Minna metropolis. The instrument use for the study was Geometry Achievement Test (GAT) with reliability index of 0.87. The results indicated that students taught geometry using Computer animation performed significantly better in post-test and retention test than their counter parts taught geometry using instructional model and conventional method respectively. However, there was no significant difference reported in the post test performance scores of male and female students taught geometry using computer animation and instructional model respectively. These findings indicated that geometry concept in mathematics could be taught and learnt meaningfully through the use of computer animation. The two studies are similar in design. The two are related in comparing achievement and retention of male and female students. However, the two studies differ in terms of subject, content area, scope and also sample.

In another study, Ado (2014) explored the impact of constructivist teaching strategy on students' academic performance, retention and Attitude towards Trigonometry among

senior secondary schools in Kaduna state. The study took place at Zaria and Kaduna metropolis. The study was a quasi-experimental research in nature. The sample of the study consisted of four hundred (400) SSSII students drawn from four schools. Six hypotheses guided the study; three instruments were used for the study are : Trigonometric performance Test (TPT), Trigonometric Retention Test (TRT) and Trigonometric attitude Questionnaire (TAQ).The instruments were validated by experts and the reliability coefficient was found to be 0.84, 0.82 and 0, 87 respectively. Data analyses employed for the study were mean, standard deviation t-test and wilcoxon signed-rank test. The result revealed that students taught trigonometry using constructivist teaching strategy performedbetter, retained more on the content taught, and improve on their attitude. Also constructivist teaching strategy was not gender friendly on academic performance and retention ability but it was gender friendly on attitude. It was recommended that teacher should engage students in an active process of learning. The two studies are similar in the sense that both of them are rooted to relatively new approaches. Again they are similar in terms of design, subject, and content area. The two are also related in comparing performance, retention and attitudes of male and female students. However, the two studies differ in terms of scope, sample and method of data analysis; they also differ in sampling technique. The present researcher therefore investigated the impact of inquiry and problem solving strategies on attitude, retention and performance in trigonometry among senior secondary school students' in Zamfara state, Nigeria.

More recently, Njoroge, Changeiywo andNdirangu (2014) investigated the effects of Inquiry based teaching approach on secondary school students' achievement and motivation in physics. The main purpose of the study was to determine the effect of inquiry- Based Teaching approach on secondary school students' achievement in the learning of physics. One hypothesis guided the study. The study adopted a

quasiexperimental research Design Solomon four non –equivalent groups designs.The sample consisted 370 students comprising of 185 boys and 185 girls in eight intact classes.the study took place in Kenya, the instrument employed for the study was students' physics achievement test (SPAT) ,it was validated by experts and the reliability coefficient of SPAT was 0.87. Data collected were analyzed using one-way ANOVA, Analysis of covariance (ANCOVA) and t-test theresult revealed that students taught. Inquiry based teaching (IBT) approach have higher students' scores in physics. Achievement it was recommended that teacher training should be designed to produce teacher capable of planning and implementing inquiry-based teaching approach.The two studies are similar in terms of design; they are also in the sense that both of them are rooted to relatively new approaches. However, the two studies differ in terms of subject, content area, scope and method of data analysis.

Similarly, Usman and Musa (2015) investigated the effect of inquiry teaching method on students' achievement in algebra in Bauchi Local Government Area of Bauchi State, Nigeria. The study took place at Bauchii local Government area of Bauchi state. The sample used for the study was 135 JSSII students from randomly selected Secondary School in Bauchi metropolis. The study was a quasi-experimental of non –equivalent control group design in which pre-test-post-test was used.The Algebraic Achievement Test (AAT) was the instrument used for data collection. Two research questions and two hypotheses guided the study. The instrument was validated by experts. The mean and standard deviation were used to answer the research questions while the Analysis of Covariance (ANCOVA) was employed to test the hypotheses. The result indicated that the post-test performance of inquiry method was higher than the conventional method. It was recommended that teachers should be trained and motivated to use the inquiry method, so as to bring about better academic achievement among the students in mathematics the

above reviewed study is similar to the present study in term of design, they also related in comparing achievement of male and female students. However the two studies differ in terms of subject, scope and content area. While Usman and Musa (2015) concentrated on comparing one instructional method, the present study was comparing two instructional strategies.

In another study, Ibrahim andBusari (2016) explored the impact of Enriched lecture method with Geotrigmetric Set on academic performance of secondary school students in trigonometric concepts in Katsina. The study was carried out on senior secondary two (SSII) students. Two research questions were raised and two hypotheses were tested. The study adopted the pre-test post test Quasi-experimental control group design. Purposivesamplings of 130 students were drawn from the two co-educational schools in Funtua educational Zone of Kastina state. The students in the experimental group were exposed to enriched-lecture method with geotrigmetric set, while those in control group were exposed to lecture method. TheInstrument for data collection was Trigonometry Performance Test (TPT),A reliability coefficient of 0.81 were obtained on the instrument,mean,standard deviation and t-test were used to analyse the data, The findings revealed that experimental group perform better than the control group. It was recommended that secondary school teachers should be trained to use enriched-lecture method with geotrigmetric set to enhance students' academic performance in trigonometric. The two studies are similar in terms of design, subject, and content area.They are also related in comparing the performance of male and female students. However, they differ in terms of scope and method of data analysis.

In another study, Abdullahi (2016) investigated the impact of student Team –Achievement division Strategy on Secondary School Students Trigonometric Performance and retention in Katsina, State, Nigeria. The study was carried out on Senior Secondary two (SSII)

Students' four research questions were raised and four hypotheses were tested. Stratified simple samplings of 110students' were drawn from two sample schools. The study adopted Non –randomised pre-test, post-test and post post-test quasi control group design. The instruments for data collection were Trigonometric Achievement Test (TAT) and Student Team- Achievement Division Test (STADT) .The instruments employed for the study was validated by experts. The reliability value was found to be 0.78. Data were analysed using mean, standard deviation and also t-test. The results revealed that there were significant differences in the mean performance and retention scores of students 'in trigonometry using STAD Strategy and lecture method. It was recommended that trained programmes, seminars and workshops should be organised for mathematics teachers in secondary schools to use STAD Strategy in their teaching. The two studies are similar in terms ofsubject, contentarea. They are also similar in terms of comparing achievement and retention of male and female students. However, the two studies differ in terms of scope and sample of the study. In general, overview of related studies revealed that the previous researchers let gaps that need to be filled. There is mix up of intellectual formation. In this study the researcher employed three instructional strategies; namely inquiry, problem solving strategies and the lecture method to teach senior secondary school students' (SSII) trigonometry concepts. The present study therefore investigated the impact of inquiry and problem solving strategies on attitude retention and performance in trigonometry among senior secondary school students in Zamfara, Nigeria

2.13 Implication of the Reviewed Literature to the study

Right from the introduction, Mathematics has been defined and its importance and the importance of Trigonometry as a branch of study have been stressed. It is evident from the reviewed literature that there are some gaps, which this study attempt to bridge. The review

has show that literature cited in Usman&Musa (2015) on the effect of inquiry teaching method on student's achievement in algebra in Bauchi local Government area of Bauchi State. Generalization made from this result may not be true about inquiry teaching method. The study was carried out within Bauchi State and to JSS students. The study was not extended to Senior Secondary School Students and other aspect of mathematics to see what would be the effect of inquiry teaching method. Hence, there are no bases for generalization.

Also Popoola &Fijuyigbe (2010)investigated the effect of activity based and inquiry method on performance and attitude of junior secondary school Students towards computer study. Generalization made from this study may also not be true. The study was carried out in Ekiti State, and the content of the study was computer study. It should be extended to other state. In general Usman &Musa (2015) and Popoola&Fijuyigbe (2010) studies were on junior Secondary Schools not Senior Secondary Schools. There is need to investigate the effect of inquiry and other teaching methods on senior Secondary School Students in some aspect of Mathematics, and in other states of the country. Also retention ability of the students should be included, which the study envisaged.

Furthermore, the study of Nfon (2013) was on the effect of Rubbult's Problem Solving Strategy on Secondary School Students' achievement in trigonometry. The generalisation made from this result may not be true because the study was carried out within Fako Division in Cameroon. The study was not carried out in Nigeria Secondary School, and it was onachievement only, attitude and retention were not including in the study. Hence there are no bases for generalisation. Obeka (2010) studies the effect of inquiry and demonstration methods on student's achievement and retention in some environmental education concepts of geography. The study was carried on concept of geography, and attitude was not included in the study. Nneji (2013) Study the effect of Polya Georges'

Problem Solving Model on student's achievement and retention in Algebraic. The study was carried out in Ebonyi State and it was conducted on algebra concepts of mathematics. There are nobases for generalisation because the study was on one teaching method. It should be compared with other teaching methods to see the effect, and other aspects of mathematics. There is need to investigate the effect of inquiry and problem solving methods on Trigonometry aspect of mathematics for better generalization.

More so, Fajemidgba&Sulaiman (2012) Studies on the effects of Polya's Bransford and Stein Problem Solving on Student's Performance in Mathematics. Thestudy only compares different types of problem solving methods of teaching; it should be extended to other teaching methods. The concept of attitude and retention were not including in the studying. General Fajemidgba& Sulaiman(2012) were on problem Solving Methods of Teaching. A critical look at literature reviewed so far, there is a question not yet been properly addressed by most of the literature reviewed is what could be done to improve student's attitude and interest in mathematics and trigonometry in particular for better performance. There is a need to carry out more research on how to promote positive attitude of students towards mathematics and trigonometry. A number of suggestions have been offered by researcher towards curbing the problem of poor achievement, dismal performance and negative attitudes of students to mathematics and trigonometry in particular.These include the use of innovative teaching methods, games, organized teaching (NCTM, 2000; WAEC Chief Examiner's Report, 2015).Perhaps if teaching strategies like inquiry and problem solving can be used would yield positive result. Both the two strategies are student centred could be of greater assistance in facilitating student's achievement in trigonometry. The strategies of teaching would influence student's attitude, retention and performance, and would exhibit superiority over other strategies of teaching because of student's active involvement. Thus there is need for this study.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

The study investigated the impact of inquiry and problem–Solving strategies on Attitude, Retention and Performance in Trigonometry among Senior Secondary School Students' in Zamfara State, Nigeria. Therefore this chapter described the following; Research design, Population of the Study, Sample and Sampling Techniques, instrumentation and validation of the instruments, others subheadings include pilot testing, Reliability of instruments, administration of treatment and procedure for data collection and Data Analysis.

3.2 Research Design

This studyadopted quasi-experimental research design. The design was considered appropriate because it was not possible to have a complete randomization of the subjects into experimental and control groups .intact classes were therefore assigned to be experimental and control groups.. The design was illustrated in figure 3.1

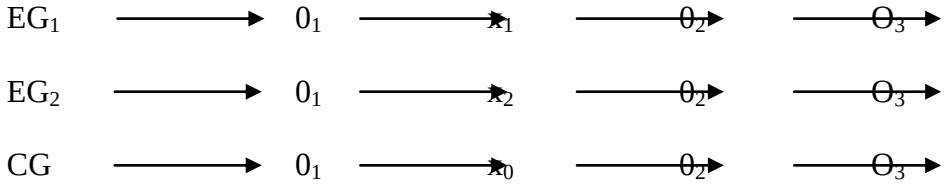


Figure 3.1; Attitude, Retention and Performance research design illustration

Key:

EG_1 = Experimental group 1

EG_2 = Experimental group 2

CG = Control group

O_1 = Pre-Test (to determine ability level of students in trigonometry)

O_2 = Post-Test (to determine students trigonometry performance after treatment)

O_3 = Post –Post test (to determine students' retention in trigonometry)

X_1 = Treatment (with inquiry Strategy)

X_2 = Treatment (with problem solving strategies)

X_0 = No treatment (control)

Three groups of students were used for data collection; the experimental group 1&2 and the control groups. A pre-test (O_1) was administered to the three groups in order to determine the level of trigonometry understanding of the three groups. Also the Pre-test of TASQ was given to both the Experimental and Control groups before the treatment in order to ascertain the level of attitude of the students to the learning of trigonometry. After the Pre-tests the Experimental groups were subjected to treatment using Inquiry and Problem Solving strategies. On the other hand, no treatment was given to the Control group. After the six weeks of the treatment, Post-test of (O_2)was administered to the three groups to determine the significant differences if any in their mean performance scores in trigonometry, and also TASQwas also administered as Post-test after the treatment in order to determine a change if any in the attitude of the students towards trigonometry. After two weeks interval, the three groups was subjected to Post-Post test (O_3) in order to measure their retention ability in Trigonometry using the same instrument only that Trigonometry Performance Test wasbe re-shuffled as it is assumed that after two weeks gap the students might have forgotten the instrument being administered(Usman,2012)

3.3 Population of the Study

The population of the study comprised all 112 Senior Secondary Schools across the four education zones in Zamfara State. The population of the schools weretwenty three thousand nine hundred and ten (23,910) SS II Students admitted in the 2015/2016 academic year. The students' population made up of 17,936 male and 5,974 female students from urban and rural area with the same academic backgrounds. Zamfara State Public Schools were selected for convenience in terms of staffing, teaching materials,

learning environment and infrastructure which were all averagely the same. The same syllabus was used in teaching the students.The details of the population are presented in Table 3.01 based on the 4 Educational Zones.

Table 3.01 Population of SSII Students in Zamfara state

S/No.	EducationZones	No. of schools	Gender		Total
			M	**F**	
1	Gusau	44	8140	4107	12247
2	Kaura Namoda	28	4123	836	4959
3	Talata Mafara	19	3083	548	3631
4	Anka	21	2590	483	3073
Total		**112**	**17936**	**5974**	**23910**

Source: Zamfara State Ministry of Education, (2015)

3.4 Sample and Sampling Procedure

The multi-stage sampling procedure was used for the study. The first stage, simplerandom sampling method involving balloting was used to selectthreezones out of four educational Zones in the state. Three zones happened to be Gusau, KauraNamoda and TalataMafara zones respectively. In order to ensure relative similarities in the variables of interest such as gender, 6 sample schoolsweredrawn from the 91 publicsenior secondary schools in the three zones. In the second stage,Simple random sampling technique was used to select two schools from each of the three educational zones to give the six schools that were used for the study, due to security challenges in the state.The 6 schools are of single type and comprise ofthree boys' and 3 girls'schools.This was to ensure uniformity in the nature of subject selected for the study. In selecting the schools for experimental and control groups of the six sampled schools, the researcher used simple random sampling technique by categorizing the schools in each zone according to gender.

In the third stage, sample random sampling technique was used to select one intact class from each of 6schools. Since most of the schools has more than one arms, the researcher decide to used simple random sample method to select one class from each of the sample

schools, such that all the students can benefit from the lesson. This gives a total sample of 381 students consisting of 200 males and 181 females used for the study. This is because secondary schools exist as intact classes and because of the design proposed for this study. The sample size is in line with Central Limit theory that recommends ($N \geq 30$)sample size as pointed out by (Sambo, 2005).The sample selected is presented in Table 3.02.

Table 3.02: Sample SS II Students in Zamfara state

Group	No of schools in each Zone	Gender		Total
		M	**F**	
Experimental 1	2	73	64	137
Experimental 2	2	64	57	121
Control	2	63	60	123
Total	6	200	181	381

Source: Field Survey, 2016

3.5 Instrumentation

There were three instruments (measured variables) used in this study namely; Trigonometry Performance Test (TPT) Trigonometry Retention Test (TRT) and Trigonometry Attitude Scale Questionnaire (TASQ).

3.5.1 Trigonometry Performance Test (TPT)

The Trigonometry Performance Test (TPT) is a multiple choice instrument designed and used to measure students' performance in trigonometric concepts, it was the same version of TPT that was used as pre-test and post test to ascertain students' level of understanding trigonometric concept before and after the treatment. The test was constructed by the researcher using new general mathematics for senior secondary school two and SSCE past questions papers. It consist of two sections, these are section A and B. Section A contained respondents Bio-Data while Section B is made up of fifty (50) items on trigonometry drawn from SSCE past question papers and new general mathematics test book. The total of fifty (50) multiple choice itemsdeveloped by the researcher covering the contents of Pythagoras theorem, Trigonometric ratio, Special angles, Angle of Elevation and

Depression, Sine and cosine rules and Bearing and Distance were made with four options letter A to D. it was developed based on the six bloom taxonomy of educational objective using six trigonometric content areas .A test specification table was drawn to make sure that question selected for the study covered the different units contents covered within the treatment. This can be seen in table 3.03

Table 3.03: Table of Specifications for trigonometry performance test based on bloom taxonomy

S/N	Content Area	Knowledge 24%	Comprehension 12%	Process Objective Application 20%	Analysis 14%	Synthesis 14%	Evaluation 16%	Total
1.	Pythagoras theorem (10%)	2	1	2	1	1	1	8
2.	Trigonometric ratio (10%)	2	1	2	1	1	2	9
3.	Special angles (30^0, 45^0, and 60^0) (20%)	2	1	2	1	1	1	8
4.	Angle of Elevation depression (20%)	2	1	1	2	1	2	9
5.	sine and cosine rules (20%)	2	1	1	1	1	1	7
6.	Bearing and distance (20%)	2	1	2	1	2	1	9
	Total	**12**	**6**	**10**	**7**	**7**	**8**	**50**

3.5.2 Trigonometry Retention Test (TRT)

The items TRT being essentially items of Trigonometry Performance Test (TPT) with Serial numbers reshuffled by random selection process. Theinstrument was made up of two sections. Section A dealt with the demographic variable of the respondents, while section B consists of 50 items. It comprised of fifty (50) multiple choice questions developed by the researcher covering the contents of Pythagoras theorem, Trigonometricratio, Special angles, Angle of Elevation and Depression, Sine and cosine rules and Bearing and Distance. It was administered to both experimental groups 1&2 and the control group at the same time after two weeks interval. The items were set to measure student's retention abilities in trigonometry. (Appendix C)

3.5.3 Trigonometry Attitude Scale Questionnaire(TASQ)

The Trigonometry Attitude Scale (TAS) determinedthe students'attitudinal change towards trigonometry. The instrument was adapted from the Fennema-Sherman (1976)Mathematics attitude scale as cited in Utley (2007) which was modified to suit the present study. The questionnaire was made of five sections, A-E.Section A dealt with the demographic variable of the respondents, while section B contains 7 items measures confidence in learning trigonometry. In section C, it contains 11items which measures interest in learning trigonometry. Also in Section D contain 6 items measuring Enjoyment in learning trigonometry. While section E contain 7 items which all measures the usefulness of trigonometry.The instrument had a total of 32-itemswith five–points on a Likert-Scale.

. The questionnaire is constructed based on five–pointsLikert- Scale of Strongly Agree (SA), Agree (A), Neutral (N), Disagree (D) and Strongly Disagree (SD) respectively. With positively worded items are scored as 5 and 1 respectively.And the data was analyzed, scoring was reversed for negatively worded items, from 1 to 5.The questionnaire was administered to both the experimental and control groups to determine whether the students have a positive or negative attitude towards trigonometry, the same questionnaire was also administered before and after to the three groups.. (Appendix E)

3.5.4 Validity of Instruments

3.5.4.1 Trigonometry Performance Test (TPT)

The constructed test items of TPT and TRT with the marking schemes went through content validity by three (3) experts. PhD holders in Mathematics Department, and Science Education, Department, Ahmadu Bello University, Zaria, and Zamfara State College of Education Maru..The expert's suggestions led to the reframing and eliminating of ambiguous and so appropriate questions. For example the following adjustments were effected:

(I)some of the questions were rephrased, for example ,in question3,the option were not proper stated, and the diagram on question 48 on trigonometric ratio was redrawn ,so that the there would be an answer in the option.

(II) The option in question 31 was properly written from cot to cotangent

They also observed if the items in the instrument match the ability of the students.Is the language used clear to the students'Based on their decisions, the content validity of the test items were found to be within the ability level of the students.

3.5.4.2 Trigonometry Attitude Scale Questionnaire (TASQ)

The Trigonometry Attitude Scale Questionnaire(TASQ) was also content validated by three experts made up of one expert in Educational Psychology, one expert in Mathematics Education and one Mathematics Teacher. They ascertained the validation of the instrument in terms of clarity, applicability to the level of students involved in the study as well as language of presentation. Suggestions led to the reframing and replacing of not so appropriate attitudinal statements.

3.5.4.3 Lesson Plan

The lesson plans were subjected to content validity by three experts made up of one expert in Mathematics Education, one Measurement and Evaluation expert and Mathematics Teacher. The experts checked whether the lesson plans contain no ambiguous diagrams or figures and were clearly stated in terms of the reading difficulty level of the students' understanding. See appendices K,L,&M

3.5.5 Pilot Testing of the instruments

The instruments: Trigonometry Performance Test (TPT), Trigonometry Retention Test (TRT) and Trigonometry Attitude Scale (TAS) were pilot –tested on SSII students inGovernmentDay Secondary School Jabaka in Maru Local Government area and Government Girls Day Secondary School Bungudu, Zamfara state which is not included in

the sample for actual conduct of the research. Forty-five SSII students were randomly selected and used in pilot-testing the instrument. Trigonometry performance test (TPT) and Trigonometry Attitude Scale Questionnaire (TASQ) were administered to both experimental and control groups. After treatment on selected topics on trigonometric concept, the trigonometry performance test (TPT) and Trigonometry attitude scale Questionnaire was administered to test their performance and their attitudinal level .TRT test was administered two weeks later, to test their retention ability of the three groups. The test scores were correlated using Cronbach alpha to establish the coefficient of stability using the SPPS Package.

The main objective of the pilot test was to determine the psychometric properties of the instruments. From the pilot test, the following adjustments were made based on the findings of the study.

(i) The researcher had to be flexible in the conduct of the treatment.

(ii) The length of the time to answer the Trigonometry Performance Test (TPT) and Trigonometry Retention Test (TRT) were increased to an hour because students needed more time to carry out calculations.

(iii) The researcher need research assistants

3.5.6 Reliability of the Instruments

3.5.6.1 **Reliability of Trigonometry Performance Test (TPT)**

The reliability coefficient of Trigonometry Performance Test (TPT) and Trigonometry Retention Test (TRT) were determined by administrating the test twice using test re-test method within an interval of two weeks as Sambo (2005) The reliability of the instrument (TPT) was determined by administering the test twice using test re-test method within an interval of two weeks as Sambo (2005) recommended, on the same sample students used in the pilot study. The scores from the two administrations were then correlated as an estimate

of the reliability of the test, with Pearson Product Moment Correlation Co-efficient (PPMCC) using Statistical Package for the Social Science (SPSS) Package Therefore co-efficient of 0.68 was obtained the value. Hence the instrument (TPT) was reliable for this study. The TRTwas also administered twice to the students' using test re-test method of reliability, with two weeks interval. The result of the two tests were also co-related with Pearson Product Moment Correlation Co-efficient(r), a positive co-efficient of 0.83 was obtained. The instrument (TRT) was also reliable for the study.

3.5.6.1 Reliability of the Trigonometry Attitude Scale Questionnaire (TASQ)

The reliability coefficient for Trigonometry Attitude Scale was found to be 0.78 using the Cronbach-alpha method of estimating reliability. The method is more generalized method of estimating internal consistency. This reliability coefficient showed that TASQ was also reliable to measure what it was supposed to measure. The reliability coefficient for the TASQ is shown in appendix 1

3.5.7 Item Analysis

The purpose of item analysis is to enable the researcher to distinguish between good and bad items. A good item is one which is at roughly the correct level of difficulty and sufficiently high discrimination. It involves Item difficulty and item discrimination. A detail of the procedure is explained as follows.

Difficulty index

Item difficulty is measured as a percentage of the number of students who got the item right over the total numbers of students that attempted the item (Sambo, 2005).In this study items with difficulty index between 40%-60% were be considered. Those with difficulty index below 40% were be rejected as too difficulty, while those with difficulty index above 60% were be considered too easy, and therefore were be rejected in this study. To ensure that a proper content validity was done for the trigonometry performance test (TPT) .the

item difficulty was carried out on the scored obtained from the pilot-test, where items 3,6,16 and 32 are considered difficulty, while items questions 1 and 5 are very simple, and it led to the reframing of some questions.

Discrimination index

To calculate the discriminating index of the items, the researcher arrange all the students' test scores in rank order from highest to lowest according to their performance in the whole test. Then theresearcher selectedtop27% of the students that got the particular item correct and also selected bottom27% of the students that got the particular item correct. Thus items that fell within the range 40% - 60% are considered appropriate for this study while those that fell out of the range were discarded. Therefore items 3, 10, 44, and 46 were further reviewed

3.6 Administration of the Treatments

The treatments administered to the subjects involved in the teaching of trigonometry concepts were:

a. InquiryStrategy, adapted from Eisenkraft (2003) and Kajuru and Kaura (2014) for the experimental 1

b. Problem Solving Strategy adapted from Polya's (1973) and Augie (2015) for experimental group 2 and

c. Lecture method for the control group

Lesson plans were prepared to teach the selected trigonometric concepts (Appendices J, K&L).The treatment session for the two experimental groups and one control group took six (6) weeks.Before the commencement of the treatment, the researcher through the help of the research assistant (teachers) administered Trigonometry performance Test (TPT) aspre test, (O_1) to all the groups in order to determine their knowledge in trigonometry.

While Trigonometry Attitude Scale Questionnaire (TASQ) was also administered to students in all the three groups and their scores and responses were be collected.

3.6.1 Inquiry Strategy Lesson Plan

Inquiry Strategy is based on the constructivist theory of learning where learners construct new ideas or concepts based on their current past knowledge. In this study, the inquiry strategy used was adapted from Eisenkraft (2003) and Kajuru and Kauru (2014), the instruction was designed based on one of many instructional strategies that support inquiry-based science: 7E'S learning cycle model, which includes seven specific components: Elicit, Engage, Explore, Explain, Elaborate, Evaluate, and Extend, and modified into 7E's lesson plan. Teaching of the experimental group1 was handled by the researcher herself. Eight lessons based on 7e's inquiry lesson plan were prepared and used on the treatment group 1. After an introduction of thelesson. The researcher now presents the stages as follows:

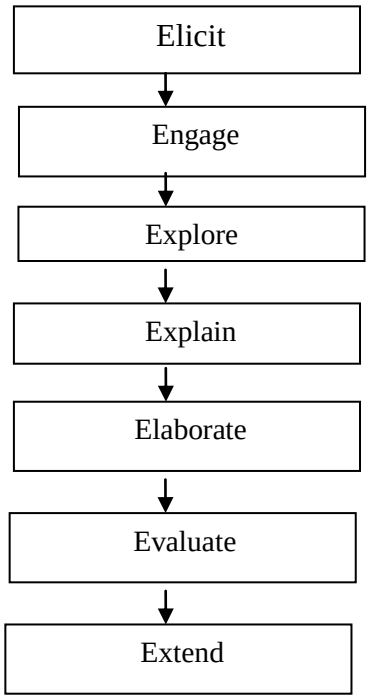


Figure 3.2: Flowchart on 7E'S learning cycle of Inquiry Strategy
Source: Eisenkraft, (2003) and Kajuru and Kauru (2014)

The lesson plan is presented in Appendix K

The Modelis illustrated as shown below:

ELICIT	Objects, Charts, event or questions were used to engage students connections between which students know and can do
ENGAGE	Object and Phenomena are explored Hand – on activities, such as drawing, measuring and constructing with guidance of the teacher about certain concept relating to Pythagoras theorem, and also do some proofs on sine and cosine rules.
EXPLORE	Students were group in to four or more and guided with Hand mind – on activities to identify and explain their understanding on concepts and processes through step by step presentation of the activities that relate each concept.
EXPLAIN	students were guided theoretically and practically through constructions, drawing and demonstration of different concept to relate to their knowledge, and discussed their observations with peers and the teacher.
ELABORATE	Theoretical proofs and projects work were given to the students individually or grouped asses their knowledge, skills and abilities.
EVALUATE	Activities such as construction of charts or objects individual or group will permit evaluation of student development and lesson effectiveness
EXTEND	Activities gained from previous phases will help and allow students to expand, formulate rules and apply on the concepts in contexts, and build on or extend understanding of skills

Source :Eisenkraft (2003) and Kajuru and kauru (2014)

3.6.2 Experimental Group 2 (Problem Solving Strategy Lesson Plan)

The study used Polya's (1973) which suggests that the teacher leads a discussion on every problem to help the students solve it in the following steps. After the pre-test the experimental group 2 was subject to treatment using the problem solving method which adopted Polya's four stages model. Teaching of the experimental group2 was handled by the researcher herself. Eight lessons based on Polya's four stages lesson plan were prepared and used on the treatment group 2. The eightlessons were planned in such a way that after an introduction of the lesson. The teacher divides the class into manageable, and also assigning roles to group member, the researcher now presents the stages as follows:Flowchart of polya's four stages as per figure 3.4

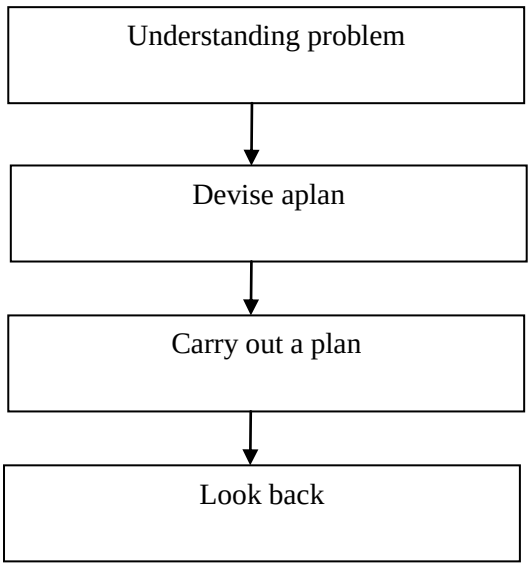


Figure 3.3: Flowchart on the polya's four stages model lesson plan
Source: polya's (1973), Augie (2015)

At the stage one: **Understanding the problem:** The teacher ask students questions such as: Do you understand all the words used in stating the problem? What are you asked to find or show? Can you restate the problem in your own words? Can you think of a picture or diagram that might help you understand the problem? Is there enough information to enable you find a solution? among others.

At the stage two:**Devise a Plan**: students are to devise a plan for solution and are guided by the teacher to choose appropriate plan for solving the problem at hand,the teacher will lead the students to draw or make a sketch of the information given.

At the stage three **carry out the plan:** showing the students how to solve the problem after their have devise a plan through discussion for the procedure.

At stage four **look back**: The teacher evaluate the result in stage three and see if it can be use in similar situation.

3.6.3 Teaching the Control Group

After the pre-test,Lecture method was used to teach the control group. The Regular mathematics teachers in the control schools used the traditional chalk, talk and board method of teaching in the class, by jotting down some points on the board and ask students questions related to the trigonometry concepts, the teachers solve problems and asks the students to copy the note in their notebooks, class work and take home assignment was be given to the students. The lesson plan for lecture method was presented in Appendix M

3.7 Procedure for Data Collection

The researcher collected an introductory letter from the Head of Department (H.O.D), Department of Science Education, Ahmadu Bello University Zaria, which was forwarded to Ministry of Education (M.O.E) Gusau, Zamfara State. (Appendix F), permission for conducting the study in public Secondary Schools in the State was obtained from (M.O, E) (Appendix G), copies of the Ministry‘s letter were given to the principals of the selected schools to obtained the acceptance to conduct the study in their schools.Trigonometry Performance Test (TPT), Trigonometry Retention Test (TRT), and Trigonometry Attitude Scale Questionnaire (TASQ) (Appendix E) formed the tools for data collection. The answer scripts all three groups for pre-test, post-test and retention test were collected marked based on the marking scheme, and recorded the scores for analysis. The scores of

Male and Female students in Experimental and Control groups were tabulated and compare on the basis of post test for both performance, and attitude. While retention scores of both male and female in experimental and control groups students' were also tabulated and compared on the basis of post- post test for retention during the analysis.

3.8 Procedure for Data Analysis

The data collected were analyzed using relevant statistics at $P \leq 0.05$ to answer research questions and tested the null hypotheses using relevant statistical tool from statistical packages for the social science (SPSS). The research questions were answeredusing (Mean, standard deviation, Mean differences, Mean rank, Mean rank differences) the null hypotheses were stated with the corresponding statistics at $P \leq 0.05$ for testing as follows:

Ho_1: There is no significant difference between the mean attitude scores of students taught trigonometry using inquiry, problem solving and lecture methods among senior secondary schools in Zamfara state.

Statistics Used: Kruskal Wallis H Test. This statistics was used because the three groups were drawn from the same sample. Also the data was ordinal in nature. Hence; it is the comparison of median rank of three samples from the same population.

Ho_2: There is no significant difference between the mean performance scores of students taught trigonometry using inquiry, problem solving and lecture methods among senior secondary schools in Zamfara State.

Statistics Used: One way ANOVA. This statistics was used because the three groups were drawn from the same sample. The data collected was interval/ratio in nature. Hence, it is the comparison of means of three samples from the same population.

Ho_3: There is no significant difference between mean retention scores of students taught trigonometry using inquiry,problem solving and lecture methods among senior secondary schools in Zamfara State.

Statistics Used: One way ANOVA. This statistics was used because the three groups are drawn from the same sample. The data collected was interval/ratio in nature. Hence, it is the comparison of means of three samples from the same population.

Ho_4: There is no significant difference between the mean attitude scores of male and female students taught trigonometry using inquiry and problem solving methods among senior secondary schools in Zamfara State.

Statistics Used: Manny U- Test. This Statistics was used because the two groups were drawn from the same sample. Also the data are ordinal in mature. Hence; it is the comparison of median rank of two samples from the same population.

Ho_5: There is no significant difference between mean performance scores of male and students taught trigonometry using inquiry and problem solving methods among senior secondary schools in Zamfara State.

Statistics Used: Two Way ANOVA.This statistics was used because the three groups were drawn from the same sample. The data collected was interval/ratio in nature. Hence, it is the comparison of means of three samples from the same population

Ho_6: There is no significant difference between mean retention score of male and female students taught trigonometry using inquiry and problem solving methods among senior secondary schools in Zamfara State.

Statistics Used: Two Way ANOVA.This statistics was used because the three groups are drawn from the same sample. The data collected was interval/ratio in nature. Hence, it is the comparison of means of three samples from the same population

CHAPTER FOUR

DATA ANALYSIS, PRESENTATION AND DISCUSSION

4.0 Introduction

This study was conducted on impact of inquiry, problem solving strategies and lecture method on attitude, performance and retention in trigonometry. The result is presented under the following sub-headings: introduction, preliminary analysis, data analysis, summary of major findings and discussion.

4.1 Preliminary Analysis

This section presents the preliminary analysis of the data collected based on the type of instruction received and the gender of the participants. Descriptive statistics of frequency counts, means, medians, and Standard deviation were used to presents the results. The result of the analysis is presented in Tables 4.1 to 4.4.

Table 4.1 Descriptive statistics of pre-test, post-test and retention scores by groups

Group	Statistic	Pre-test	Post-test	Retention
Inquiry	Number	137	137	137
	Mean	11	26	22
	Median	12	28	21
	Standard Deviation (SD)	2	5	5
Problem solving	Number	121	121	121
	Mean	11	21	20
	Median	11	20	20
	Standard Deviation (SD)	2	3	4
Lecture method	Number	123	123	123
	Mean	11	18	15
	Median	11	17	15
	Standard Deviation (SD)	3	3	3

Table 4.1 presented the mean performance scores of students taught trigonometry using inquiry, problem solving strategies and lecture method before and after treatment. The pre-test mean scores for inquiry, problem solving and lecture method were (M=11, MD=12,

SD=2), (M=11, MD=11, SD=2) and (M=11, MD=11, SD=3) respectively. The result shows that the three schools that participated in the study were homogeneous in terms of trigonometry knowledge before the commencement of the study.

The post-test performance scores of students taught trigonometry using inquiry strategy was M=26, MD=28, and SD=5; that of those taught using problem solving was M=21, MD=20, and SD=3; and that of students taught using lecture method was M=18, MD=17, and SD=3. The result shows that students taught trigonometry using inquiry method performed better than those taught using problem solving strategy and lecture method. The mean performance scores for the students taught inquiry and problem solving were better than that of those taught using lecture method. That is, inquiry instructional strategy was better than problem solving and problem solving was better than lecture method in students' trigonometry performance.

The retention performance scores of students taught trigonometry using inquiry strategy was M=22, MD=21, and SD=5; that of those taught using problem solving was M=20, MD=20, and SD=4; and that of students taught using lecture method was M=15, MD=15, and SD=3. The result shows that students taught using inquiry method retain more of trigonometry concepts than those taught using problem solving strategy and lecture method. The mean retention scores for the students taught inquiry and problem solving were better than that of those taught using lecture method. That is, inquiry instructional strategy was better than problem solving and problem solving was better than lecture method in retaining trigonometry concepts.

Table 4.2: Descriptive statistics of pre-test, post-test and retention scores by gender

Gender	Statistics	Pre-test	Post-test	Retention
Male	Number	200	200	200
	Mean	11	22	20
	Median	11	20	20
	Standard Deviation	3	6	6
Female	Number	181	181	181
	Mean	11	21	18
	Median	11	20	18
	Standard Deviation	3	5	4

Table 4.2 presented the means, medians and standard deviations on pre-test, post-test and retention scores of male and female students who participated in the study. The pre-test results for both male and female students was M=11, MD=11, and SD=3. This shows that before the treatment was given to the participants, male and female students' had the same performance scores. After the treatment, the male students' performance scores was M=22, MD=20, and SD=6; that of female students was M=21, SD=20, and SD=5. This shows that male students performed better than the female students'. At the retention test, the male students' had M=20, MD=20, and SD=6; while female students had M=18, MD=18, and SD=4. This revealed that male students' were able to retain more of trigonometry concepts than the female students'.

Table 4.3: Descriptive statistics on attitude level by instructional strategy before and after treatment

Instructional strategy		Attitude before		Attitude after	
	Count	Mean Rank	Median Rank	Mean Rank	Median Rank
Inquiry	137	94.28	94.00	102.67	102.00
Problem solving	121	96.24	96.00	101.74	101.00
Lecture method	123	99.63	97.00	102.56	103.00
Total	**381**				

Table 4.3 presented the descriptive statistics of mean and median on students' trigonometry attitude level according to the type of instructional strategy before and after treatment. The mean and median attitude levels of students taught trigonometry using inquiry, problem solving and lecture method before treatment were (M=94.28, MD=94.00), (M=96.24,

MD=96.00) and (M=99.63, MD=97.00) respectively. After treatment, the mean and median attitude levels were (M=102.67, MD=102.00), (M=101.74, MD=101.00) and (M=102.56, MD=103.00) for inquiry, problem solving and lecture method, respectively.

Table 4.4: Descriptive statistics on attitude scores by gender before and after treatment

		Attitude before		Attitude after	
Gender	**Count**	**Mean Rank**	**Median Rank**	**Mean Rank**	**Median Rank**
Male	200	96.29	96.50	118.58	119.00
Female	181	97.01	94.50	117.69	119.00
Total	**381**				

Table 4.4 presents the descriptive statistics of mean and median on students' trigonometry attitude level according to gender before and after treatment. The mean and median attitude level of male and female students taught trigonometry using inquiry, problem solving and lecture method before treatment were (M=96.29, MD=96.50) and (M=97.01 MD=94.50) respectively. After treatment, the mean and median attitude level were (M=118.58, MD=119.900.50) and (M=117.69, MD=119.00) for male and female, respectively.

4.2 Data Analysis

This section presents the data analysis on effects of inquiry, problem solving strategies and lecture method on students' academic performance and attitude level in trigonometry. The data was analysed using parametric and nonparametric statistics.

Research Question One

What are the effects of inquiry, problem solving strategies and lecture method on students' attitudinal level in trigonometry among senior secondary schools in Zamfara state?

This research question was answered using descriptive statistics of mean and median rank attitude level.

The result of the analysis is presented in Table 4.5.

Table 4.5: Mean and median ranks on students' attitudinallevel by instructional strategy

Treatment	Count	Mean Rank	Median Rank
Inquiry	137	102.67	102.00
Problem solving	121	101.74	101.00
Lecture method	123	102.56	103.00
Total	**381**		

Table 4.5 shows the mean and median ranks on students' attitude level when taught using inquiry, problem solving strategies and lecture method. The mean and median rank on attitude of students taught trigonometry using inquiry strategy (M=102.67, MD=102.00) was higher than (M=101.74, MD=101.00) and (M=102.56, MD=103.00) for students taught trigonometry using problem solving strategy and lecture method, respectively.

Null Hypothesis One

There is no significant difference in the mean attitudinallevel of students taught trigonometry using inquiry, problem solving strategies and lecture methodin senior secondary schools in Zamfara state.

Table 4.6: Kruskal-Wallis Test on students' attitudinal level change on the three groups

Treatment	N	Mean Rank	Median Rank	χ^2	df	P
Inquiry	137	102.67	102.00			
Problem solving	121	101.74	101.00	1.445	2	0.486
Lecture method	123	102.56	103.00			
Total	**381**					

a. Kruskal Wallis Test
b. Grouping Variable: treatment

Table 4.6 presented the mean and median ranks on students' attitudinal level when taught using inquiry, problem solving strategies and lecture method. The mean and median rank on attitude of students taught trigonometry using inquiry strategy (M=102.67, MD=102.00) was higher than (M=101.74, MD=101.00) and (M=102.56, SD=103.00) for students taught

trigonometry using problem solving strategy and lecture method, respectively. That is, attitude level of students towards learning of trigonometry was higher when taught trigonometry using inquiry instructional strategy than when taught using problem solving and lecture method. This is supported by χ^2 (2) =1.445, p=0.486; the null hypothesis which stated no significant difference was retained. Therefore, there was no significant difference between the mean attitude scores of students taught trigonometry using inquiry, problem solving strategies and lecture method among senior secondary schools in Zamfara state. This shows that the attitudinal level of students' towards learning of trigonometry when taught using inquiry, problem solving strategies lecture method was the same among the students'.

Research Question Two

What are the effects of inquiry, problem solving strategies and lecture method on students' performance in trigonometry among senior secondary schools in Zamfara state?

This research question was answered using descriptive statistics of means and standard deviations.

The result of the analysis is presented in Table 4.7.

Table 4.7: Means and Standard deviations on students' performance scores among the Group

Treatment	N	Mean	SD
Inquiry	137	26.39	5.421
Problem solving	121	19.88	3.426
Lecture method	123	17.48	3.166
Total	**381**	**21.45**	**5.667**

Table 4.7 presented the means and standard deviations on performance in trigonometry of students' taught using inquiry, problem solving strategies and lecture method. The mean academic performance of students' taught trigonometry using inquiry strategy was (M=26.39, SD=5.421) and (M=19.88, SD=3.426), (M=17.48, SD=3.166) for problem solving and lecture method, respectively.

Null Hypothesis Two

There is no significant difference in the mean performance scores of students taught trigonometry using inquiry, problem solving and lecture strategies in senior secondary schools in Zamfara state.

Table 4.8a: Inferential statistics on students' academic performance scores

Source of Variance	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	5574.571	2	2787.286	158.971	.000
Within Groups	6627.576	378	17.533		
Total	**12202.147**	**380**			

Table 4.8a presents the mean academic performance scores of students taught trigonometry using inquiry, problem solving strategies and lecture method.The analysis revealed that F(2,378)=158.971), p=0.001; the null hypothesis that stated no significant difference was rejected. Therefore, there was a significant difference between the mean performance scores of students taught trigonometry using inquiry, problem solving strategies and lecture method.

Since a significant difference exists between the three instructional methods, Scheffe's post-hoc test was conducted in order to find where the difference is among the groups. The result of the post-hoc test is presented in Table 4.8b.

Table 4.8b: Scheffe'sPost Hoc Tests on students' performance scores among the group

(I) Group	(J) Group	Mean Difference (I-J)	Sig.
Inquiry	Problem solving	6.503*	.000
	Lecture method	8.907*	.000
Problem solving	Inquiry	-6.503*	.000
	Lecture method	2.405*	.000
Lecture method	Inquiry	-8.907*	.000
	Problem solving	-2.405*	.000

*. The mean difference is significant at the 0.05 level.

Table 4.8b presentedScheffe'sPost Hoc tests on students' academic performance scores based on the three groups comparison. The result revealed that when all the groups were

compared in pairs, there was a significant difference ($p<0.05$). Therefore, there was a significant difference between the mean performance scores of students taught trigonometry using inquiry, problem solving strategies and lecture method. Hence, the null hypothesis which stated no significant difference was rejected.

Research Question Three

To what extent does inquiry, problem solving strategies and lecture method affects retention ability in trigonometry insenior secondary schools' students in Zamfara state?

This research question was answered using descriptive statistics of means and standard deviations.

The result of the analysis is presented in Table 4.09.

Table 4.09: Means and standard deviations on students' retention ability scores by instruction strategy

Treatment	N	Mean	SD
Inquiry	137	22.07	4.953
Problem solving	121	19.83	4.455
Lecture method	123	18.52	5.530
Total	**381**	**20.21**	**5.204**

Table 4.09 presented the means and standard deviations on retention ability in trigonometry of students' taught using inquiry, problem solving strategies and lecture method. The mean retention ability of students' taught trigonometry using inquiry strategy was (M=22.07, SD=4.953) and (M=19.83, SD=4.455), (M=18.52, SD=5.530) for problem solving and lecture method, respectively.

Null Hypothesis Three

There is no significant difference in the mean retention scores of students taught trigonometry using inquiry, problem solving strategiesand lecture method insenior secondary schools in Zamfara state.

Table 4.10a: Inferential statistics on students' retention ability scores

Source of Variance	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	840.739	2	420.369	16.818	.000
Within Groups	9448.463	378	24.996		
Total	**10289.202**	**380**			

Table 4.10a presents the mean retention ability scores of students taught trigonometry using inquiry, problem solving strategies and lecture method.The analysis revealed that F(2,378)=16.818), p=0.001; the null hypothesis that stated no significant difference was rejected. Therefore, there was a significant difference between the mean retention ability of students taught trigonometry using inquiry, problem solving strategies and lecture method.

Since a significant difference exists between the three instructional methods, Scheffe's post-hoc test was conducted in order to find where the difference is among the groups. The result of the post-hoc test is presented in Table 4.10b.

Table 4.10b: Scheffe'sPost Hoc Tests on students' retention ability scores

(I) Group	(J) Group	Mean Difference (I-J)	Sig.
Inquiry	Problem solving	2.239*	.002
	Lecture method	3.545*	.000
Problem solving	Inquiry	-2.239*	.002
	Lecture method	1.306	.003
Lecture method	Inquiry	-3.545*	.000
	Problem solving	-1.306	.003

*. The mean difference is significant at the 0.05 level.

Table 4.10b presentedScheffe'sPost Hoc tests on students' retention ability scores based on the three groups comparison. The result revealed that when all the groups were compared

in pairs, a significant difference ($p<0.05$) exists between inquiry and problem solving, and inquiry and lecture method. While no significant difference ($p>0.05$) was found between problem solving and lecture method. Therefore, there was a significant difference between the mean retention ability of students taught trigonometry using inquiry, problem solving strategies and lecture method. Hence, the null hypothesis which stated no significant difference was rejected.

Research Question Four

What are the impacts of inquiry and problem solving strategies on gender and attitude in trigonometry among senior secondary schools students' in Zamfara state?

This research question was answered using descriptive statistics of mean and median rank attitude level.

The result of the analysis is presented in Table 4.11a and 4.11b.

Table 4.11a: Mean Rank score on attitude level of students' taught using inquiry and problem solving

Group	N	Mean Rank	Median Rank
Inquiry	137	102.67	102.00
Problem Solving	121	101.74	101.00
Total	**258**		

Table 4.11a shows the mean and median ranks on students' attitude level when taught using inquiry and problem solving strategies. The mean and median rank on attitude of students taught trigonometry using inquiry strategy (M=102.67, MD=102.00) was higher than (M=101.74, MD=101.00) for students taught trigonometry using problem solving strategy. That is, attitude level of students towards learning of trigonometry was higher when taught trigonometry using inquiry instructional strategy than when taught using problem solving.

Table 4.11b: Mean Rank score on male and female students' attitude level

Gender	N	Mean Rank	Median Rank
Male	137	118.58	119.00
Female	121	117.69	119.00
Total	**258**		

Table 4.11b shows the mean and median ranks on male and female students' attitude level when taught using inquiry and problem solving strategies. The mean and median rank on attitude of male students taught trigonometry (M=118.58, MD=119.00) was higher than (M=117.69, MD=119.00) for female students taught trigonometry. That is, attitude level of male students towards learning of trigonometry was higher than that of female students when taught trigonometry using inquiry and problem solvingstrategies.

Null Hypothesis Four

There is no significant difference in the mean attitude level of male and female students taught trigonometry using inquiry and problem solving strategies in senior secondary schools in Zamfara state.

This null hypothesis was tested using nonparametric statistic of Mann-Whitney U test.

The result of the analysis is presented in Table 4.12a and 4.12b.

Table 4.12a: Mann-Whitney U test on attitude level of students' taught using inquiry and problem solving

Treatment	N	Mean Rank	Median Rank	Mann-Whitney U	Wilcoxon W	Z	p
Inquiry	137	102.67	102.00	7677.5	15058.5	-0.83	0.406
Problem Solving	121	101.74	101.00				
Total	**258**						

a. Grouping Variable: treatment

In Table 4.12a, the mean attitude level of students taught trigonometry using inquiry and problem solving strategies. The mean and median ranks for inquiry strategy (M=102.67, MD=102.00) was higher than that of problem solving strategy (M=101.74, MD=101.00). The Mann-Whitney U test of 7677.5, Z= -0.83, p=0.406 shows that there was no significant difference in attitude level of students taught trigonometry using inquiry and problem

solving strategies. The null hypothesis which stated no significant difference was retained. Therefore, there was no significant difference between the mean attitude level of students taught trigonometry using inquiry and problem solving strategies.

Table 4.12b: Mann-Whitney U test of male and female students' attitude level

Gender	N	Mean Rank	Median Rank	Mann-Whitney U	Wilcoxon W	Z	p
Male	137	118.58	119.00	8130.5	15511.5	-0.063	0.95
Female	121	117.69	119.00				
Total	**258**						

a. Grouping Variable: gender

In Table 4.12b, the mean attitude level of male and female students taught trigonometry using inquiry and problem solving strategies. The mean and median ranks for male students (M=118.58, MD=119.00) was higher than that of female students (M=117.69, MD=119.00). The Mann-Whitney U test of 8130.5, Z= -0.063, p=0.95 shows that there was no significant difference in attitude level of male and female students taught trigonometry using inquiry and problem solving strategies. The null hypothesis which stated no significant difference was retained. Therefore, there was no significant difference between the mean attitude level of male and female students taught trigonometry using inquiry and problem solving strategies.

Research Question Five

To what extent does inquiry and problem solving strategies affects gender and performance in trigonometry among senior secondary schools students in Zamfara state?

This research question was answered using descriptive statistics of means and standard deviation.

The result of the analysis is presented in Table 4.13.

Table 4.13: Means and Standard deviations ofmale and female students' performance on inquiry and problem solving

Group	Gender	N	Mean	SD	Mean difference
Inquiry	Male	73	27.26	6.551	1.87
	Female	64	25.39	3.535	
Problem Solving	Male	64	20.73	3.965	1.80
	Female	57	18.93	2.389	

Table 4.13 presents the means and standard deviations of male and female students' academic performance in trigonometry when taught using inquiry and problem solving strategies. The mean academic performance of male students taught using inquiry (M=27.26, SD=6.551) was higher than that of female students (M=25.39, SD=3.535). The mean difference between male and female students was 1.87 in favour of male students. That is, male students performed better than female students' when taught using inquiry strategy. Again, the mean academic performance of male students taught using problem solving (M=20.73, SD=3.965) was higher than that of female students (M=18.93, SD=2.389). The mean difference between male and female students was 1.80 in favour of male students. That is, male students performed better than female students' when taught using problem solving strategy.

Null Hypothesis Five

There is no significant difference in the mean performance scores of male and female students taught trigonometry using inquiry and problem solving strategies among senior secondary schools in Zamfara state.

This null hypothesis was tested using Analysis of variance.

The result of the analysis is presented in Table 4.14.

Table 4.14: Summary of Analysis of variance on male and female students' performance scores

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	2934.170[a]	3	978.057	47.889	.000
Intercept	136369.625	1	136369.625	6677.192	.000
Treatment	2698.794	1	2698.794	132.144	.000
Gender	216.022	1	216.022	10.577	.001
treatment * gender	.068	1	.068	.003	.954
Error	5187.493	254	20.423		
Total	148635.000	258			
Corrected Total	8121.663	257			

a. R Squared = .361 (Adjusted R Squared = .354)

Table 4.14 presents the analysis of variance on male and female students' performance scores when taught using inquiry and problem solving strategies. The analysis revealed that there was a significant difference in academic performance of students when taught using inquiry and problem solving strategies where F(1,254)=132.144, p=0.001. The null hypothesis which stated no significant difference was rejected. Also, when gender was compared a significant difference was found in academic performance of students when taught using inquiry and problem solving strategies where F(1,254)=10.577, p=0.001. The null hypothesis which stated no significant difference was rejected. Again, when type of instructional strategy and gender were compared, no significant difference was found where F(1,254)=0.003, p=9.54. The null hypothesis which stated no significant difference was retained. Therefore, there was no significant difference between the mean performance scores of male and female students taught trigonometry using inquiry and problem solving strategies.

Research Question Six

What is the impact of inquiry, problem solving strategies on gender and retention ability in trigonometry among students' of senior secondary schools in Zamfara state?

This research question was answered using descriptive statistics of means and standard deviation.

The result of the analysis is presented in Table 4.15.

Table 4.15 Means and Standard deviations on students' performance on inquiry and problem solving

Group	Gender	N	Mean	SD	Mean difference
Inquiry	Male	73	24.14	4.860	4.44
	Female	64	19.70	3.914	
Problem Solving	Male	64	20.89	4.640	2.26
	Female	57	18.63	3.944	

Table 4.15 presents the means and standard deviations of male and female students' retention level in trigonometry when taught using inquiry and problem solving strategies. The mean retention level of male students taught using inquiry (M=24.14, SD=4.860) was higher than that of female students (M=19.70, SD=3.914). The mean difference between male and female students was 4.44 in favour of male students. That is, male students retained trigonometric concepts better than female students' when taught using inquiry strategy. Again, the mean retention level of male students taught using problem solving (M=20.89, SD=4.640) was higher than that of female students (M=18.63, SD=3.944). The mean difference between male and female students was 2.26 in favour of male students. That is, male students retained trigonometric concepts better than female students' when taught using problem solving strategy.

Null Hypothesis Six

There is no significant difference between the mean retention scores of male and female students taught trigonometry using inquiry and problem solving strategies among senior secondary schools in Zamfara state.

This null hypothesis was tested using Analysis of variance.

The result of the analysis is presented in Table 4.16.

Table 4.16: Summary of Analysis of variance on male and female students' retention ability scores

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1146.451[a]	3	382.150	19.836	.000
Intercept	111201.772	1	111201.772	5772.009	.000
Treatment	298.345	1	298.345	15.486	.000
Gender	716.806	1	716.806	37.206	.000
treatment * gender	75.686	1	75.686	3.929	.049
Error	4893.487	254	19.266		
Total	119986.000	258			
Corrected Total	6039.938	257			

a. R Squared = .190 (Adjusted R Squared = .180)

Table 4.16 presented the analysis of variance on male and female students' retention level when taught using inquiry and problem solving strategies. The analysis revealed that there was a significant difference in retention level of students when taught using inquiry and problem solving strategies where F(1,254)=15.486, p=0.001. The null hypothesis which stated no significant difference was rejected. Also, when gender was compared a significant difference was found in retention level of students when taught using inquiry and problem solving strategies where F(1,254)=37.206, p=0.001. The null hypothesis which stated no significant difference was rejected. Again, when type of instructional strategy and gender were compared, a significant difference was found where F(1,254)=3.929, p=0.049. The null hypothesis which stated no significant difference was also rejected. Therefore, there wasa significant difference between the mean retention level of male and female students taught trigonometry using inquiry and problem solving strategies.

4.3 Summary of Major Findings

1. No relationship was found in the mean attitudinal level of students taught trigonometry using inquiry, problem solving strategies and lecture method.
2. Students performed better when taught trigonometry using inquiry and problem solving strategies than lecture method.

3. Students' retention ability was high in trigonometry concepts taught using inquiry, problem solving strategies than lecture method.
4. Female students were rated equally with their male counter parts in their attitude towards trigonometry when taught using inquiry and problem solving strategies.
5. The use of inquiry and problem solving strategies had no influence on the performance of male and female students
6. The retention ability of male students exposedto inquiry and problem solving strategies was found to be high than that of the female students.

4.4 Discussionsof the findings

This study investigated the impact of inquiry and problem solving strategies on attitude, retention and performance in trigonometry among senior secondary school students' in Zamfara state. Several findings were made and were briefly discussed and related to the available literature. The data collected for this study with chi-square $x^2(Z) = 1.445$, df = 2, and p- value =0.486 ,the null hypothesis which stated no significant difference between the attitudinal level of students taught trigonometry using inquiry, problem solving strategies and those taught using lecture method among senior secondary schools in Zamfara state was retained. The finding from this study showed that there was no difference between the attitudinal level of Senior Secondary School (SSII) students taught trigonometry concepts using inquiry, problem solving. Strategies and those taught using lecture method. The students taught using inquiry and problem solving strategies dono differs in their attitudes towards trigonometry concepts with those taught using lecture method of teaching. This finding disagree with the finding of Meriam (2000); Adaramola and Adolphus (2013); and Ado (2014); who attested to the superiority of the constructivist instructional strategies over the conventional method of teaching in improving students attitude towards the study

of mathematics and trigonometry in particular. This outcome could be as a result of the fact that new instructional strategies improve students attitude..The finding of the study agrees with klin & Noor (2009)in their study who found that students attitude towards mathematics were not significantly difference in pre-test and post-test scores The outcome may be possible because the importance attach to the teaching of trigonometry by all the groups.

In table 4.7 the mean academic performance scores of students taught trigonometry using inquiry and problem solving strategies were higher than the lecture method..The finding from this study showed that there was a significant difference between the performance scores of inquiry, problem solving strategies and the lecture method.From the results obtained, senior secondary school (SS11) students taught trigonometric concepts using inquiry and problem solving strategies performed better than students taught using lecture method. The findings agrees with the findings of Usman and Musa (2015) and Ibrahim and Busari (2016) who observed in their various reports that experimental group performed better than the controlgroup. The reason has to do with that students' learn more by getting actively involved in the lesson rather than being passive.It further revealed that method was a significant factor on students' performance in trigonometry. The inquiry and problem solving strategies assist the students to see the solutions to problem as been in steps which is not explicit in the lecture method. Also inquiry and problem solving strategies has some implications in the teaching and learning of trigonometry which many students find it difficult to understand.For a students to have a good understanding of a concept or topic. The learner needs to interact with it. The inquiry and problem solving strategies affords learner the opportunities of getting to the roots of a given problems or task. This finding contradicts the finding Samuelson (2010) which shows that there is no significant

difference between problem solving method and conventional teaching method in terms of students' performance.

The finding from this study showed that there was a difference the retention scores of senior secondary school (SS11) students taught inquiry, problem solving strategies and those taught using lecture method of teaching. The students taught trigonometric concepts using inquiry and problem solving strategies retained more than those taught using lecture method of teaching. This shows that the experimental groups retained more of trigonometry contents taught than the control group. This was further confirmed by the ANOVA result which shows that the experimental groups significantly retained higher than control group in the trigonometry concept taught. The finding of this study was in accordance with those of Chianson, Kurumeh, and Obida (2011) Obi, Agwagah and Agah (2014); Ado (2014); and Abdullahi (2016) who found that experimental group retained more than the control group. The results of this study have shown that inquiry and problem solving strategies in teaching trigonometry help students to retain the things the students have learnt and in turn improve achievement in trigonometry. However, thefinding disagrees with the findings ofHenderson (2005); and seyhan and Morgil (2007) in their various studies found that lecture method retained more information than the experimental group.

In table4.12a the data collected for this study was analysed with mann- whitney test of 7677.5,Z =.083, df=2, and p-value =0.406 shows that there was no significant difference on attitudinal level of students taught inquiry and problem solving strategies. When gender was compared. In table 4.12b the data collected for this was analysed with mann- whitney test of 8130.5,Z= -0.063,p- value =0.95 shows that there was no significant difference in attitudinal level of male and female students taught trigonometry using inquiry and

problem solving strategies.The finding from this study showed that there was no difference between the attitudinal level of male and female senior secondary school (SS11) students taught trigonometric concept using inquiry and problem solving strategies. The attitude level of male students taught trigonometryusing inquiry and problem solving strategies do not differs with the female students taught using inquiry and problem solving strategies. The finding agrees with the finding of Yusuf (2009); who observed that gender of students does not affect their attitude toward mathematics concepts. The finding of thestudy disagrees with the finding ofTekerek, Yeniterzi and Ercan (2011) who reported that there was a significant difference between male and female students' and their mathematics attitude scores. This result showed that there was no significant difference between attitudes means score of male and female students.

The finding from the study showed that there was no difference between the performance scores of male and female senior secondary school (SS11) students taught trigonometric concepts using inquiry and problem solving strategies. This showed that both inquiry and problem solving strategies are not gender sensitive in the teaching of trigonometry concepts. This finding is supported by the work of other researchers on the performance scores of male and female students with respect to treatment given to the students. Yusuf (2009);Salman and Ameen (2014); Attah and Guwan (2015);this findings confirmed that when male and female students are exposed to Mathematics using different methods of teaching, their performance will not differ significantly. This implies that the treatment given to the experimental groups did not affect gender as a factor as far as performance in trigonometry concepts in this study are concerned.. The finding of the study disagreeswith the finding of Asim et al (2007); Usman and Musa (2015); and Abdullahi (2016); who all attested that male students performed better than female students in mathematics. The gender gap identified by authors who found significant differences in mean achievement

male and female students in favour of males can be bridged by the used of inquiry and problem solving strategies in teaching trigonometry.

The finding from this study showed that there was a difference in the retention scores of male and female senior secondary school (SS11) students taught trigonometric concepts using inquiry and problem solving strategies. This finding agrees with the findings of Ado (2014) and Abdullahi (2016) in their various studies that indicate male students retained better than their female students in Trigonometry.

CHAPTER FIVE

SUMMARY, CONCLUSIONSAND RECOMMENDATIONS

5.1 Introduction

This study investigated the impact of inquiry and problem solving strategies on attitude, retention and performance in trigonometry among senior secondary school students' in Zamfara State, Nigeria. In thischapter the summary of the study, conclusions, contribution to knowledge are presented. Also presented are recommendations, limitation of the study and suggestion for further studies.

5.2 Summary

This study investigated the impact of inquiry and problem solving methods on attitude, retention and performance in trigonometry among senior secondary school students in Zamfara state, Nigeria. The main objective of this research study was to explore different strategies of teaching that are expected to be better than lecture method in teaching trigonometry at senior secondary school two students (SSSII) in Zamfara State. It was discovered that lecture method of teaching has many deficiencies among them that is, it is more of teacher-centred than student-centred learning. For this reason two more teaching strategies (inquiry and problem solving) were considered. This study was carried out in Zamfara state. The study specifically centred on SS11 students and lesson plans were developed based on SS11 mathematics syllabus in the areas of trigonometry concepts. The trigonometry concepts taught are: Pythagoras Theorem, Trigonometry ratio, Special Angle (30^0,45^0&,60^0) Angle of elevation and depression, Sine and Cosine rule, and also bearing and Distance.

Available literature on the research study was reviewed. Among the topics being reviewed were generally on theories of learning and the strategies of teaching, which include Behaviourism theory, Cognitive theories, as well as the Constructivist learning theory. All the three strategies were also discussed. Implicationof reviewed literature to the present study was discussed. The population of the study was 112 public secondary schools and made up of 23,910 SSII students. 6 public schools made up of 3 boys and 3 girls' schools were randomly selected for the sample and a total number of 381 SSIIstudents were used in the study. Analysis and interpretation of the findings for the study were carried out based on pre-test, post test and post-post test (retention) administered on the two experimental groups (inquiry and problem solving strategies) and the control group (lecture) and the conclusions draw according to the discussion rule at 5% (0.05) level of significance. Based on this rule it was found that:

1. No relationship was found in the mean attitudinal level of students taught trigonometry using inquiry, problem solving strategies and lecture method.
2. Students taught trigonometry with inquiry and problem solving strategies performed better than lecture method.
3. Students taught trigonometry with inquiry and problem solving strategies retain more than students' taught with lecture method
4. Male students taught trigonometry with inquiry and problem solving strategies do not differs in their attitude level than the female students
5. Male students taught trigonometry with inquiry and problem solving strategies do not performed better that the female students
6. Male students taught trigonometry with inquiry and problem solving strategies retain more than the female students.

5.3 Conclusions

This study investigated the impact of inquiry and problem solving strategies on attitude, retention, and performance in trigonometry among senior secondary school students' Zamfara State, Nigeria.In view of the findings reported in chapter four, the following conclusions were reached for the study.

1. No relationship was found in the attitudinal level of students taught trigonometry using inquiry, problem solving strategies and lecture method.
2. Students performed better when taught trigonometry using inquiry and problem solving strategies than lecture method.
3. Students' retention ability was high in trigonometry concepts taught using inquiry, problem solving strategies than lecture method.
4. Female students were rated equally with their male counter parts in their attitude towards trigonometry when taught using inquiry and problem solving strategies.
5. The use of inquiry and problem solving strategies had no influence on the performance of male and female students.
6. The retention ability of male students exposed to inquiry and problem solving strategies was found to be high than that of the female students.

5.4 Contributions to Knowledge

The gaps filed by this study are:

1. The 7Es Learning cycle of inquiry and 4 polya problem solving strategies are students' centred approach and can have tremendous effect when used to teach trigonometry at the senior secondary school level. These strategies raise students' academic performance and retention.
2. Through inquiry and problem solving strategies, the students in senior classes would find mathematics especially trigonometry very interesting and focused. Since they would be involved in the teaching and learning process.

5.5 Recommendations

This study investigated the impact of inquiry and problem solving strategies on attitude, retention, and performance in trigonometry among senior secondary school students' Zamfara State, Nigeria.Based on the conclusion and the discussions, following recommendations are made.

1. Since the results of the study have been found in favour of inquiry and problem solving strategies, therefore for developing reasoning and critical thinking in students, teacher, may include inquiry and problem solving strategies as their teaching methods.
2. The teaching of Mathematics in general and trigonometry in particular should be conducted in such a way that students should be actively involved in the learning process, which enable them to see mathematics as part of their daily life activities and there by enhance the student performance academically.
3. Inquiry and problem solving strategies should be use to teach senior secondary school students in order to aid students retention above in trigonometry concepts.

4. Mathematics teacher should adopt inquiry and problem solving strategies in teaching trigonometry concepts to enhance better performance of the student's
5. Emphasis should be adapted to these methods (inquiry and problem solving strategies) at training institutions across the nation.
6. The useof lecture method of teaching has been found in this study not tobe suitable for teaching, withrespect to performanceand retention in Trigonometry, Mathematics teachers should avoid a situation where poor teaching method is promoted during teaching in the classroom.

5.6 Limitations of the study

This study has some limitations, which include the following:

1. The study was restricted to only 6 secondary schools in Zamfara state as such generalization of the study is narrow
2. The study concentrated on schools in urban towns instead of covering both rural areas due to security challenges
3. Intact class was used instead of random selection of students. This was because school authority did not permit the researcher to do that

5.7 Suggestions for Further Studies

From the findings and conclusions reached in this study the following suggestions are made to encourage further findings:

1. Impact of inquiry and problem solving strategies on performance, retention and motivation to Algebraic process among senior secondary school students.
2. Impact of inquiry and problem solving strategies on interest and academic achievement to geometry among senior secondary school students

3. Impact of inquiry and problem solving strategies on performance and motivation to number and numeration among junior secondary schools students

References

Abdullahi, U. (2016). Impact of Student Team Achievement Divisions Strategy on Secondary School Students trigonometric performance and retention in Katsina state, Nigeria. *proceeding of September2016 Annual conference, Mathematical Association of Nigeria (MAN).* Pp 30-44

Abrams, E. Southerland, S. & Silva, P. (Eds) (2008). *Inquiry in Classroom*/ Charlotte, N.C: information Age Publishing

Adaramola,M.O.&Adolphus, T.(2013).Teaching Further Mathematics in Nigeria Secondary Schools for technological Development through poly model. *Proceedings of the Annual National Conferenceof the Mathematical Association of Nigeria,*24-33.

Adedeji. T. (2007).The impact of motivation on students' academic achievement and learning outcomes in Mathematics among Secondary Schools Students in Nigeria'',*Eurasia.Journal of Mathematics, Science &technical Education*,3(2), 149-156.

Adeleke, J.O & Amoo, S.A. (2007). *Gender and Subject choice effects on students Psycho-cognitive outcomes in mathematics* Sept (1) IH2

Adeniyi, C.O (2012). Effects of Personalized system of Instruction on Senior School Students' Performance in Mathematics in Kwara south, Nigeria. Unpublished Ph.D thesis, University of Ilorin, Ilorin, Nigeria.

Adetula,I.O.(2005). Notes and Worked examples on Trigonometry, ISBN97837716-20

Adeyemi, T.O. (2008). The influence of class size on the quality of output in secondary schools in Ekiti state Nigeria American *Eurasian Journal of Scientific Research,* 3(1), 7-14

Ado, I.K. (2014). Impact of Constructivist teaching strategy on students' academic performance, retention and attitude towards trigonometry among senior secondary schools in Kaduna state, Nigeria. PhD. Thesis, Ahmad Bello University, Zaria Nigeria.

Aiyedun, J.O. (2000). Influence of sex difference of students on their achievement in secondary school mathematics". *Abacus Journal of the Mathematical Association of Nigeria*, 24(1), 102-113.

Alhassan,D.S.Victoria, I.E& Dantani I.W (2013) "Effects of Computer Assisted Instructional Package on Junior Secondary School Students Achievement and Retention in Geometry in Minna Niger State, Nigeria". *International Journal of Humanities and Social Science Invention,* 2(5),

Ali,I. (2004) A Comparative Study of the Student Achievement Taught by Lecture Method and Lecture cum Workbook Method of Teaching General Science at Middle Level in NWP Unpublished M.Phil,Thesis Allama Iqbal Open University Islamabad , Pakistan. Pp, 12-17.

Alieme, S.O and Monica N.odinko (2015). Primary 5 pupils attitude as a predictor of learning outcome in Mathematics using Personalized and direct system of Instruction and conventional method. *Journal of Educational Research and Development* (AJERD),1(2), 112-119

Asante K.O (2010). Sex differences in Mathematics in Ghana Retrieved from http://www.tags.org/perioddical=201012/28771338/.html

Asim, A.E Kalu, I.M, Idaka, I.E & Bassey, S.W (2007). Competency in STM Assessment the case of Primary school Teacher in cross Rivers state Nigeria. *In Proceeding of the International Conference to Review in science, Technology and Mathematics Education* (Episten) Feb 12-15. Munbai.

Attah, B & Guwan B. (2015). Effect of Remediation on Students' Performance in Mathematics in Government Secondary School. Kuwiri, Jos-North Plateau state. Nigeria. *Abacus, the Journal of Mathematical Association of Nigeria, 40(1) 63-69*

Augie, H.A. (2015). Effects of Dominant Constructivist Teaching Strategies on Attitude and Performance in mathematics among Junior Secondary School Students in Zamfara State, Nigeria. PhD Thesis Ahmadu Bello University, Zaria. Nigeria.

Azuka, B.F. (2003). The Challenges of Mathematics in Nigeria's Economic and Technological Development-Implication for Tertiary Education.*Journal of the Mathematical Association of Nigeria,* 8(1), 18-26

Azuka,B.F. (2012). Improving the memory of students in Mathematics classroom towards better performance. *Abacus,The journal of the mathematical Association of Nigeria*.3 7(1), 65-72

Baker, A. Jensen, P., Kolb, D.(2002).Conversational Learning: An Approach to Knowledge Creation Wesport:Quorum.w.w.w.encyclopedia.com/doc/IGI-1723767.html.Retrieved on May 1,2012.

Barakasta, A. (2005). A Topology of Mathematics Teachers Beliefs about Teaching Mathematics and Instructional practices."*Mathematics Educational Research Journal*.17 (2), 69-90.

Bay,J.(2001).Student reactions to standards-based mathematics curricula; The interplay between Curriculum, Teachers, and Students School Science and Mathematics, 99(4), 182-187.

Bichi,S.S.(2002), Effect of problem solving strategy and enriched curriculum secondary school students achievement in evolution concepts, unpublished Ph.D thesis Abu Zaria Brown, W.M (2003).A study of Elementary Teachers' abilities Attitude and Beliefs about problem solving.Dissertation Abstract international 64(10) 3620.(Umi no3108818).

Brown, W.M. (2003). A study of Elementary Teachers' abilities Attitude and Beliefs about problem solving. Dissertation Abstract international 64(10) 3620. (Umi no3108818).

Bybee R.W (2002). Scientifics Inquiry Student Learning and the science curriculum learning science and the science of learning.Arington, VA NSTA Press.

Chaianson, M.M, Kuremeh, M.S &Obida, J.A (2011). Effect of Cooperative Learning strategy on students' rentation in circle geometry in secondary schools in Benue state, Nigeria.*American journal of science and industrial Research. Retrieved April 20, 2011 from w.w.w.scihub.org/AJSIR*

Chang, C & Mao, S. (2001)."Comparison of Taiwan science students' outcomes with inquiry group verses traditional instruction." *Journal of Educational Research,* 92(6), 340-346.

D' Angelo, C.M, Touchman, S. & Clark, D.B.(2009) Constructivism.Education.Com. Retrieved on 4/8/2015 from:http://www.Education.com/reference/article/…

Dang, A.S & Jwan, M.Y. (2000). *Methodology of teaching. A handbook for students*. Jos: WAIS Press

Desiree, S. (2009). The effects of constructivist and traditional Teaching Methods of Students' Mathematical Achievement. A project submitted to the faculty of the Evergreen state College. www.encyclopedia.com/doc/igi-1723767.html.

Dewey, J. (2001). The child and the curriculum Mineola, N.Y Dover Publications inc.

Dewitt, S. (2003). Multicultural Democracyand inquiry pedagogy intercultural Education, 14(3), 279-290.

Ebisine, S.S (2013) "Re-Engineering Mathematics Education for Technological Development in Nigeria". *Abacus: Journal of the Mathematical Association of Nigeria.*38 (1).196-204

Effendi, Z. & Normah, Y. (2009). Attitudes and Problem solving skills in algebra among Malaysian College students.*European Journal of social science* 8, 232-245.

Eisenkraft A, (2003). Expending the 5E model. "*The science teacher*" Vol. 70, No:6 pp 57-59. National science Teacher Association (NSTA). Arlington V.A

Eluwa,A.I.(2005). School ownership and instructional effectiveness in mathematics.*Nigerian Journal of Educational Administration and Planning,* 5, 104-107.

Emaikwu. S.O. (2012). Assessing the effect of prompt feedback as a motivational strategy on students' achievement in secondary school mathematics *Journal of Educational Research,* 3(4) 371-379.

Eriba,J.O&Sesugh A.(2006). Gender Differences in Achievements in Calculating Reacting Masses from Chemical Equations Among Secondary School Students in Makurdi Metropolis. *Educational Research Review*, 1(6), 170-173

Ezeamenyi M.O (2004). Facing Challenges of the Third Millennium through Varieties in Mathematics Science and Computer Education. Enugu Royal ventures

Fajemidagba, M.O. & Sulaiman, B (2012) Explore the effects of polya's and Bransford and Stein Problem solving models on students performance in mathematics *journal of mathematical Association of Nigeria,* 38(1), 198-207

Farooq,C.M.S.AH. Chaudhry &Mohmood, A. (2005). Comparison of Impact of Activity Based and Traditional Method of teaching on Achievement of Mathematics in Bulletin of education and Reserch.V27.No.2.Institute of Education Research University of Punjap Lahore(Pakistan) Pp.58-59

Fazahur, R., Nabi, B. & Jumam, M.A., Nazoora, K. (2011). Impact of Project Based Method on Performance of Students Language in India. Retrieved from www.languageinidia.com 2/10/2018

Federal Republic of Nigeria (2013). *National Policy on Education: Roadmap for Nigerian Educational Sector*. NERDC: Yaba. Lagos.

Fennema. E. & Sherman J. (1976). Fennema-Sherman Mathematics attitudes scales instruments designed to measure attitudes towards the learning of mathematics by females and males. Wisconsin: University of Wisconsin-madiso

Fritz, R. (2008). Mathematics Educational for Scientific Technology and Industrial society. *Journal of the Mathematics Teacher,* 665-671

Galadima I. (2002). The relative effects of Heuristic problem- solving instruction on Secondary school student's performance on algebraic word problem. *Journal of Mathematics Association of Nigeria,* 27(1), 57-65

Galilio EducationalNetwork. (2004). what is inquiry? Inquiry & ICT Retrieved July 12, 2004, from *http://www.galileo.org/inquiry* what http

Gambari, A.I, Falode, C O& Adegbenro, O.A (2014). Effectiveness of Computer animation and geometrical Instructional Model on Mathematics achievement and retention Among Junior Secondary School Students.*European Journal of Scienceand Mathematics Education*, l2(2), 67-76

Gay,L.R., Geoffrey, M.,Peter, W.A. (2009) . Educational research: *Competencies for analysis and applications (9th Ed.)*. Upper Saddle River, NJ: Merrill Prentice Hall.

Gibson, HL. & Chase, C(2002)." Longitudinal Impact of inquiry based science program on middle school students' attitude towards science."*Journal of science Education* .86, 693-705.

Gillman, L. (2001). The limit $\sin_x$Teaching of Mathematics 346-352

Gimba,R.W (2013). Effects of computer package on achievement, retention and interest in set theory among secondary school students in Niger State, unpublished M.ed Dissertation, and Department. of Educational Foundation and Curriculum, Faculty of Education. Ahmadu Bello University Zaria, Nigeria.

Gok, T.& Silay, I. (2010). The effects of problem solving strategies on students' Achievement Attitude and motivation Retrieved from*http://www. journallapen.org.mx*23/4/2018

Goodbey, S.I BarnettJ. &Webster, L. (2005). Electrifying science activities, 42(3), 26-30

Goodlad, J.I (2008). The nonnegotiable agenda In J.I Goodlad, R. Soder, & B. Mc Daniel (eds), *Education and the making of a democratic people* (pg 9-28) Boulder, C.O Paradigm Publishers

Heafner, L.A & Zembal-Saul, C. (2004)."Learning by doing? Prospective elementary teachers' developing Understanding of scientific inquiry and science teaching and learning". *International Journal of science Education,* 26(13), 1653-1674

Henderson, K.B. &Davis, E.J. (2005). *Teaching Mathematical Concepts Dynamics of Teaching Secondary School Mathematics*. Houghton: Boston.

Hernandez-Ramos, P. & De la Paz, S. (2009). Learning History in Middle School by designing multimedia in a project –based learning experience.*Journal of Research on Technology in Education*. 42,151-173.

Hickman, I.A. (2007). *Pragmatism as post modernism; lessons from Dewey.* NY, NY: fordhan University press

Howard, B (2005). Cooperative Learning Structures improve Performance and Attitudes of High School Journalism students (on-line www). Retrieved on may 1, 2012. Available; http://www.cooperativelearning.com kagar club /free articles.html.

HSU, E, Kysh, J. Ramage, K & Resek, D. (2009). Helping Teachers Un-structure A promising approach.*The Montana Mathematics Enthusiast* 6, 423-433.

Ibrahim, M.O & Busari, I.O (2016) Impact of Enriched lecture Method with Geo Trig metric sets on Academic Performance of Secondary School Students in Katsina state, Nigeria. The Proceeding of Annual Conference, Mathematical Association of Nigeria (MAN). pp. 16-24.

Ifeakor,A.C.(2003). Effect of Peer Assessment on Students Academic Achievement in Mathematics Education".*Knowledge Review a Multidisciplinary Journal*, 6(3), 139-144

Iji. C.O (2012). Using ICT in Teaching and Learning Process for functional Education for Nation. Building: Implication for University staff school Association of Nigeria.

Inah, L.I. (2014). Influence of activity method of teaching word problems in geometry on interest and academic achievement of senior secondary school students in Zaria Education Zone, Kaduna state, Nigeria pre-proposal Seminar Presentation, Department of Science Education. A.B.U Zaria.

Inekwe, O.I. (2002). Grammatical Stops Affecting Conceptualization in Ordinary Level Mathematics. *Journal of Science Teachers Association of Nigeria* (STAN)37 (1&2), 15-19.

Iwendi, B.C (2012). Effects of gender and age on the Mathematics achievement of Secondary School Students in Minna Metropolis, Nigeria".*JOSTMED*, 9(1), 215-223.

Jane, S.H & Janet, T.M. (2016). Gender, culture and Mathematics Performance. www.pnas.org/content/106/22/880/.full

Jong,O.D.,& Brinkman,F.,(2002). Teacher thinking and conceptual change in Science and Mathematics Education. *European journal of Teacher Education*, 20(2), 121-124

Kaino, L.M.(2012). Undergraduates Attitudes of the study of mathematics at the University of Swazi land. Paper presented to the Association of African Universities (AAU) Accra Ghana

Kajuru, Y.K & Kauru A.I. (2014).Effect of the 7E's Constructivist approach to Teaching Trigonometry on polytechnic students' Achievement and retention in Kaduna state, Nigeria. The *Journal of Mathematical Association of Nigeria*,39(1), 106-122

Kankia,A.O. (2008). Effectiveness of cooperative learning approach over lecture Method in learning Mathematics in overcrowded classes in Kaduna state secondary schools. *Abacus: Journal of mathematical Association of Nigeria* 33(1), 110-118

Kassim, A.O, Abisola, L.O & Adeyanju, H.I. (2011). Effects of Students' attitude and self concept on achievement in senior secondary school Mathematics Ogun state, Nigeria JORIND, 9(2), 202-211

Kauru, A.I . & Sodangi, U.M (2016). Effects of the 7E's constructivist approach to teaching elementary algebra on senior secondary school students' performance and retention in Kaduna education zone, Kaduna state, Nigeria. Proceedings of the 5th

Teaching and Learning in Africa Conference: Africa Forum of Teaching Regulatory Authorities, South Africa.

Kesan.C &Caliskan.S (2013). The effect of learning Geometry Topics of 7th Grade in Primary Education with dynamic Geometer's Sketchpad geometry Software to success and retention.*The Turkish on line Journal of Educational Technology*, 12(1), 131-140.

Klin, H & Noor, K. (2009). The Effect of Cooperative Learning Strategies towards Students' Mathematical Achievement and Attitude of Primary 5 Students in water village Primary Schools. M.Ed thesis submitted to University of Brunei Darussalam.

Kurumeh M.S. Jimin N & Mohammed, A.S (2012) Enhancing Senior Secondary Student's Achievement in Algebra Using Inquiry Method of Teaching in Onitsha Educational Zone of Anambra state, Nigeria. *Journal of Emerging Trends in Educational Research and Policy Studies (JETERAPS) 3(6), 863-868.*

Kurumeh, M.S (2006). Effect of Ethno- Mathematics Approach on Students' Achievement in Geometry and Mensuration.*Abacus, journal of mathematics Association of Nigeria* 31(1), 103-114.

Kurumeh, M.S. Onah, F.O. & Mohammed, A.S (2012) improving student's retention in Junior secondary school statistics using the Ethno- Mathematics teaching Approach in Obi and Oju Local Government Area of Benue state, Nigeria Greener *Journal of Educational Research,* 2(3), 54-62 www.gjournals.org

Lee, V.S. (Ed) (2004). *Teaching and Learning Through inquiry: A Guide book for Institution and Instructors*. Sterling, Virginia: Stylus

Liewelyn D (2005). *Teaching high school through inquiry A case study Approach.*Thousand Oaks: Corwin press.

Maduabum, M.A& Odili, G.A (2007). Trends in Males and Females Students Performance in Senior School Certificate Further Mathematics in Nigeria. *Journal of Mathematical Association of Nigeria,* 32(1), 115-123.

Martinello M.L & Cook G. (2000). *Interdisciplinary inquiry in teaching and learning 2nd ed.* Upper saddle River, NJ: Merril

Meriam Ismail,(2000)."The Effect of Teams – games-tournament (TGT) on the attitudes of year four students towards mathematics in SRK sekaan kecil,in the district of matu,Sarawak". *International conference on cooperative learning and constructivism in science and mathematics education proceedings* (pp.23-1to23-22)Penang:SEAMEO-RECSAM.

Miller, S.D. (2003). How high and low challenge Tasks affect motivation and learning. Implications forstrugglinglearnersreading and writing Quarterly, 191 39-57.

Moses M.T (2010)."Effect of Polya problem solving techniques on Secondary school students' Achievement in physics" *NASHER.* 8, 6-12

Nahuche T.H. (2001). Relationship between Students Personality Teachers Leadership preference and Academic Achievement of Secondary school students in Gusau''Unpublished M.ed Dissertation A.B.U Zaria

Nasir, .I. (2003). A Study of Education of Teaching of General Science at Secondary School: Level in GujarKhan Unpublished; M.AThesis International Islamic University Islamabad (Pakistan)

National Council of Teachers of Mathematics (2000).Curriculum and Evaluation Standards for School mathematics. Reston, V.A: NCTM

NationalExamination Council (2009). Chief Examiner' report, SSCE.June 2009.Abuja:FME

National Examination Council (2010). Chief Examiner' report, SSCE.June 2010.Abuja:FME

Nfon N.F (2013). Effect of problemsolving strategy on secondary school students Achievement in trigonometry classroom. *Journal of mathematics Education,* 6(1) 38-55.

Njoroge, H.N, Chnagerywo, J.M, & Ndrangu, M. (2014).Effects of inquiry based teaching approach on secondary school student's achievement and motivation in physics in Nyeri country, Kenya. *Internal journal of Academic Research in Educational and review*, 2(1), 1-16

Nneji S.O. (2013). Effect of polya George'sproblem –solvingmodel on students Achievement and Retention in Algebra".*Journal of Educational and Social Research,* l3(6), 99-107.

Nworgu,L.N.(2004). Effect of Gender Sensitisation of Sciences Teachers on Gender Gap in Science Achievement and Interest among Students An Unpublished Ph.D. Thesis, University of Nigeria, Nsukka.

Obeka, S.S. (2010). Effect of inquiry and demonstration methods on student's achievement and retention in some environmental education concepts of geography.*Journal of studies in science and mathematics Education,*1(1), 52-58

Obi, C.N,Agwagah U.N,V &Agah,J.J. (2014). Effect of Origamion Students Retention in Geometry.*Journal of Research and Method in Education,* 4(5), 46-50

Obodo, G.C (2007). Evaluation of available resources materials in secondary schools *InternationalJournal of Education Research,* (4), 62-69.

Obodo, G.C. (2004). *Principle and Practice of Mathematics Education in Nigeria*. Enugu: Academic Forum.

Odeyemi, J.O. (2004). Nature of Mathematics and its instructional problems.A valedictory lecture at institute of Education.University Ibadan, Nigeria.

Odili, G.A (2006).Mathematics in Nigeria secondary schools. A Teaching perspective port-Harcourt Anachuma Education Books.

Odogwu, N.W (2002). "The Mathematics teachers factor in achievement of the goals of Universal Basic Education". *Abacus. Journal of Mathematical Association of Nigeria,* 27(1&2), 72-79

Ogunyemi,O.O. (2010). Wood's Osbome parnes'Problem Solving Models and Students' learning outcomes in junior Secondary School SocialStudies. Unpublished M.Ed. Dissertation,Olabisi Onabanjo University, Ago- Imoye

Ojim, D.K & Nyim, S.P.(2012). A comparative study of the mean interest, achievement and retention scores of public and private schools student taught mathematics with CAI.http://www.scholar/ib.vt.edu/ejour/ijev/1472/haynie/.html

Okafor, C.C. &. Okeke, E.A. (2006). Concept mapping as an effective Technique for Teaching difficult concept in Biology. *Proceeding of 46th Annual Conference of Science Teachers Association of Nigeria,* 122-127

Okeke, E.C (2008).Classification and analysis of gender concepts. Fucus on Research, Reproductive Health Education and Gender *Sensitive* Classrooms. Ibadan, Nigeria: School Teacher Association of Nigeria. Gender and STM Education Series,2, 5-8.

Okereke S.C (2006). Effect of prior knowledge of implications of mathematical task/concepts to career types and gender on student achievement, interest and retention. In V. Nzewi (Ed) STAN of the 47th annual conference 253-259.

Olorundare, A.S (2007). Utilization of Information and Communication Technology (ICT) in D.N.Ezeh and Nkadi Onyegebu. *Curriculum Development, Implementation, Technology in the service of Education*. Enugu: Timex.

Olosunde, G.R & Olaleye. O.O. (2010). Effect of concrete mapping strategy on senior secondary school students' performance in mathematics. *Journal of Mathematics Science Education,* 1(1), 121-130

Oteze, I.K (2011). Mock Examination as a predictor of students' performance in Senior Secondary school certificate Examination. Mathematics for the Attainment of Millennium Development Goals.*Abacus the Journal of Mathematical Association of Nigeria,* 36(1), 18-26

Paul, N.K, Hwa, T.Y & Lau S.H (2007).Mathematical problem solving of for students proceeding of the redesigning pedagogy, culture, knowledge and understanding conference Singapore.

Piaget J. (1966). Cognitive Development Retrieved September 17 2012 from http:www.msu.edu.compeava/techorsop.html

Polya . G. (1973). *How to solve it (2nd ed)* Princeton, Ng: Princeton University press.

Popoola, A.A & Fijuyigbe. K.T. (2010). Effects of Activity-Based and Inquiry Methods on academic performance and attitude of junior secondary students towards computer science. *Annual National Conference of Mathematical Association of Nigeria* (MAN) 280-289.

Rohner, D.Taylor k. Pashler,H. Cepeda N.J&Wixted,J.T. (2005). Effect of over learning on long –term retention .Applied Cognitive Psychology, 19, 361.374.

Ryder, M. (2010). Constructivist models. Retrieved on 4/8/2015 from http//carbon.ucdenver.edu/-mryder/itc-data/idmodels.htm constructivism.

Sadi, M.S. (2014). Impact of cooperative learning strategies on remediating identified errors and academic performance in algebra among senior secondary school students in Kano, Nigeria PhD. Thesis, Ahmadu Bello University, Zaria. Nigeria

Salman,M.F. &Ameen, S.K. (2014). Comparative effects of two problem- Solving Models on Senior Secondary School Students Performance in Mathematics Word Problems. *Journal of the Mathematical Association of Nigeria (MAN)* 89, 1-13.

Sambo, A.A. (2005). *Research Methods in Education*. Lagos: Stirling-Horden Publisher (nig.)Ltd.

Samuelson, J. (2010). The impact of Teaching Approaches on Students' mathematical proficiency in Sweden. International Electronic *Journal of Mathematics Education-/£JME,* 5(2), 61-78

Scheonfield A. (2008). Mathematical problem solving Retrieved from http://www.gse.berkeley.edu/faculty/aschoenfeld.

Seyhan,H&Morgil, I. (2007). Effect of 5E Learning Model on teaching of acid-base topic in chemistry Education.*Journal of Science Education,* 8(2), 120-123

Shaffer,S.C(2006) 5E's of constructivism lesson plan http//www.miamisci.org/ph /ipintro.sehtml retrieved on May 11-2012

Smyth, J. (2000). Reclaiming social capital through critical teaching. *The Elementary school journal,*100(5), 49-511.

Stanley,M.(2008). Indoor and outdoor laboratory experience on secondary school students academic Achievement and retention in Ecology in Kaduna State. Unpublished M.Ed Thesis, ABU, Zaria

Steen, L.A (2003). Out from Under achievement, issue in science and Technology. http://www.issue.org.// 119.41 up data steen Html.

Stein, M.K (2001). Teaching and Learning Mathematics How instruction can faster the knowing and understanding of number.

Suleiman, B (2010). Effects of problem solving models on secondary school students' performance in statistics concepts of mathematics in Zamfara state, Nigeria A Ph.D Thesis submitted to Department of science education, University of Ilorin, Nigeria.

Tahir, N.F, Ismail, Z. Zamani, N.D & Adnan, N. (2010).Students Attitude towards mathematics; the use of factor Analysis in Determining the criteria.*Procedia social and Behaviour sciences,* 8, 476-481

Tekerek, M., Yeniterzi, B., & Ercan , O. (2011) Mathematics attitude of computer education and instructional technology students. *The Turkish Online Journal of Educational, 10(3), 168-174*

Tella, J. Indoshi, F.C. & Othuon, L.A. (2010). Relationship between students' perspectives on the secondary school English curriculum and their academic achievement in Kenya. *Journal of Educational Research,* 1(9),382-389.

Tenty. O.J. & Awe, U.L (2011) Pedagogy in secondary school mathematics http://www.mathsedu.org.com

Unodiaku, S.S (2015) Comparative study of mathematics potential of single sex secondary schools in Enugu state. *International Journal of Education. Micheal Okpara University of Agriculture, Umudike, (1) 121-128*

Usman, I.A. (2012). An explanation about testing retention of students after post test was administered. Institute of Education Ahmadu Bello University Zaria.

Usman, M.A & Musa, D.C (2015). Effect of Inquiry Teaching Method on Students' Achievement in Algebra in Bauchi LGA of Bauchi State, Nigeria. *Abacus, the journal of the Mathematical Association of Nigeria,* 40(1), 70-76.

Utley, J.G. (2007). Construction and Validity of Geometry Scales. *School Science and Mathematics*, 107, 89-93

Vygotsky, L.S (2005). Constructivism and its criticism examined by liu and Mathews. *Journal of Science Education and Technology*., 6(3), 386-399.

West African ExaminationCouncil (2007). Mathematics Chief Examiner's Reports Lagos.WAEC.

West African ExaminationCouncil (2011). Chief Examiner's Report Lagos. WAEC.

West African Examination Council (2014). Chief Examiner's Report Lagos. WAEC.

West African Examination Council (2015). Chief Examiner's Report Lagos. WAEC.

Wilson, B.G.(2005). Broadening our foundation for instructional design: Four pillars of practice. *Educational technology*,45(2), 10-15

Yusuf, M.O (2009) students' attitude towards mathematics in academic achievement in some selected schools in south western Nigeria. *European Journal of Scientific Research 36(3), 336-34*

Zamafara State Ministry of Education (2015). Department of Research and Statistics Unit

APPENDIX A

TRIGONOMETRY PERFORMANCE TEST (TPT)

Time 1hr

A. BIO-DATA

Fill appropriately

1. School:_____
2. Class: _____
3. Sex: _____

B. INSTRUCTION

Choose the correct alternatives by ticking or circling.

1. The angle of elevation of the top of a tree 39m away from a point on the ground is 30^0. Find the height of the tree.
   a. 22.52m
   b. 20.22m
   c. 21.23m
   d. 22.40m.
2. Find the value of x in the figure below

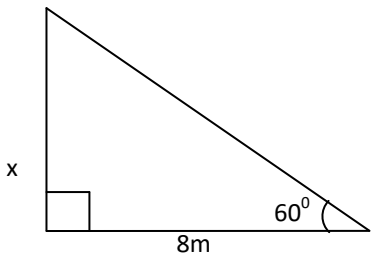


Figure i

   a. 13.86m
   b. 12.46m
   c. 17.32m
   d. 28.36m

3. An aircraft is circling an airport at a height of 600m, the navigator. If the angle of depression of the control tower of the airport is 12^0, what is the distance between the aircraft and the control tower?

   a. 2.886m

   b. 27.97m

   c. 28.97m

   d. 3.886m

4. A city K is 200km from a city T in the direction 080^0. What is the bearing of T from K?

   a. 260^0

   b. 200^0

   c. 080^0

   d. 120^0

5. In a right angle triangle ABC, [AB] = 15m and angle C is 30^0. Find the length of the hypotenuse AC.

   a. 30m

   b. 15m

   c. 20m

   d. 25m

6. A vertical pole 6m high cast a shadow 9m long at the same time that a tree cast a shadow xm long. Find the height of the tree.

   a. 18m

   b. 20m

   c. 30m

   d. 45m

Points X and Y are respectively 20km north and 9km east of a point O. Use this information to answer questions 7, 8 and 9.

7. What is the area of $\triangle$XOY in km^2

   a. $881km^2$

   b. $90km^2$

   c. $180km^2$

   d. $400km^2$

8. Find /XY/ to the nearest whole km.

   a. 17km

   b. 18km

   c. 21km

   d. 22km

9. Find the bearing of y from x to the nearest whole degree.
   a. 024^0
   b. 114^0
   c. 156^0
   d. 204^0

10. A ladder 8m long rests against a vertical wall. The angle of depression from the top of the ladder is 60^0. How far is the foot of the ladder from the wall?

    a. 40m

    b. 46m

    c. 69m

    d. 16m

11. If $\sin x = \frac{1}{q}$, which of the following is equal to tan x?

    a. $\frac{1}{\sqrt{q^2-1}}$

    b. $\frac{\sqrt{q^2-1}}{a}$

    c. $\frac{\sqrt{q^2+1}}{1}$

    d. $\frac{1}{\sqrt{q^2+1}}$

12. In a right angle triangle ABC, if angle C = 90^0, c = 10cm, a = 6cm and b = 8cm. Calculate A.

    a. 22.5m
    b. 20.22m
    c. 21.23m
    d. 22.40m

13. There are three observation towers E, F and G in a city. E is 8km on the bearing of 090^0 from F, G is 8km due south of F. Find the bearing of G from E.

    a. 135^0
    b. 180^0

    c. 225^0

    d. 315^0

14. In the diagram below, <PQS = 50^0, <PRS = 30^0, and /PR/ = 8cm. Find QS.

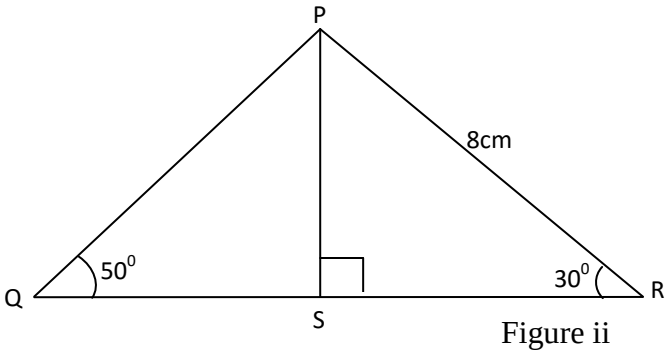


Figure ii

a. $8 \sin 30^0 \tan 50^0$

b. $\frac{8 \cos 30^0}{\tan 50^0}$

c. $\frac{\tan 50^0}{8 \cos 30}$

d. $\frac{\tan 50^0}{8 \sin 30}$

15. The angle of depression from the top of a building of height 30m of a stationary carts 41^0. Find the distance between the car and top of the building.

a. 44m

b. 45.7m

c. 49m

d. 50m

16. If cos$x$ is negative and sin x is negative, which of the following is true of$x$?

a. $0^0 < x < 90^0$

b. $90^0 < x < 180^0$

c. $180^0 < x < 270^0$

d. $270^0 < x < 360^0$

17. The bearing of Q from P is 122^0, what is the bearing of P from Q?

a. 302^0

b. 122^0

c. 360^0

d. 180^0

18. When an aero plane is 800m above the ground, its angle of elevation from point p on the ground is 30^0. How far is the aero plane from P?

    a. 400m

    b. 800m

    c. 500m

    d. 1600m.

19. What is the trigonometric ratio of sin 60^0?

    a. $\frac{1}{\sqrt{3}}$

    b. $\frac{1}{2}$

    c. $\frac{1}{\sqrt{2}}$

    d. $\frac{\sqrt{3}}{2}$

20. From the top of a building 10m high the angle of depression of a stone lying on the horizontal ground is 69^0. Calculate the distance of the stone from the foot of the building in metres to one decimal place.

    a. 36m

    b. 38m

    c. 60m

    d. 93m.

Points L and M are respectively 24m North and 7m East of a point N. Use the above information to answer questions 21 and 22.

21. Calculate /LM/ in metres

    a. 20m

    b. 24m

    c. 25m

    d. 31m.

22. What is the bearing of M from L to the nearest degree?

    a. 16^0

    b. 17^0

    c. 73^0

    d. 164^0

23. A triangular field has two sides 60m and 75m long and the angle between them is 102^0. How long is the third side?

a. 105m

b. 100m

c. 120m

d. 107m

24. Given that 3 sin x = 15, where $0^0 < x < 90^0$. Find x.

a. 27^0

b. 30^0

c. 45^0

d. 60^0

25. A man is at a point 18m away from the foot of a tree. From that point the angle of elevation on the top of the tree is 29^0. Calculate the height of the tree.

a. 9.9m

b. 8.9m

c. 7.9m

d. 6.9m

26. In a diagram below [BC] = 6cm, [AC] = 8cm and <ACB = 90^0. Find the side of <BAC

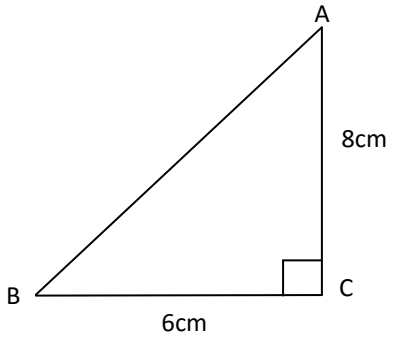


Figure iii

a. 37^0
b. 39^0
c. 53^0
d. 47^0

27. The bearing of R from P and Q are 330^0 and 240^0 respectively. If /PQ/ = 50km, calculate /QR/.

a. 20km

b. 25km

c. 30km

d. 40km

28. A cliff is 102m high; from the top of the cliff the angle of depression of a boat is 27^0. Find the distance of the boat from the foot of the cliff.

a. 104m

b. 114m

c. 200m

d. 244m.

29. Given that $\sin\theta = \frac{5}{12}$ and θ is an acute, find $\tan\theta$.

a. $\frac{13}{12}$

b. $\frac{5}{12}$

c. $\frac{12}{5}$

d. $\frac{12}{13}$

30. In a triangle $\triangle$ with /AB/ = 9cm, AC = 6cm, the sides AB and BC are produced to points Xand Y respectively such that <BXY = 62^0, <AYX = 53^0, calculate /BC/.

a. 18.6cm

b. 7.0cm

c. 6.6cm

d. 10.6cm.

31. In the second quadrant only _____ is positive

a. sine

b. cosine

c. tangent

d. cot.

32. The bearing of X from Y is 074^0, what is the bearing of 7 from X

a. 160^0

b. 148^0

c. 164^0

d. 254^0

33. A vertical pole is held in position by a wire 5.5m long. The wire slopes at 62^0 to the horizontal. Find the distance from the foot of the pole to the point where the wire is fixed to the ground.

a. 2.58m

b. 4.86m

c. 6.23m

d. 11.72m.

34. In PQR, R = 53^0, q = 3.6m, r = 4.3m, find Q

a. 42

b. 22^0

c. 40^0

d. 45^0

35. Find the angle of depression from the top of a tower 50m high of an object on the ground distance 70m from the root of the tower (correct to the nearest degree).

a. 50^0

b. 36^0

c. 70^0

d. 120^0

36. The sides of a triangle are 3cm, 4cm and 4cm, find the side of its smallest angle (correct to the nearest whole degree).

a. 22^0

b. 42^0

c. 44^0

d. 56^0

Use the information below to answer questions 37 and 38 in the diagram. /AB/ = 12cm, /BE/ = 8cm and = 30cm. BE and CD are perpendicular to the base ABC.

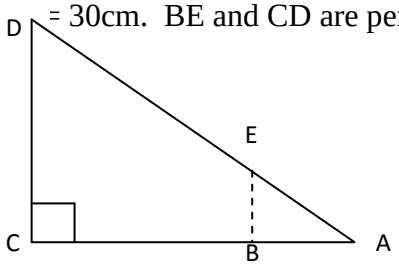


Figure IV

37. Find the length /BC/

a. 45cm

b. 33cm

c. 20cm

d. 8cm.

38. Find <CDA

a. 56.3^0

b. 53.2^0

c. 36.8^0

d. 33.7^0

39. Sin 240^0 is equal to

a. $\sqrt{3}$

b. $\frac{\sqrt{3}}{2}$

c. ½

d. $\frac{-\sqrt{3}}{2}$

40. If the shadow of a vertical pole 8m height is ½ its length, calculate the angle of elevation of the sun correct to the nearest degree.

a. 27^0

b. 37^0

c. 45^0

d. 63^0

41. By the Pythagoras Theorem in any right angle triangle

a. $(\text{Hypotenuse})^2 = (\text{Base})^2 + (\text{Perpendicular})^2$

b. $(\text{Perpendicular})^2 = (\text{Base})^2 + (\text{Hypotenuse})^2$

c. $(\text{Base})^2 = (\text{Hypotenuse})^2 + (\text{Perpendicular})^2$

d. $(\text{Hypotenuse})^2 = (\text{Base})^2 – (\text{Hypotenuse})^2$.

42. P is a point 2m above the ground and 15m away from a tower the angle of elevation on the top of the tower from P is 65^0. Calculate the height of the tower.

a. 8.33m

b. 15.59m

c. 32.17m

d. 34.17m.

43. The sides of a triangle are pcm, (p+7) cm and (p+8)cm. Find the length of the hypotenuse if its perimeter is 30cm.

a. 5cm

b. 6cm

c. 12cm

d. 13cm.

44. Which of the following do not form a Pythagorean triple?

i. 3, 4, 25 (ii) 12, 16, 20 (iii) 9, 12, 16

a. i and ii only
b. ii and iii only
c. i and iii only
d. i, ii and iii only.

45. If $r^2 = p^2 + q^2$ where r = 10 and p = 8, find q

a. 6.1

b. -6

c. 6

d. 9

46. Calculate the length of the altitude of an isosceles triangle whose base is 24cm long and whose equal sides are 13cm long.

a. 5cm

b. 24cm

c. 12cm

d. 13cm

47. In the diagram below, solve for the value of /SR/.

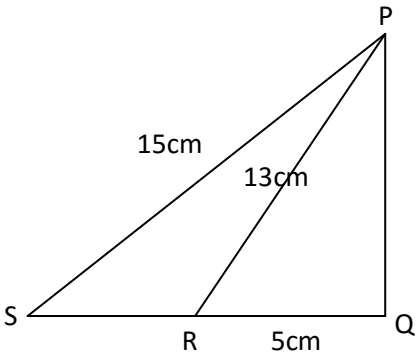


Figure V

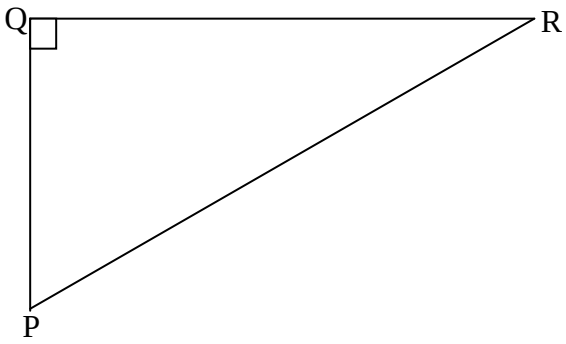
a. 4cm

b. 15cm

c. 13cm

d. 5cm

48. In a right angle triangle PQR shown below sin R equals



a. sın p

b. cos p

c. tan p

d. cos R.

49. A ladder which is 13m long made to rest on a vertical pole, which is 5m away from the foot of the ladder. How far up the pole is the ladder?

a. 65m

b. 12m

c. 7m

d. 18m.

50. From the top of a building a boy is watching a lizard on the ground. If the angle of depression of the lizard is 45^0 and lizard is 15m away from the building, how tall is the building to the nearest meters?

a. 65m

b. 15m

c. 25m

d. 10m.

APPENDIX B

MARKING SCHEME FOR TRIGONOMETRY PERFORMANCE TEST

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

Total =1mark× 50 =50 marks

Appendix C

TRIGONOMETRY RETENTION TEST (TRT)

Time: 1hr

A. BIO-DATA

Fill appropriately

1. School:_____
2. Class: _____
3. Sex: _____

B. INSTRUCTION

Choose the correct alternatives by ticking or circling.

1. In the second quadrant only _____ is positive
   a. sine
   b. cosine
   c. tangent
   d. cot.
2. The bearing of X from Y is 074^0, what is the bearing of 7 from X
   a. 160^0
   b. 148^0
   c. 164^0
   d. 254^0
3. A vertical pole is held in position by a wire 5.5m long. The wire slopes at 62^0 to the horizontal. Find the distance from the foot of the pole to the point where the wire is fixed to the ground.
   a. 2.58m
   b. 4.86m
   c. 6.23m
   d. 11.72m.
4. In $\triangle$PQR, R = 53^0, q = 3.6m, r = 4.3m, find Q
   a. 42
   b. 22^0
   c. 40^0
   d. 45^0

5. Find the angle of depression from the top of a tower 50m high of an object on the ground distance 70m from the root of the tower (correct to the nearest degree).

   a. 50^0

   b. 36^0

   c. 70^0

   d. 120^0

6. The sides of a triangle are 3cm, 4cm and 4cm, find the side of its smallest angle (correct to the nearest whole degree).

   a. 22^0

   b. 42^0

   c. 44^0

   d. 56^0

Use the information below to answer questions 7 and 8 in the diagram. /AB/ = 12cm, /BE/ = 8cm and /CD/ m. BE and CD are perpendicular to the base ABC.

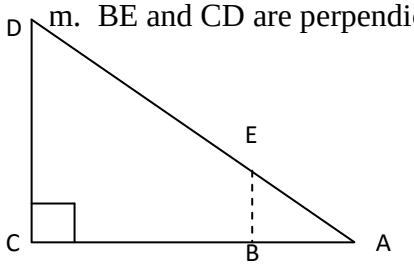


Figure I

7. Find the length /BC/

   a. 45cm

   b. 33cm

   c. 20cm

   d. 8cm.

8. Find <CDA

   a. 56.3^0

   b. 53.2^0

   c. 36.8^0

   d. 33.7^0

9. Sin 240^0 is equal to

   a. $\sqrt{3}$

   b. $\frac{\sqrt{3}}{2}$

   c. ½

   d. $\frac{-\sqrt{3}}{2}$

10. If the shadow of a vertical pole 8m height is ½ its length, calculate the angle of elevation of the sun correct to the nearest degree.

   a. 27^0

   b. 37^0

   c. 45^0

   d. 63^0

11. By the Pythagoras Theorem in any right angle triangle

   a. $(\text{Hypotenuse})^2 = (\text{Base})^2 + (\text{Perpendicular})^2$

   b. $(\text{Perpendicular})^2 = (\text{Base})^2 + (\text{Hypotenuse})^2$

   c. $(\text{Base})^2 = (\text{Hypotenuse})^2 + (\text{Perpendicular})^2$

   d. $(\text{Hypotenuse})^2 = (\text{Base})^2 – (\text{Hypotenuse})^2$.

12. P is a point 2m above the ground and 15m away from a tower the angle of elevation on the top of the tower from P is 65^0. Calculate the height of the tower.

   a. 8.33m

   b. 15.59m

   c. 32.17m

   d. 34.17m.

13. The sides of a triangle are pcm, (p+7) cm and (p+8)cm. Find the length of the hypotenuse if its perimeter is 30cm.

   a. 5cm
   b. 6cm
   c. 12cm
   d. 13cm.

14. Which of the following do not form a Pythagorean triple?

   i. 3, 4, 25 (ii) 12, 16, 20 (iii) 9, 12, 16

   a. i and ii only

   b. ii and iii only

   c. i and iii only

   d. i, ii and iii only.

15. If $r^2 = p^2 + q^2$ where r = 10 and p = 8, find q

a. 6.1

b. -6

c. 6

d. 9

16. Calculate the length of the altitude of an isosceles triangle whose base is 24cm long and whose equal sides are 13cm long.

a. 5cm

b. 24cm

c. 12cm

d. 13cm

17. In the diagram below, solve for the value of /SR/.

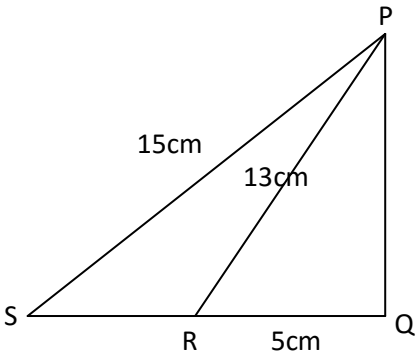


Figure II

a. 4cm

b. 15cm

c. 13cm

d. 5cm

18. In a right angle triangle PQR shown below sin R equals

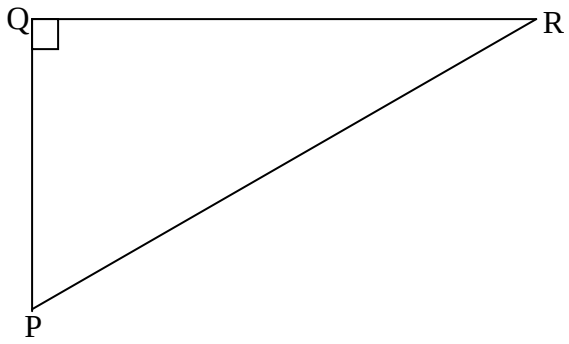


Figure III

a. sin p
b. cos p
c. tan p
d. cos R.

19. A ladder which is 13m long made to rest on a vertical pole, which is 5m away from the foot of the ladder. How far up the pole is the ladder?
    a. 65m
    b. 12m
    c. 7m
    d. 18m.

20. From the top of a building a boy is watching a lizard on the ground. If the angle of depression of the lizard is 45^0 and lizard is 15m away from the building, how tall is the building to the nearest meters?
    a. 65m
    b. 15m
    c. 25m
    d. 10m.

21. The angle of elevation of the top of a tree 39m away from a point on the ground is 30^0. Find the height of the tree.
    a. 22.52m
    b. 20.22m
    c. 21.23m
    d. 22.40m.

22. Find the value of x in the figure below

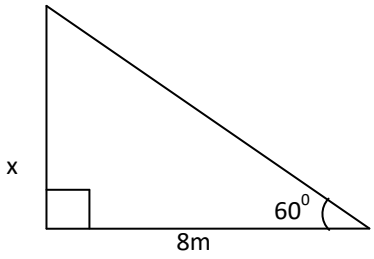


Figure IV

a. 13.86m
b. 12.46m
c. 17.32m
d. 28.36m

23. An aircraft is circling an airport at a height of 600m, the navigator. If the angle of depression of the control tower of the airport is 12^0, what is the distance between the aircraft and the control tower?

a. 2.886m
b. 27.97m
c. 28.97m
d. 3.886m

24. A city K is 200km from a city T in the direction 080^0. What is the bearing of T from K?

a. 260^0
b. 200^0
c. 080^0
d. 120^0

25. In a right angle triangle ABC, [AB] = 15m and angle C is 30^0. Find the length of the hypotenuse AC.

a. 30m
b. 15m
c. 20m
d. 25m

26. A vertical pole 6m high cast a shadow 9m long at the same time that a tree cast a shadow xm long. Find the height of the tree.

a. 18m
b. 20m
c. 30m
d. 45m

Points X and Y are respectively 20km north and 9km east of a point O. Use this information to answer questions 27, 28 and 29.

27. What is the area of $\triangle$XOY in km^2

a. 881km^2

b. 90km^2

c. 180km^2

d. 400km^2

28. Find /XY/ to the nearest whole km.

a. 17km

b. 18km

c. 21km

d. 22km

29. Find the bearing of y from x to the nearest whole degree.

a. 024^0

b. 114^0

c. 156^0

d. 204^0

30. A ladder 8m long rests against a vertical wall. The angle of depression from the top of the ladder is 60^0. How far is the foot of the ladder from the wall?

a. 40m

b. 46m

c. 69m

d. 16m

31. If $\sin x = \frac{1}{q}$, which of the following is equal to tan x?

a. $\frac{1}{\sqrt{q^2-1}}$

b. $\frac{\sqrt{q^2-1}}{a}$

c. $\frac{\sqrt{q^2+1}}{1}$

d. $\frac{1}{\sqrt{q^2+1}}$

32. In a right angle triangle ABC, if angle C = 90^0, c = 10cm, a = 6cm and b = 8cm. Calculate A.

a. 22.5m
b. 20.22m
c. 21.23m
d. 22.40m

33. There are three observation towers E, F and G in a city. E is 8km on the bearing of 090^0 from F, G is 8km due south of F. Find the bearing of G from E.

a. 135^0
b. 180^0
c. 225^0
d. 315^0

34. In the diagram below, <PQS = 50^0, <PRS = 30^0, and /PR/ = 8cm. Find QS.

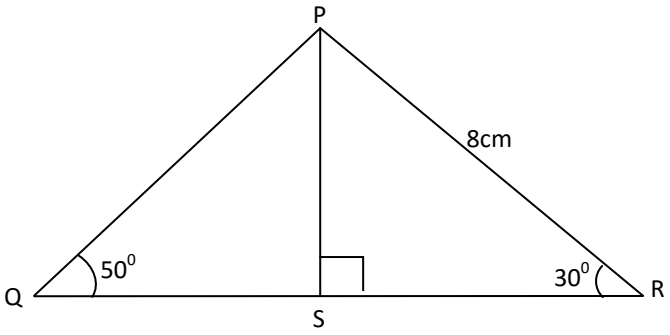


Figure V

a. $8 \sin 30^0 \tan 50^0$
b. $\frac{8 \cos 30^0}{\tan 50^0}$
c. $\frac{\tan 50^0}{8 \cos 30}$
d. $\frac{\tan 50^0}{8 \sin 30}$

35. The angle of depression from the top of a building of height 30m of a stationary carts 41^0. Find the distance between the car and top of the building.

a. 44m
b. 45.7m
c. 49m
d. 50m

36. If cos$x$ is negative and sin x is negative, which of the following is true of$x$?

a. $0^0 < x < 90^0$
b. $90^0 < x < 180^0$
c. $180^0 < x < 270^0$
d. $270^0 < x < 360^0$

37. The bearing of Q from P is 122^0, what is the bearing of P from Q?

a. 302^0

b. 122^0

c. 360^0

d. 180^0

38. When an aero plane is 800m above the ground, its angle of elevation from point p on the ground is 30^0. How far is the aero plane from P?

a. 400m

b. 800m

c. 500m

d. 1600m.

39. What is the trigonometric ratio of sin 60^0?

a. $\frac{1}{\sqrt{3}}$

b. $\frac{1}{2}$

c. $\frac{1}{\sqrt{2}}$

d. $\frac{\sqrt{3}}{2}$

40. From the top of a building 10m high the angle of depression of a stone lying on the horizontal ground is 69^0. Calculate the distance of the stone from the foot of the building in metres to one decimal place.

a. 36m

b. 38m

c. 60m

d. 93m.

Points L and M are respectively 24m North and 7m East of a point N. Use the above information to answer questions 41 and 42.

41. Calculate /LM/ in metres

a. 20m

b. 24m

c. 25m

d. 31m.

42. What is the bearing of M from L to the nearest degree?

a. 16^0

b. 17^0

c. 73^0

d. 164^0

43. A triangular field has two sides 60m and 75m long and the angle between them is 102^0. How long is the third side?

a. 105m

b. 100m

c. 120m

d. 107m

44. Given that 3 sin x = 15, where $0^0 < x < 90^0$. Find x.

a. 27^0

b. 30^0

c. 45^0

d. 60^0

45. A man is at a point 18m away from the foot of a tree. From that point the angle of elevation on the top of the tree is 29^0. Calculate the height of the tree.

a. 9.9m

b. 8.9m

c. 7.9m

d. 6.9m

46. In a diagram below [BC] = 6cm, [AC] = 8cm and <ACB = 90^0. Find the side of <BAC

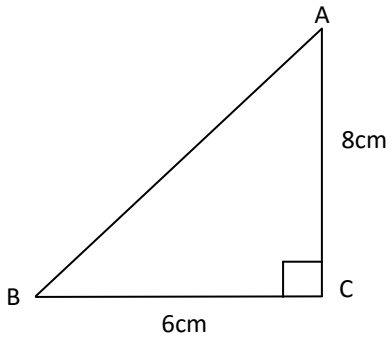


Figure VI

a. 37^0

b. 39^0

c. 53^0

d. 47^0

47. The bearing of R from P and Q are 330^0 and 240^0 respectively. If /PQ/ = 50km, calculate /QR/.

a. 20km
b. 25km
c. 30km
d. 40km

48. A cliff is 102m high; from the top of the cliff the angle of depression of a boat is 27^0. Find the distance of the boat from the foot of the cliff.

a. 104m
b. 114m
c. 200m
d. 244m.

49. Given that $\sin\theta = \frac{5}{12}$ and θ is an acute, find $\tan\theta$.

a. $\frac{13}{12}$
b. $\frac{5}{12}$
c. $\frac{12}{5}$
d. $\frac{12}{13}$

50. In a triangle $\triangle$ with /AB/ = 9cm, AC = 6cm, the sides AB and BC are produced to points Xand Y respectively such that <BXY = 62^0, <AYX = 53^0, calculate /BC/.

a. 18.6cm
b. 7.0cm
c. 6.6cm
d. 10.6cm

APPENDIX D

MARKING SCHEME FOR TRIGONOMETRY RRTENTION TEST

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

Total = 1mark $\times$ 50 $=$ 50$marks$

Appendix E

TRIGONOMETRY ATTITUDE SCALE (TAS)

This questionnaire is for academic research purpose. The questionnaire aimed at getting information on attitude of students towards Trigonometry. In view of this you are assured that your kind response would be treated confidently.

Thank you in advance for your cooperation. Please response by ticking(√)the appropriate response.

SECTION A: Participants profile

Name of School:-_____

Class: _____

Gender: Female ( ) Male ( ) Education Zone _____

	Respond by ticking the appropriate CSA= strongly agree, A= agree N= neutral, D= disagree, SD= strongly disagree					
S/N	**QUESTION ITEMS**					
	SECTION B Confidence in Learning Trigonometry	**SA**	**A**	**N**	**D**	**SD**
1	I often have trouble solving trigonometry problems.					
2	I am confident I can get good grades in trigonometry.					
3	I lack confidence in my ability to solve trigonometry problems					
4	Trigonometry problems often scare me					
5	Trigonometry test usually seen difficult					
6	I have a lot of confidence when I comes to studying trigonometry					
7	Spend a lot of time on study of trigonometry concept but often forget what I learnt					

Section C Interest in Learning Trigonometry

1	I am sure that I can learn trigonometry concepts					
2	Trigonometry is not a practical subject to study					
3	When I can't figure out a trigonometry problem, I feel as if am lost and can't find my way out.					
4	Trigonometry has many interesting topics to study					
5	I can usually make sense of trigonometry concepts					
6	Trigonometry is a practical subject					

	to study.					
7	I often see trigonometry in everyday thing					
8	When I leave class with trigonometry question unanswered, I continue to think about it					
9	I just try to get my homework done for trigonometry class in order to get a grade					
10	I attend trigonometry class with zeal and regularly.					
11	Working out trigonometry problems does not appeal to me					

Section D Enjoyment in Learning Trigonometry

1	Trigonometry problems are boring					
2	Time drags during trigonometry class					
3	When I start solving a Trigonometry problem, I find it hard to stop working on it.					
4	Trigonometry is fun					
5	Solving trigonometry problems is enjoyable					
6	I can see ways of using trigonometry concepts to solve everyday problems					

Section E Usefulness of Trigonometry

1	I believe that I will need trigonometry for my future.					
2	Trigonometry has no relevance in my life.					
3	I will not need trigonometry for my future					
4	I think knowledge of trigonometry is not useful					
5	I will need a firm understanding of trigonometry in my future work.					
6	I do not expect to use trigonometry when I get out of school					
7	Trigonometry is not worthwhile to study					

Source: Fennema and -Sherman (1976), Utley (2007)

APPENDIX F

DEPARTMENT OF SCIENCE EDUCATION
AHMADU BELLO UNIVERSITY ZARIA

Vice Chancellor: ***Professor Abdullahi Mustapha*** *B.Sc(Hons)Pharm(ABU), Ph.D(London) FPSN*
Head of Department: ***Dr. Mamman Musa*** *B.Ed, M.Ed, Ph.D (ABU, FMAN, FANE, DAC.*

Your Ref:
Our Ref: DSE/R/I/Vol.1 ***Date:*** 25/02/2015

TO THE HONOURABLE
COMMISSIONER OF EDUC
MINISTRY OF EDUCATION
ZAMFARA STATE

Dear Sir/Madam,

AN INTRODUCTORY LETTER TO ACCESS RESEARCH DATA

This is to introduce the bearer, GANIYATU ALIYU, with registration number Phd/EDUC/7025/11-12, as one of our Ph.d Science Education students who is conducting a research on the topic: IMPACT OF INQUIRY METHOD AND PROBLEM SOLVING METHOD ON STUDENTS ACADEMIC PERFORMANCE, RETENTION AND ATTITUDE TOWARDS GEOMETRY IN SENIOR SECONDARY SCHOOLS STUDENTS IN ZAMFARA STATES.

Please accept our sincere thanks in advance for your kind action.

DGPA
DSS
Attend to the bearer accordingly.
9/10/15

Yours faithfully,

Dr. Mamman Musa
Head, Science Education Department

APPENDIX G

MINISTRY OF EDUCATION, GUSAU

ZAMFARA STATE OF NIGERIA

J.B Yakubu Secretariat, P.M.B 1034 Gusau, Zamfara State.
Tel: 063-200046, 201720, 204662

*Our Ref:*_____ *Date:* 19/10/2017

The Principal,

LETTER OF INTRODUCTION

The bearer of this Letter Ganiyatu Aliyu is conducting a Phd research on Mathematics (Trigonometry).

In view of this she is going to conduct a practical exercise in your school.

Please give her any necessary assistance.

09/10/2017

DSS
Director Senior Secondary School
For: Hon. Commissioner.

APPENDIX H

IMPACT OF INQUIRY AND PROBLEM - SOLVING METHODS ON STUDENTS' ATTITUDES, RETENTION, AND PERFORMANCE IN TRIGONOMETRY AMONG SENIOR SECONDARY SCHOOLS IN ZAMFARA STATE, NIGERIA

By

Vetted & certified
13/05/2017

Ganiyatu ALIYU

B.Sc Ed (Mathematics), 2000
M.Ed Mathematics Education, 2009
PhD/EDUC/7025/2011-2012

SUPERVISORS

Prof.Y.K.Kajuru
Prof. C. Bolaji
Dr. M. Musa.

2017

TRIGONOMETRY PERFORMANCE TEST (TPT) FOR PRE-TEST

A. BIO-DATA

Fill appropriately

1. School: _____
2. Class: _____
3. Sex: _____

B. INSTRUCTION

Choose the correct alternative by ticking or circling.

1. The angle of elevation of the top of a tree 39m away from a point on the ground is 30^0. Find the height of the tree.
   a. 22.52m
   b. 20.22m
   c. 21.23m
   d. 22.40m.
2. Find the value of x in the figure below

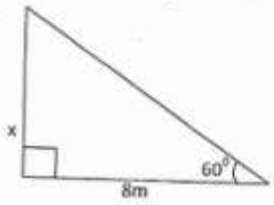


Figure i

   a. 13.86m
   b. 12.46m
   c. 17.32m
   d. 28.36m

3. An aircraft is circling an airport at a height of 600m, the navigator. If the angle of depression of the control tower of the airport is 12^0, what is the distance between the aircraft and the control tower?
   a. 2.886m
   b. 27.97m

27. The bearing of R from P and Q are 330^0 and 240^0 respectively. If /PQ/ = 50km, calculate /QR/.

a. 20km

b. 25km

c. 30km

d. 40km

28. A cliff is 102m high; from the top of the cliff the angle of depression of a boat is 27^0. Find the distance of the boat from the foot of the cliff.

a. 104m

b. 114m

c. 200m

d. 244m.

29. Given that $\sin\theta = \frac{5}{12}$ and θ is an acute, find $\tan\theta$.

a. $\frac{13}{12}$

b. $\frac{5}{12}$

c. $\frac{12}{5}$

d. $\frac{12}{13}$

30. In a triangle $\triangle$ with /AB/ = 9cm, AC = 6cm, the sides AB and BC are produced to points X and Y respectively such that $< BXY = 62^0$, $< AYX = 53^0$, calculate /BC/.

a. 18.6cm

b. 7.0cm

c. 6.6cm

d. 10.6cm.

31. In the second quadrant only _____ is positive

a. sine

b. cosine

c. tangent

d. cotangent

d. 13cm

47. In the diagram below, solve for the value of /SR/.

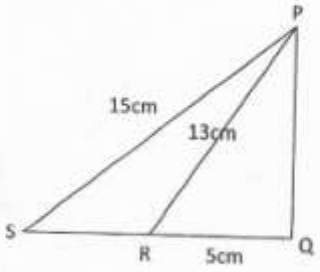
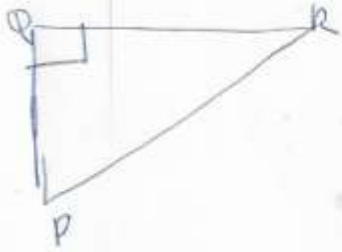


Figure V

a. 4cm
b. 15cm
c. 13cm
d. 5cm

48. In a right angle triangle PQR shown below, sin R equals





a. sin p
b. cos p
c. tan p
d. cos R.

49. A ladder which is 13m long made to rest on a vertical pole, which is 5m away from the foot of the ladder. How far up the pole is the ladder?

a. 65m
b. 12m
c. 7m
d. 18m.

APPENDIX: G

TRIGONOMETRY ATTITUDE SCALE (TAS)

SECTION: 1

This questionnaire is for the academic research purpose. The questionnaire aimed at getting information on attitude of students towards Trigonometry. In view of this you are assured that your kind response would be treated confidently.

Thank you in advance for your cooperation. Please response by ticking (✓) the appropriate response.

SECTION: A : Participants profile

Name of School:-_____

Class: _____

Gender: Female ( ) Male ( )

	Respond by ticking the appropriate SA= strongly agree, A= agree N= neutral, D= disagree, SD= strongly disagree					
S/N	**QUESTIONS ITEM**					
	SECTION B	**SA**	**A**	**N**	**D**	**SD**
1	I am sure that I can learn trigonometry concepts In					
2	I believe that I will need trigonometry for my future. U					
3	Trigonometry problems are boring Interest E					
4	I often have trouble solving trigonometry problems. C In					
5	Time drags during trigonometry class E Inte					
6	I am confident I can get good grades in trigonometry. C					
7	When I start solving a Trigonometry problem, I find it hard to stop working on it. E					
8	Trigonometry has no relevance in my life. U					
9	Trigonometry is fun E					
10	Trigonometry is not a practical subject to study U Int					
11	I lack confidence in my ability to solve trigonometry problems C					
12	When I can't figure out a trigonometry problem, I feel as if am lost and can't find my way out. C Int					
13	Trigonometry problems often scare me C					
14	Solving trigonometry problems is enjoyable E					

APPENDIX I

RELIABILITY OF THE RESEARCH INSTRUMENTS

A. Test Instrument

The test re test method (measure of stability) of reliability estimate was used in this study to arrive at the Reliability Coefficient.

```
CORRELATIONS
  /VARIABLES=test retest
  /PRINT=TWOTAIL NOSIG
  /STATISTICS DESCRIPTIVES
  /MISSING=PAIRWISE.
```

Correlations

```
[DataSet0]
```

Descriptive Statistics

	Mean	Std. Deviation	N
test	20.40	2.973	45
retest	20.56	3.027	45

Correlations

		Test	retest
test	Pearson Correlation	1	.682**
	Sig. (2-tailed)		.000
	N	45	45
retest	Pearson Correlation	.682**	1
	Sig. (2-tailed)	.000	
	N	45	45

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

```
CORRELATIONS
  /VARIABLES=retentiontest retentionretest
  /PRINT=TWOTAIL NOSIG
  /STATISTICS DESCRIPTIVES
  /MISSING=PAIRWISE.
```

Correlations

```
[DataSet0]
```

Descriptive Statistics

	Mean	Std. Deviation	N
Retentiontest	20.60	3.271	45
Retentionretest	19.89	3.178	45

Correlations

		retentiontest	retentionretest
retentiontest	Pearson Correlation	1	.833**
	Sig. (2-tailed)		.000
	N	45	45
retentionretest	Pearson Correlation	.833**	1
	Sig. (2-tailed)	.000	
	N	45	45

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

B. Trigonometry Attitude Scale

The Cronbach alpha method (measure of internal consistency) of reliability estimate was used in this study to compare the reliability coefficient for the questionnaire using statistical package for the social sciences (SPSS) as Shown in the computer printout

```
RELIABILITY
  /VARIABLES=q1 q2 q3 q4 q5 q6 q7 q8 q9 q10 q11 q12 q13 q14 q15 q16 q17
q18 q19 q20 q21 q22 q23 q24 q25 q26 q27 q28 q29 q30 q31 q32
  /SCALE('ALL VARIABLES') ALL
  /MODEL=ALPHA
  /STATISTICS=DESCRIPTIVE SCALE CORR
  /SUMMARY=TOTAL CORR.
```

Reliability

```
[DataSet0] C:\Users\umar\Documents\Ganiyat Reliability.sav
```

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	44	97.8
	Excluded[a]	1	2.2
	Total	45	100.0

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

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.784	.783	32

Item Statistics

	Mean	Std. Deviation	N
q1	4.14	.795	44
q2	3.75	.991	44
q3	3.30	1.193	44
q4	3.36	1.123	44
q5	3.89	1.185	44
q6	4.16	.963	44
q7	3.43	1.319	44
q8	3.05	1.180	44
q9	3.05	1.346	44
q10	2.84	1.363	44
q11	3.55	1.337	44
q12	3.64	1.183	44
q13	3.23	1.379	44
q14	3.68	1.343	44
q15	3.43	1.404	44
q16	3.61	1.298	44
q17	3.64	1.241	44
q18	2.75	1.123	44
q19	3.55	1.210	44
q20	3.93	1.169	44
q21	3.82	1.063	44
q22	2.89	1.061	44
q23	2.86	1.407	44
q24	3.39	1.243	44
q25	3.91	1.096	44
q26	3.05	1.329	44
q27	3.80	1.212	44
q28	4.05	1.011	44
q29	3.91	1.096	44
q30	3.68	1.177	44
q31	3.77	1.292	44
q32	3.64	1.241	44

Summary Item Statistics

	Mean	Minimum	Maximum	Range	Maximum / Minimum	Variance	N of Items
Inter-Item Correlations	.101	-.348	.576	.923	-1.657	.031	32

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
q1	108.57	187.507	.251	.847	.780
q2	108.95	186.510	.226	.810	.780
q3	109.41	178.294	.436	.818	.771
q4	109.34	183.997	.274	.817	.778
q5	108.82	184.710	.233	.757	.780
q6	108.55	187.789	.185	.826	.782
q7	109.27	182.203	.271	.840	.779
q8	109.66	185.811	.199	.856	.782
q9	109.66	182.695	.250	.925	.780
q10	109.86	184.353	.200	.868	.782
q11	109.16	182.649	.254	.751	.780
q12	109.07	186.809	.167	.854	.783
q13	109.48	184.395	.195	.798	.783
q14	109.02	180.162	.323	.863	.776
q15	109.27	179.366	.326	.925	.776
q16	109.09	179.433	.359	.901	.774
q17	109.07	185.507	.194	.901	.782
q18	109.95	183.440	.293	.881	.778
q19	109.16	180.555	.357	.879	.775
q20	108.77	179.575	.404	.834	.773
q21	108.89	182.010	.365	.832	.775
q22	109.82	189.362	.107	.701	.785
q23	109.84	176.137	.415	.843	.771
q24	109.32	179.245	.385	.828	.773
q25	108.80	186.306	.204	.695	.781
q26	109.66	182.649	.256	.815	.779
q27	108.91	183.573	.261	.822	.779
q28	108.66	186.974	.203	.877	.781
q29	108.80	180.957	.388	.901	.774
q30	109.02	184.627	.238	.779	.780
q31	108.93	176.670	.445	.889	.770
q32	109.07	180.623	.343	.829	.775

Scale Statistics

Mean	Variance	Std. Deviation	N of Items
112.70	193.608	13.914	32

Appendix J

Id	1	2	3	4	5	6	7	8	9	10	40	41	42	43	44	45	49	50	tottal
1	1	1	1	0	1	0	1	1	1	1	0	1	1	1	1	0	1	0	30
2	1	0	1	1	1	1	1	1	1	1	1	0	1	0	1	1	1	0	28
3	0	1	1	0	0	1	1	0	1	1	0	1	1	0	0	1	0	0	28
4	1	0	0	0	1	0	1	1	0	0	1	1	0	0	1	1	0	1	27
5	1	0	1	1	1	0	1	0	1	1	1	1	0	1	1	0	1	0	27
6	1	1	1	1	1	0	0	0	0	1	1	0	0	1	1	1	0	1	26
7	1	0	0	1	1	0	1	0	1	1	0	1	0	1	1	1	0	0	25
8	1	0	0	0	1	0	0	1	0	0	1	0	0	0	1	0	1	0	24
9	0	0	1	0	0	1	1	1	1	1	0	0	0	0	1	1	1	1	24
10	0	0	1	1	1	0	1	1	0	0	0	1	0	1	1	1	1	1	24
11	0	1	1	1	1	0	1	1	0	1	0	0	0	0	0	1	1	0	23
12	1	1	1	1	0	0	0	1	1	1	0	0	1	0	0	1	1	1	23
13	1	0	1	1	1	0	0	1	0	1	0	1	0	0	1	0	0	0	22
14	1	0	1	1	1	0	1	1	1	0	1	0	0	1	0	1	0	0	22
	D	B	A	A	A	A	A	A	A	C	B	A	A	C	A	C	A	D	D	
Correct	10	5	9	7	9	3	9	8	7	9	5	6	4	5	9	9		8	5	
Wrong	4	7	3	5	3	9	3	4	5	3	7	6	8	7	3	3		4	7	
%correct	71	36	64	50	64	21	64	57	50	64	36	43	29	36	64	64		57	36	
%wrong	29	50	21	36	21	64	21	29	36	21	50	43	57	50	21	21		29	50	

15	1	1	1	0	0	1	0	0	1	0	0	1	0	0	1	0		1	0	22
16	1	0	1	1	1	1	0	0	1	1	0	0	0	0	0	1		0	0	21
17	1	0	0	1	0	0	1	0	0	1	1	0	0	0	0	0		0	0	21
18	0	1	0	1	0	0	1	0	1	1	0	0	0	1	0	1		0	0	21
19	0	0	1	0	1	0	1	0	0	1	0	1	0	1	0	0		1	0	21
20	1	0	1	0	1	0	0	1	0	1	0	1	0	1	0	1		1	0	21
21	0	0	0	1	1	1	0	0	0	1	0	1	1	0	0	1		0	0	21
22	1	0	1	1	1	0	0	1	1	0	0	0	0	0	1	0		0	0	20
23	1	0	0	1	1	0	1	1	0	0	0	0	0	1	1	1		1	0	20
24	0	0	0	1	1	0	1	0	0	0	1	1	1	1	1	1		1	1	20
25	0	1	0	1	0	1	1	0	0	1	0	1	0	0	1	0		0	0	20
26	0	1	1	0	1	1	1	0	1	0	0	0	1	0	0	0		0	0	20
27	0	0	1	0	1	0	1	0	1	0	0	0	0	0	1	0		1	0	20
28	1	0	0	0	1	0	0	0	1	1	0	1	0	0	0	1		1	0	19
29	0	0	0	1	0	1	0	1	0	0	0	0	0	0	1	0		0	1	19
30	1	0	1	0	0	0	1	0	0	0	1	0	1	0	1	1		0	1	19
31	1	1	1	0	0	0	0	1	0	0	0	0	1	0	0	1		0	0	19
	D	B	A	A	A	A	A	A	A	C	B	A	A	C	A	C	A	D	D	

32	1	1	0	1	1	0	1	0	1	0	1	0	0	0	0	0		0	0	19
33	0	0	0	1	1	0	0	1	1	0	0	0	1	0	1	1		1	0	18
34	1	1	1	0	1	1	1	0	0	0	0	1	1	0	0	0		0	1	18
35	1	0	1	1	0	1	1	1	0	1	0	0	1	0	0	1		0	0	18
36	1	0	0	0	1	0	0	0	1	0	0	0	0	1	0	0		0	1	18
37	1	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1		0	0	18
38	0	1	0	0	1	0	1	0	1	0	0	0	0	1	0	0		0	0	18
39	0	0	0	1	0	0	1	0	1	0	0	1	0	0	0	0		0	0	18
40	0	0	0	1	0	0	0	1	1	0	0	0	0	0	1	0		0	0	18
41	1	0	0	0	1	0	0	0	1	0	0	0	0	0	1	1		0	0	17
42	0	0	0	0	1	0	1	0	0	0	1	0	1	0	1	0		0	0	17
43	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	1		0	1	15
44	0	1	1	0	0	0	0	1	0	0	0	0	0	1	0	1		0	0	14
45	1	0	0	0	1	1	0	0	0	1	0	1	0	0	0	1		0	0	13
	D	B	A	A	A	A	A	A	A	C	B	A	A	C	A	C	A	D	D	0
Correct	7	4	3	5	9	4	7	4	7	2	3	3	4	3	4	7		1	3	
Wrong	7	10	11	9	5	10	7	10	7	12	11	11	10	11	10	7		13	11	
%correct	50	29	21	36	64	29	50	29	50	14	21	21	29	21	29	50		7	21	
%wrong	50	71	79	64	36	71	50	71	50	86	79	79	71	79	71	50		93	79	
p%	61	33	43	43	64	25	57	43	50	39	29	32	29	29	47	57		32	29	
D	0.3	0.1	0.5	0.2	0	-0	0.2	0.3	0	0.6	0.2	0.3	0	0.2	0.4	0.2		0.6	0.2	

APPENDIX K

INQUIRY LESSON PLAN FOR EXPERIMENTAL GROUP 1

LESSON I

CLASS: SSS II

Duration: 40 minutes

Previous Knowledge:

Students have already known the sides of right angle triangles

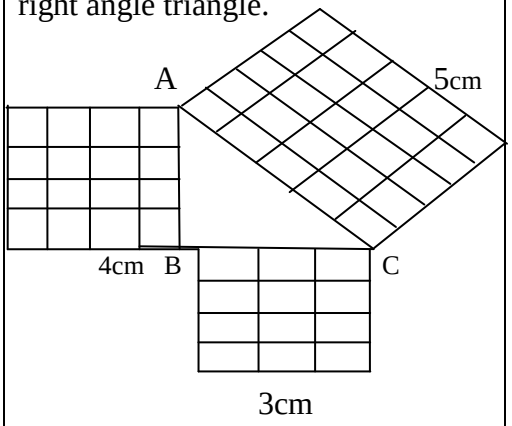
Learning Materials

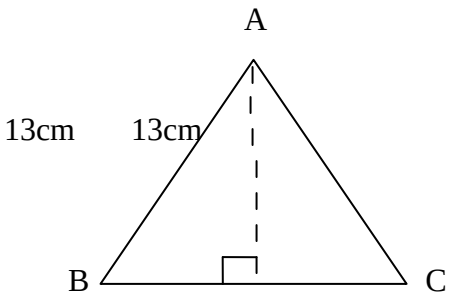
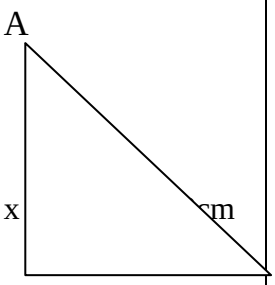
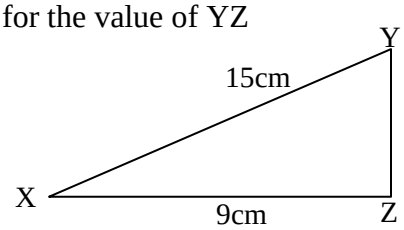
: Chart and poster of right angled triangle and, mathematical set

Teaching Approach: Inquiry Strategy

LESSON DEVELOPMENT/PRESENTATION

Topic	**Objectives**	**Teacher s' Activity**	**StudentsActivity**
Pythagoras theorem (Revision)	Students should be to state and prove Pythagoras theorem and apply it to solve problems relate to right triangle.	Teacher presents the lesson based on the following steps.	
		Step: i **Elicit:** Teacher tried to identify students prior knowledge and misconceptions about Pythagoras theorem at this phase, students tried to answer the following questions**:** what are Pythagoras theorem formula.	Students respond by saying $h^2 = op^2+adj^2$where the longest side (hypotenuse) op is the opposite side (perpendicular line which make 90^0 with the horizontal) adjacent is the horizontal making 90^0 with the vertical line.

	.	**Step: iiEngage:** Teacher tried to get attention of the students into the subject matter and ask the student toguide the students to count squares on each side of the right angle triangle.  	Students are to measure the sides of the right angled triangle from chart showing Pythagoras triangle.
		Step iii: **Explore:** Teacher divide the students in four or more groups and ask the students to shared their experience with other students in the group to draw Pythagorean triple	Students draw the Pythagorean triple model
		Step iv: **Explain** Teacher guides the student to draw different types of Pythagorean triple and relate their observation to Pythagoras theorem. And also guide the students to know that Pythagorean triple is a set of three whole numbers which give the lengths of sides of right-angled triangles, for example (5,12, and 13)	Students are drawing the Pythagorean triple in groups
		Step v: **Elaborate:** Theoretical proof of the theorem was given to the students.	Students participate in the proof of the theorem.
		Step vi: **Evaluate:** Students are to prove Pythagoras theorem and solve problems on Pythagoras theorem Draw the isosceles triangle and put the values. Bisect A at D to have the altitude. The teacher guides the students to solve the example.	Since the two Triangles are the same (ABD=ADC). Take one of the triangles and use Pythagoras theorem to calculate the altitude of the isosceles triangle.

			 C C 12cm /AD/^{2}+/DC/^{2} =/ AC/^{2} 12cm /AD/^{2} =/ AC/^{2} -/ DC/^{2} /AD/^{2} =13^2 - 12^2 /AD/^{2} =169 -144 /AD/^{2} = 25 Take the square root of both sides $\sqrt{/AD/2}$ = $\sqrt{25}$ AD= 5cm
		Step vii: **Extend:** Students are to use the knowledge gained to solve the exercises. **Exercise:** In a diagram below, solve for the value of YZ 	
	Evaluation	Teacher asked the students questions and allowed students to asked questions based on the topic	
	Conclusion	Teacher gave students homework to be submitted the next class	

LESSON II

CLASS: SSSII

Duration: 40 minutes

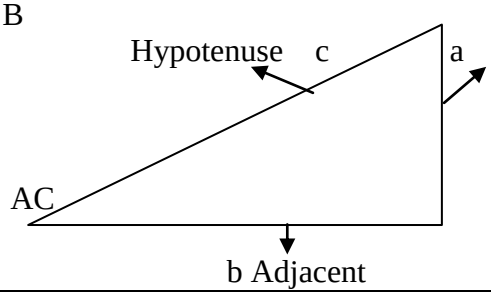
Previous Knowledge::

Students have learnt about Pythagoras theorem

Learning Materials: Charts, protector, pencil and Ruler

Teaching Approach: Inquiry method

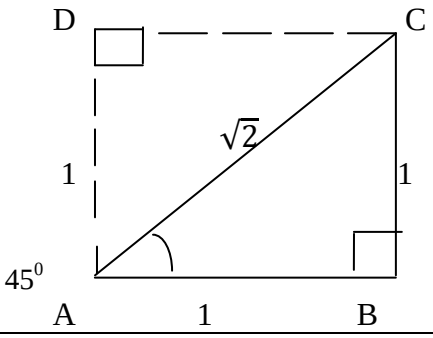
LESSON DEVELOPMENT/PRESENTATION

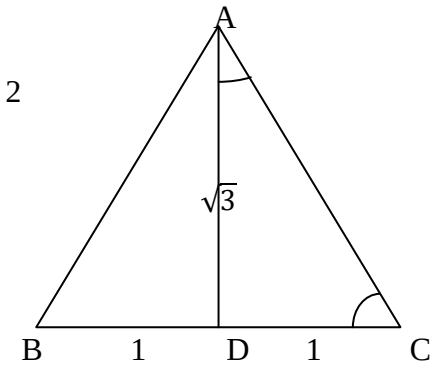
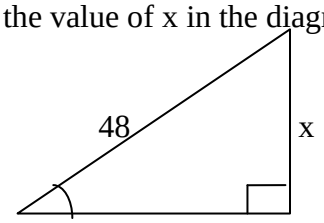
Topic	**Objectives**	**Teachers 'Activity**	**Students 'Activity**
Trigonometric Ratio and spaced angle	Student should be able to solve problem involving use of sine, cosine and tangent in right angled triangles.	Teacher presents the lesson based on the following steps	
		Step i: **Elicit:** Teacher ask the students question on their previous knowledge, what are the basic trigonometric ratio	Students respond by saying $\sin\theta \frac{\text{opposite}}{\text{hypotenuse}}$ $\cos\theta \frac{\text{adjacent}}{\text{hypotenuse}}$ $\tan\theta \frac{\text{opposite}}{\text{adjacent}}$
		Step ii: **Engage:** Teacher involves the students with materials and ask the student to identify ratios B  	Students identify ratios forming sine, cosine and tangent
		Step iii: **Explore:** Teacher guide the students to identify and explain their understanding on how sine, cosine and tangent ratio are formed.	Students explain the concepts that have been learned through written on their note books.

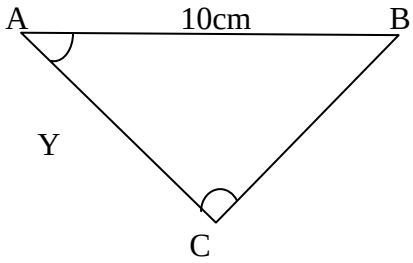
		Step iv: **Explain:** Teacher guided the students on how to proofs some trigonometric identifies $\frac{\sin\theta}{\cos\theta}$ $\frac{\cos\theta}{\sin\theta}$ $\sin^2\theta + \cos^2\theta$	Students respond by $\frac{\sin\theta}{\cos\theta} = \tan\theta$ $\frac{\cos\theta}{\sin\theta} = \cot\theta$ $sin^2\theta + cos^2\theta = 1$
		Step vi: **Elaborate:** Proof of trigonometric identities were given to students	
		Step v: **Evaluate:** Students are ask construct right angle triangles and to identify trigonometric ratio and to use it to calculate the problem below If $\tan\theta = 5/_{12}$ and $0<\theta<90^0$, find (i) $\sin^2\theta$ i) $\cos\theta - \sin\theta$	A c b B C a $\sin\theta = \sin\theta = \frac{\text{opposite}}{\text{hypotenuse}} = \frac{c}{b}$ $\text{cosine}\theta = \cos\theta = \frac{\text{adjacent}}{\text{hypotenuse}} = \frac{a}{b}$ Tangent $\theta = \tan\theta$ $\frac{\text{opposite}}{\text{adjacent}} = \frac{c}{a}$
		Step viii: **Extend:** The knowledge gained from the previous stages will help the student to apply it on the new concept	
	Evaluation	Teacher asked the students questions and allowed students to asked questions based on the topic	
	Conclusion	Teacher gave students homework to be submitted the next class	

LESSON III
CLASS:SSSII
Duration: 40 minutes
Previous Knowledge
The students have idea on basic trigonometry ratio
Learning Materials: Charts, protractor, pencil and ruler
Teaching Approach: Inquiry strategy

LESSON DEVELOPMENT/PRESENTATION

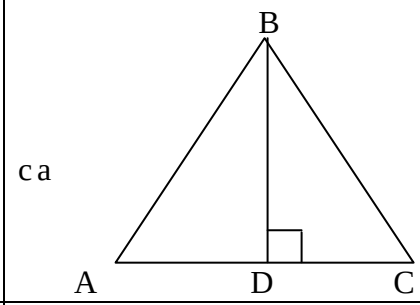
Content	**Objectives**	**Teachers' Activity**	**Students 'Activity**
Trigonometric of special angles 30^0, 45^0, and 60^0	Students should be able to drive the length of the sides of a right angled triangle with 30^0, 45^0 and 60^0 and obtain the sine, cosine and tangent of 30^0 45^0 and 60^0 without using table.	**Step i:** **Elicit:** Teacher shows chart of a square with a label of ABCD and ask the student questions on trigonometric ratio  	Students study the chart showed by the teacher and respond to the question
		Step ii: **Engage:** Teacher involves the students to study chart and draw it. $\sin 45^0 = \frac{BC}{AC} = \frac{1}{\sqrt{2}}$ $\cos 45^0 = \frac{AB}{AC} = \frac{1}{\sqrt{2}}$ $\tan 45^0 = \frac{BC}{AB} = \frac{1}{1}$	Students drawing the squares and the equilateral triangle on their note books^0
		Step iii: **Explore:** Teacher guides the students to understanding of special angles	Students explain the concept of special angle.

		Step iv: **Explain:** Teacher guides to proof the special angles  $\sin 60 = \frac{AD}{AC} = \frac{1}{\sqrt{3}/2}$ $\cos 60 = \frac{BD}{AC} = \frac{1}{2}$ $\tan 60 = \frac{AD}{CD} = \sqrt{3}/1$ Using the figure above, where C^AD = 30^0 $\sin 30 = \frac{CD}{AC} = \frac{1}{2}$ $\cos 30 = \frac{AD}{AC} = \frac{3}{2}$ $\tan 30 = \frac{CD}{AD} = \sqrt{3}\frac{1}{}$	Students involving in prove of special angles
		Step v: **Elaborate**: Teacher gives the student group work on the special angles	Students are involved in making the proofing and drawing the special angle
		Evaluation: Students are ask to solve the following questions Calculate the value of x in the diagram below  	

		Step viii: **Extend:** Teacher ask the students to use the value of the special angles to solve relate problems. Exercise: in the diagram below B^AC = 30^0 and (BA) = 10cm. find y  	
	Evaluation	Teacher asked the students questions and allowed students to asked questions based on the topic	
	Conclusion	Teacher gives students homework to be submitted the next class	

LESSON IV
CLASS: SSSII
Duration:40 minutes
Previous Knowledge:
Students most have heard the term Sine Formula
Learning materials: Charts showing Acute and Obtuse angles, pencil and ruler
Teaching Approach: Inquiry Method

LESSON DEVELOPMENT/PRESENTATION

Content	Objectives	Teachers' Activity	Students 'Activity
Sine formula	Students should be able derive the sine rule and apply it.	**Step i:** **Elicit:** Teacher show acute and obtuse angle chart to the students to see and place it on the board  	Students are to copy the diagram in their note books
		Step ii: **Engage:** Teacher assist the students to draw the acute and obtuse triangle in their note book	Students are directly involved in draw the acute and obtuse angle in their note book
		Step iii: **Explore:** Teacher guides the students to use the chart to explain	Students identify and explain the corresponding sides for each of the angle
		Step iv: **Explain:** Teacher guides the student derive the formula In△ ABC, draw the altitude h from B to AC Then in right-angled △ABD $\frac{h}{c}$ =SinA H =CSinA In right-angled △CBD $\frac{h}{a}$ =SinC H =aSinC Note h=cSinA=aSinC CSinA=aSinC	Students use the drawing to derive the formula

		$\frac{C}{SinC} = \frac{a}{SinA}$ Similarly, by drawing the altitude c to BA $\frac{b}{SinC} = \frac{a}{SinA}$ $\frac{a}{SinA} = \frac{b}{SinB} = \frac{c}{SinC}$	
		Step v: **Elaborate:** Teacher guide the students to prove sine rule and says the condition for using it.	Students prove the sine rule in their note books and also write down three condition for using sine rule
		Step vii: **Evaluation:** Teacher ask the students question in order to ascertain their knowledge	Students are to solve the problems on finding sides and angles of a triangle using sine rule.
		Step viii: **Extend:** Teacher help the student to transfer the knowledge gain in sine formula to other concept Use the formulae above to solve problem In triangle PQR, R = 53^0, q=3.6m, r = 4.3m ,find Q	Students are to use the formula and apply it. **p** 4.3m 3.6m Q R Since angle Q is to be found and two sides of the triangle with an include angle are given, then sine formulae is to be used. The sine formulae to be use is $\frac{SinR}{r} = \frac{Sin\theta}{q} = \frac{Sin53}{4.3} = \frac{Sin\theta}{3.6}$ Make SineQ the subject of the formulae $Sin\theta = \frac{3.6Sin53}{4.3}$ $Sin\theta = \frac{3.6x\ 0.7986}{4.3}$ $Sin\theta = \frac{2.875}{4.3}$ $Sin\theta = 0.6686$ Take the inverse of Sine to make Q the subject of the formulae $\theta = \sin^{-1} 0.6686$ $\theta = 41.96$ $\theta = 42$
	Evaluation	Teacher asked the students questions and allowed students to asked questions based on the topic	
	Conclusion		

LESSON V

CLASS: SSSII

Duration: 40minutes

Previous Knowledge:

Students most have heard the term cosine formula

Learning materials: Charts for acute and obtuse angles, pencil, and ruler.

Teaching Approach: Inquiry Method

LESSON DEVELOPMENT/PRESENTATION

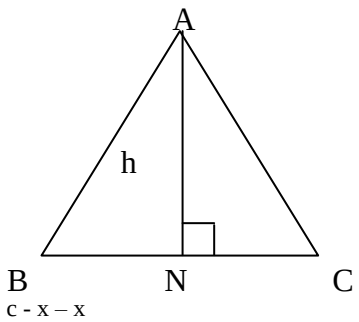
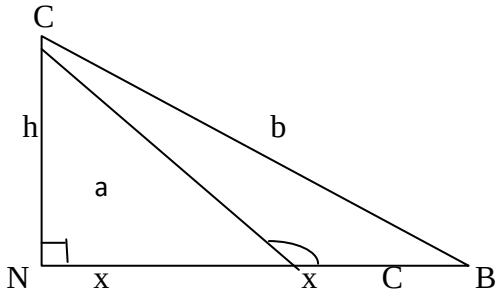
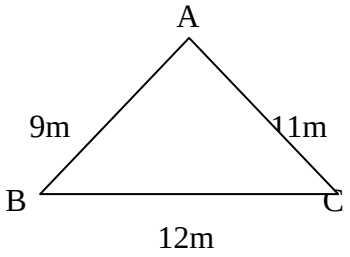
Topic	Objectives	Teachers' Activity	Students 'Activity
Cosine formula	Students should be able to derive the cosine rule and apply it.	Teacher presents the lesson based on following steps	
		Step: I **Elicit**: Teacher ask the students (i) what cosine formulae (ii) conditions for using cosine rule	Students respond by saying $a^2 = b^2+c^2-2bc \cos A$ $b^2=a^2+c^2 -2a \cos B$ $c^2 = a^2+b^2 – 2ab \cos C$ conditions for cosine rule (i) two sides with one angle between them must be given (ii) three sides of the triangle are given
		Step ii: **Engage**: Teacher shows to the students acute and obtuse angles chart  	Students are to study the cosine rule charts and copy the diagram in their note books.

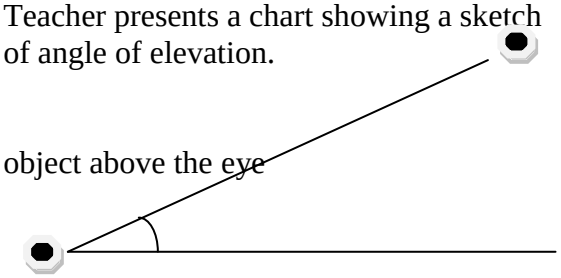
		Fig: 1  	
		Step iii: **Explore**: Teacher divide the students in four or more groups and guides the students to use Pythagoras theorem to derive two expression for h in terms of a,b,c and lead the students to obtain expression for Cos c = x/c x= a Cos c . From figure 1 where A is acute angle $A^2=h^2+(c-x)^2$ (from triangle CNB) $A^2=h^2+c^2-2cx+x^2$ $B^2=h^2+x^2$ (from triangle CAN) $A^2=b^2+c^2-2cx$ Cos A $=\frac{x}{b} \Rightarrow x = bcosA$ $A^2=b^2+c^2-2bcCosA$ Where A is obtuse $A^2= h^2+(c+x)^2$ (from triangle CBN) $H^2+c^2+2cx+x^2$ $B^2=h^2+x^2$(from triangle CAN) $A^2=b^2+c^2+2cx$ Also$cos\widehat{CAN} = \frac{x}{b}$ x=bcosCAN=bcos(180-A) = -bcosA $A^2=b^2+c^2-2bcCosA$.this is the cosine rule for angle A The three formulae are $A^2=b^2+c^2-2bcCosA$ $B^2=a^2+c^2-2acCosB$ $C^2=a^2+b^2-2abCosC$. Similarly, Cos A = $\frac{b2+c2-a2}{2bc}$, CosB =$\frac{a2+c2-b2}{2ac}$ and Cos C=$\frac{a2+b2-c2}{2ab}$	Students use Pythagoras theorem to derive the two expression for h in terms of a, b, c and x.
		Step iv: **Explain**: Teacher guides the students to equate the	Students equate the two expressions for b.

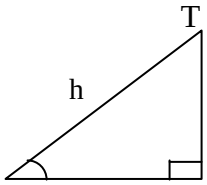
		two expressions for h and substitute x = a Cos to obtain c^2+b^2-2ab Cosc. A	
		Step v: **Elaborate**: Teacher guides the students to use the rule to find angles on sides of triangle Find the angles of the triangle with the following dimensions a = 12cm b = 11cm, c = 9m **Solution**  Using Cos A = $\frac{b2+c2-a2}{2bc}$ $= \frac{112+92-122}{2\times11\times9}$ $= \frac{121+81-144}{198}$ $= \frac{58}{198}$ = 0.2929 $= 72^0\ 58^1$ Using CosB = $\frac{a2+c2-b2}{2ac}$ $= \frac{122+92-112}{2\times12\times9}$ $= \frac{144+81-121}{216}$ $= \frac{104}{216}$ = 0.4815 $B = 16^0\ 13^1$ Using CosC = $\frac{a2+b2-c2}{2ab}$ $= \frac{122+112-92}{2\times12\times11}$ $= \frac{144+121-81}{264}$ $= \frac{184}{264}$ = 0.6970 $C = 45^0\ 49^1$	Students use the rule to find angles one sides of triangle.
		Step vi: **Evaluate**: Teacher asks the students to prove cosine rule and solve the following problems. Find the angles of the triangle with the following dimensions (i)$a = 5cm\ b = 4cm$ and $C = 7cm$	Students involves in solving the problems

		Step vii: **Extend**: Teacher guides the students to use the knowledge gained to solve the other problems	Students use the knowledge gain in cosine rule to solve various problems on triangles
	Evaluation	Teacher asked the students questions and allowed students to asked questions based on the topic	
	Conclusion	Teacher gives students home work to be submitted the next class	

LESSON VI
CLASS:SSSII
Duration: 40minutes
Previous Knowledge:
Students have basic knowledge on trigonometry ratio
Learning materials: Mathematical set, clinometers,
Teaching Approach: Inquiry strategy

LESSON DEVELOPMENT/PRESENTATION

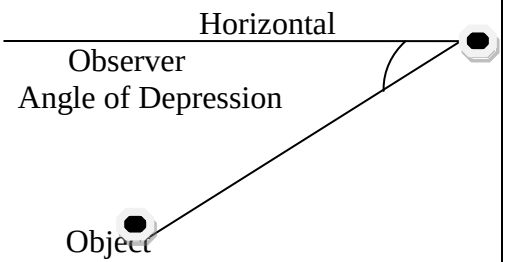
Topic	**Objectives**	**Teachers 'Activity**	**Students 'Activity**
Angle of elevation	Students should be able to solve problems related to angle of elevation	Teacher presents her lesson based on the following steps:	
		Step i: **Elicit:** Teacher asks the following questions what are angle of elevation? (ii) where is angle elevation is applicable?	Students respond by saying. (i) angles above the horizontal line (ii) right angle triangle
		Step ii: **Engage**: Teacher presents a chart showing a sketch of angle of elevation.  object above the eye **Observer** Angle of elevation Horizontal line	Students are to study the chart.
		Step iii: **Explore**: Teacher asks the students to use the sketch and explain what angle elevation means.	Students respond by saying objects that are above the eye level an angled is formed that angled is called angle of elevation
		Stepiiv: **Explain**: Teacher demonstratesshow angle of elevation is be formed, when you stand on the horizontal ground, you will realise that there are objects that are above the eye level in order to view such objects, there is the need to raise your head.	Students are asks to draw and explain diagram and relate their observation on it.

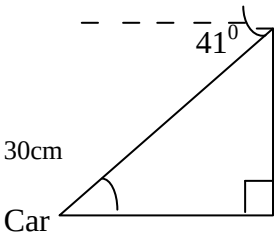
		Step v: **Elaborate**: Teacher lead the students to solve problem related to angle of elevation and to sketch the diagram A man is at a point 18m away from the foot of a tree from that point the angle of elevation of the top of the tree is 29^0. Calculate the height of the tree. What can you observe from the question is it angle of elevation or depression. If angle of elevation, why?	Students are to solve the following problems It is angle of elevation  Where h is the height P is the point where the man is and Q is the foot of the tree. By looking at the trigonometric ratio. H =opposite 18= adjacent, the ratio is $\tan\theta = \frac{opp}{adj}$ $\text{Tan}29^0 = \frac{h}{18}$ Cross multiply $h = 18\tan 29^0$ $h = 18(0.554)$ $h = 9.98m$ $h = 10m$
		Step vi: Evaluate Teacher gives the students exercise and ask them to solves **Exercises:** What is the meaning angle elevation? A man is 1.83m tall stands at a distance of 14.8m away from the base of a tower. He discovers that angle of elevation of the top of the tower is 63^0 .Calculate the height of the tower.	
		Step vii: Extend: Teacher guides the students to use the knowledge gained to solve the other problems	Students should transfer the knowledge to solve similar problems.

	Evaluation	Teacher asked the students questions and allowed students to asked questions based on the topic	
	Conclusion	Teacher gives students homework to be submitted the next class	

LESSON VII
CLASS: SSSII
Duration: 40 minutes
Previous Knowledge:
Students already have knowledge of trigonometric ratio
Learning materials: Clinometers, protractor, and ruler
Teaching Approach: Inquiry method

LESSON DEVELOPMENT/PRESENTATION

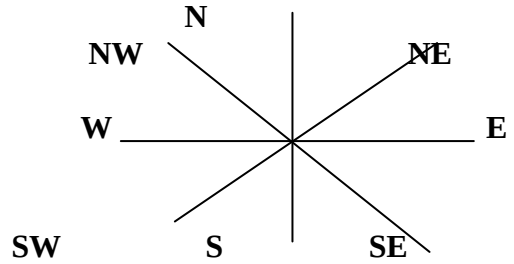
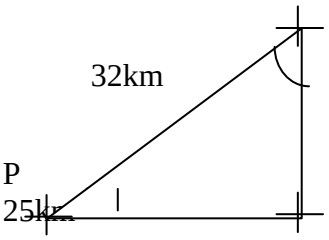
Topic	**Objectives**	**Teachers' Activity**	**Students 'Activity**
Angle of depression	Students should be able to solve problems related to angle of depression	Teacher presents her lesson based on the following steps:-	
		Step i: **Elicit**: Teacher ask question on what they understand by angle of depression	Students respond by angle of depression is an angle below the horizontal line.
		Step ii: **Engage**: Teacher shows to the students a chart showing a sketch of angle of depression  	Students are to draw it in thei note books
		Step iii: **Explore**: Teacher ask the students to explain what is angle of depression	Objects that can be view when lower the head
		Step iv: **Explain** Teacher asks the students base on their knowledge to list objects that can be viewed on the school environment when lower their head.	Students listed a lot of examples
		Step v: **Elaborate**: Teacher guides the students to solve a problem on the board The angle of depression from the top	Students are involve in solving the problem

		of a building of height 30m of a stationary car is 41^0. Find the distance between the car and the top of the building. What can you observe from the question, is it angle of depression If angle of depression why? Sketch a diagram for the question above	top of the building  Opposite and the angle are given. The trigonometric ratio of sinθ $\text{Sin}\theta = \frac{opposite}{hypotenuse}$ $\text{Sin}\theta = \frac{30}{H}$ $\text{Sin}41° = \frac{30}{H}$ Cross multiply $H\text{Sin}41° = 30$ Divide both sides by $\text{Sin}41^0$ $\frac{Hsin41°}{sin41} = \frac{30}{Sin41°}$ $H = \frac{30}{0.6561}$ $H = 45.7\text{m}$
		Step vi: **Evaluate** Students are to solve related to angle of depression. A guard observes an enemy boat from an observation tower at a height of 180m above sea level, to be at an angle of depression of 29^0 Calculate to the nearest metre, the distance of the boat from the foot of the observation tower. After some time, it is observed that the boat is 200m from the foot of the observation tower calculate the new angle of depression.	Students solve problems in their note books.
		Step vii: **Extend**: Teacher guides the Students to use the knowledge gained to solve similar problem.	
	Evaluation	Teacher asked the students questions and allowed students to asked questions based on the topic	
	Conclusion	Teacher gave students homework to be submitted the next class	

LESSON VIII

CLASS: SSSII
Duration: 40minutes
Previous Knowledge
Students already have knowledge on solution of triangles
Learning materials: Magnetic compass, protractor, pencil, and metre rule
Teaching Approach: Inquiry strategy

LESSON DEVELOPMENT/PRESENTATION

Topic	Objectives	Teacher /Activity	Students/Activity
Bearing and distance	Students should be able to solve problems related to bearing and distance.	Teacher presents based on the following step	
		Step i: **Elicit:** (i) what are bearings and distance (ii) what are the four cardinal points use in bearing and distance?	Students respond by saying bearings are the anti-clockwise angular relationships between two distant places measured in degrees (ii) North, south, East and west.
		Step ii: **Engage**: Teacher shows the chart four and secondary cardinal points to the students.  	Students to copy the diagram in their note books.
		Step iii: **Explore**: The direction of the secondary cardinal points were showed to the students	Student observe the direction of the secondary cardinal points
		Step v: **Explain:** Teacher guides the students, that for example a bearing of $N32^0E$. Means a turn of $32^0$from the north towards the direction of the East.	Students are to sketch the direction in their note boos.
		Step iv: **Elaborate**: Teacher guide the students to solve problem on bearing Example Q is 32km away from P on a bearing $042^0$and R is 25km from P on a bearing of 132^0.Calculate the bearing of R from Q. Sketch the diagram for the above relationship and find angle Q	 $QPR=132-042^0=90$ Since opposite and adjacent

			are given, the trigonometric ratio is tanθ Tanθ $=\frac{Opposite}{Adjacent}$ $=\frac{25km}{32km}$ tanθ = 0.781 θ =$\tan^{-1}$0.781 θ =37.999^0 The bearing of R from Q =37.999+42 =79.999 =80^0
		Step vi: Evaluate: teacher ask the students questions and give them exercise to solve below **Exercise:** A boat sail 6km from a port X on a bearing of 065^0 and thereafter 13km on a bearing of 136^0.What is the distance and bearing of the boat from X?	
		Step viii: Extend :Teacher lead the students to use the knowledge to solve similar problem related to bearing	
	Evaluation	Teacher asked the students questions and allowed students to asked questions based on the topic	
	Conclusion	Teacher gave students homework to be submitted the next class	

APPENDIX L

POLYA'S PROBLEM SOLVING METHOD LESSON PLAN FOR EXPERIMENTAL GROUP 2

LESSON I

CLASS: SSSII

Subject: Mathematics

Time: 40 minutes

Topic: Trigonometry

Previous Knowledge:

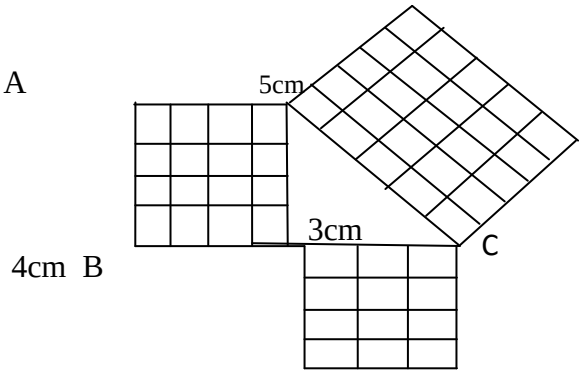
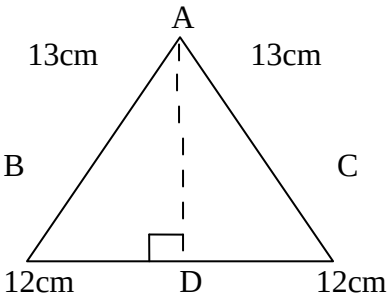
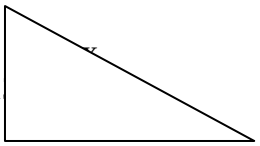
The students must have an idea about the sides of right angle triangles

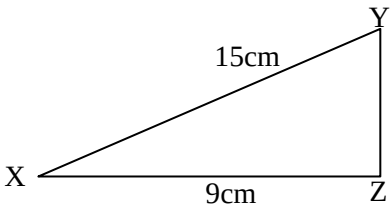
Learning materials: Chart and poster of right angled triangle and, mathematical set

Teaching Approach: Polya's Problem Solving strategy

LESSON DEVELOPMENT/PRESENTATION

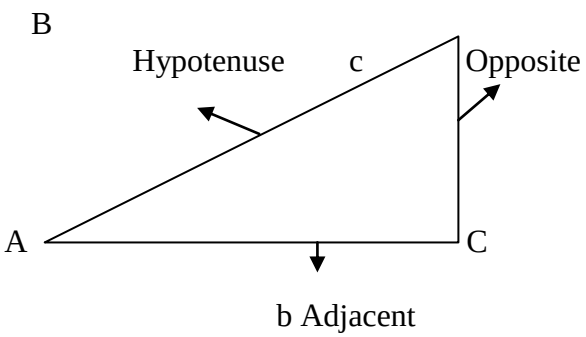
Sub -topic	Objectives	Teachers' Activity	Students 'Activity
Pythagoras theorem	Students should be to state and prove Pythagoras theorem and apply it to solve problems relate to right triangle.	Teacher present the lesson based on the following steps.	
		Step: i **Understanding the problem**: the teacher presents the concept of Pythagoras theorem on the board and asks the students what they understand by theorem.	Students respond by saying $h^2 = op^2+adj^2$ where is the longest side (hypotenuse) op is the opposite side (perpendicular line which make 90^0 with the horizontal) adjacent is the horizontal making 90^0 with the vertical line.

		Step: ii **Devise a plan:** Teacher guides the students to draw Pythagoras theorem and count squares on each side of the right angle triangle.  	Students are to measure the sides of the right angled triangle from chart showing Pythagoras triangle.
		Step iii: **Carry out the plan:** Teacher guides the students to solve problems. The teacher guides the students to solve the example.  	Students are fully engaged in solving the problem A  B C 12cm $/AD/^2+/DC/^2 =/AC/^2$ 12cm $/AD/^2 =/AC/^2 -/DC/^2$ $/AD/^2 =13^2 - 12^2$ $/AD/^2 =169 -144$ $/AD/^2 = 25$ Take the square root of both sides $\sqrt{/AD/2} = \sqrt{25}$ AD= 5cm
		Step iv: **Look back:** Teacher leads the student to check each step and see if the answer are correct	Students are drawing the Pythagorean triple in groups
Evaluation:		**Exercise:** In a diagram below, solve for the value of $\lvert YZ \rvert$	

			
Conclusion		Teacher concludes the lesson by briefly explaining the main points and allowing the students to ask questions base on what they have been taught in the class	

LESSON II
CLASS: SSSII
Subject: Mathematics
Duration: 40 minutes
Previous Knowledge: Students already have a basic knowledge on trigonometric ratio
Learning materials: Chart of right angled –triangle. Pencil and ruler
Teaching Approach: Polya's Problem solving strategy

LESSON DEVELOPMENT/PRESENTATION

Sub-topic	**Objectives**	**Teachers 'Activity**	**Students' Activity**
Trigonometric Ratio	Student should be able to solve problems basic trigonometric ratios, involving the use of sine, cosine and tangent in a right angle triangles.	Teacher presents the lesson based on the following steps	
		Step i: Understanding the problem : Teacher asks the students questions (i) what are the basic ratio? (ii). What types of angle is right angle.	Students respond by saying $\sin\theta \frac{\text{opposite}}{\text{hypotenus}}$ $\cos\theta \frac{\text{adjacent}}{\text{hypotenus}}$ $\tan\theta \frac{\text{opposite}}{\text{adjacent}}$ (ii) triangle that one of its side is 90^0
		Step ii: **Device a plan:** Teacher involves the students with materials and asks the student to identify ratios.  and also guide students to use sine, cosine, and tangents.	Students identify ratios forming sine, cosine and tangent
		Step iii:	Students

		Carryout the plan: Teacher guide the students to identify and explain their understanding on how sine, cosine and tangent ratio are formed, and how to proofs some trigonometric identity	respond by $\frac{\sin\theta}{\cos\theta} = \tan\theta$ $\frac{\cos\theta}{\sin\theta} = \cot\theta$ $\sin^2\theta + \cos^2\theta = 1$
		Step iv: **Look back:** Teacher leads the students to check each steps and see if the answer are correct	
Evaluation:		Students are ask construct right angle triangles and to identify trigonometric ratio and to use it to calculate the problem below If $\tan\theta = 5/_{12}$ and $0<\theta<90^0$, find $\sin^2\theta$ $\cos\theta - \sin\theta$	
Conclusion:		Teacher concludes the lesson by briefly explaining the main points of the lesson and allowing the students to ask questions based on what has been taught in the class.	

LESSON III

CLASS:SSSII

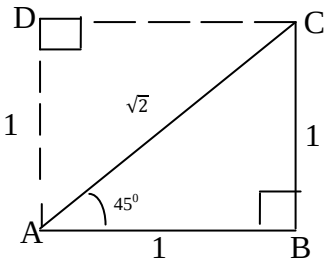
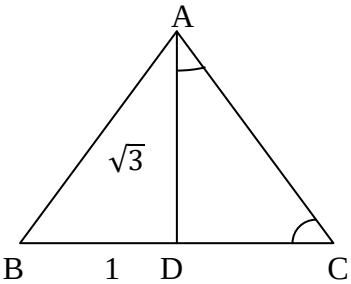
Duration: 40minutes

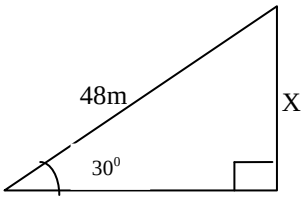
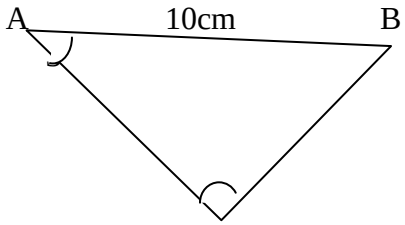
Previous Knowledge: Students have idea on basic trigonometry ratio

Learning materials: chart, pencil and ruler

Teaching Approach: Polya's Problem Solving strategy

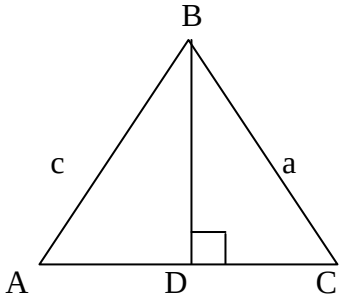
LESSON DEVELOPMENT/PRESENTATION

Topic	**Objectives**	**Teacher /Activity**	**Students/Activity**
Trigonometric of special angles 30^0, 45^0, and 60^0	Students should be able to drive the length of the sides of a right angled triangle with 30^0, 45^0 and 60^0 and obtain the sine, cosine and tangent of 30^0 45^0 and 60^0 without using table.	**Step i:** **Understanding the problem:** Teacher show chart of a square with a label of ABCD and ask the students questions on trigonometric ratio  	Students study the chart showed by the teacher and respond to the questions $\sin 45^o = \frac{BC}{AC} = \frac{1}{\sqrt{2}}$ $\cos 45^o = \frac{AB}{AC} = \frac{1}{\sqrt{2}}$ $\tan 45^o = \frac{BC}{AB} = \frac{1}{1}$
		Step ii: **Device a plan:** Teacher guide the students to proof the special angles using the diagram. Teacher guides to proof the special angles 2  $\sin 60 = \frac{AD}{AC} = \frac{\sqrt{3}}{2}$, $\cos 60 = \frac{BD}{AC} = \frac{1}{2}$, $\tan 60 = \frac{AD}{CD} = \frac{\sqrt{3}}{1}$ Using the figure above, $C\hat{A}D = 30^0$ $\sin 30 = \frac{CD}{AC} = \frac{1}{2}$, $\cos 30 = \frac{AD}{AC} = \frac{\sqrt{3}}{2}$, $\tan 30 = \frac{CD}{AD} = \frac{1}{\sqrt{3}}$	Students drawing the squares and the equilateral triangle on their note books
		Step iii: **Carry out the plan:** Teacher guides the students to solve problems special angles	

		Calculate the value of x in the diagram below  $\sin 30° = {}^{x}/_{48}$ cross multiply $x = 48 \sin 30°$ But $\sin 30^0 = {}^{1}/_{2}$ $x = 48 \times {}^{1}/_{2}$ x = <u>24m</u>	
		Step iv: **Looking back**: Teacher leads the students to crosschecks the solution process used in step three to solve other problem involving trigonometric without using table	Students involving in prove of special angles
Evaluation**:**		Exercise: in the diagram below $B\hat{A}C$ = $30^0$and$\lvert BA\rvert = 10c$. Find the value of y  	
Conclusion:		Teacher concludes the lesson by briefly explaining the main points of the lesson and allowing the students to ask questions based on what has been taught in the class.	

LESSON IV
CLASS: SSS II
Subject: Mathematics
Duration: 40minutes
Topic: Trigonometry
Previous Knowledge: Students have heard the term sine formula
Learning materials: Charts, pencil and ruler
Teaching Approach: Polya's Problem Solving strategy

LESSON DEVELOPMENT/PRESENTATION

Topic	**Objectives**	**Teachers 'Activity**	**Students' Activity**
Sine formula	Students should be able derive the sine rule and apply it.	**Step i:** **Understanding the problem:** Teacher show acute and obtuse chart to the student to see and place it on the black board and guide them to draw it on their note book	Students are to copy the diagram in their note books
		Step ii: **Devise a Plan:** Teacher guides the students to make representation to deriving the sine rule.  In $\triangle$ ABC, draw the altitude h from B to AC Then in right-angled $\triangle$BD $\frac{h}{c}$ =SinA H =CSinA In right-angled $\triangle$BD $\frac{h}{a}$ =SinC H =aSinC Note h=cSinA=aSinC CSinA=aSinC $\frac{C}{SinC} = \frac{a}{SinA}$ Similarly, by drawing the altitude c to BA $\frac{b}{SinC} = \frac{a}{SinA}$ $\frac{a}{SinA} = \frac{b}{SinB} = \frac{c}{SinC}$	Students are directly involved in draw the acute and obtuse angle in their note book
		Step iii:	Students identify

		Carry out a plan: Teacher guide the students to solve problems on sine formula. In a Triangle PQR, $R=53^0$, q =3.6m, r =4.3m find Q	and explain the corresponding sides for each of the angle
		Step iv: **Look back:** Teacher leads the students to crosscheck to solution process used in step three to solve other problems.	Students use the drawing to derive the formula
Evaluation		In a Triangle ABC if I A $=38^0$ B $=27^0$ b =17m find a and C II A $=69^0$ b = 9cm, a =19cm find B and C.	
Conclusion:		Teacher concludes the lesson by briefly explaining the main points of the lesson and allowing the students to ask questions based on what has been taught in the class.	

LESSON V

CLASS: SSSII

Subject: Mathematics

Duration: 40 minutes

Topic : Trigonometry

Previous Knowledge: Students have heard the term cosine formula

Learning materials: charts of acute and obtuse angle, pencil and ruler

Teaching Approach:Polya's Problem Solving strategy

LESSON DEVELOPMENT/PRESENTATION

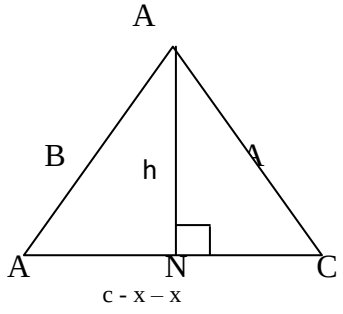
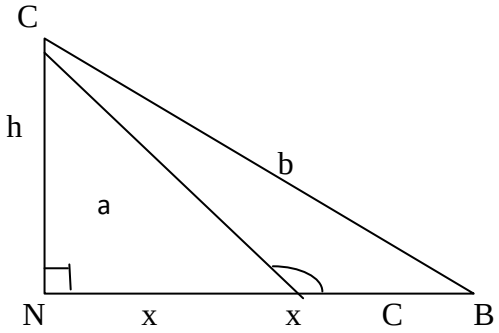
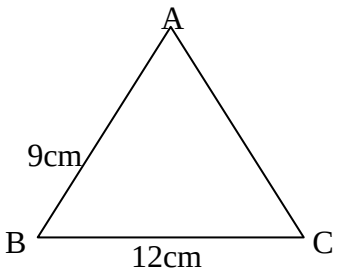
Topic	**Objectives**	**Teachers' Activity**	**Students' Activity**
Cosine formula	Students should be able to derive the cosine rule and apply it.	Teacher presents the lesson based on following steps	
		Step: I Understanding the problem: Teacher ask the students (i) what cosine formula (ii) conditions for using cosine rule	Students respond by saying $a^2 = b^2+c^2-2bc \text{ Cos } A$ $b^2=a^2+c^2 -2a \text{ Cos } B$ $c^2 = a^2+b^2 – 2ab \text{ Cos } C$ conditions for cosine rule (i) two sides with one angle between them must be given (ii) three sides of the triangle are given
		Step ii: **Devise a plan:** Teacher shows the students acute and obtuse angles and also guides the students to make representation to deriving the cosine formula.  	Students are to study the cosine rule charts and copy the diagram in their note books.

		Fig: 1  From figure 1 where A is acute angle $A^2=h^2+(c-x)^2$ (from triangle CNB) $A^2=h^2+c^2-2cx+x^2$ $B^2=h^2+x^2$ (from triangle CAN) $A^2=b^2+c^2-2cx$ Cos A $=\frac{x}{b}$ X=bcosA $A^2=b^2+c^2-2bcCosA$ Where A is obtuse $A^2= h^2+(c+x)^2$ (from triangle CBN) $H^2+c^2+2cx+x^2$ $B^2=h^2+x^2$(from triangle CAN) $A^2=b^2+c^2+2cx$ Also Cos CAN $=\frac{x}{b}$ x=bcos CAN=bcos(180-A) = -bcosA $A^2=b^2+c^2-2bcCosA$.this is the cosine rule for angle A The three formulae are $A^2=b^2+c^2-2bcCosA$ $B^2=a^2+c^2-2acCosB$ $C^2=a^2+b^2-2abCosC$. Similarly. Cos A = $\frac{b2+c2-a2}{2bc}$, CosB = $\frac{a2+c2-b2}{2ac}$ and Cos C=$\frac{a2+b2-c2}{2ab}$	
		Step iii: **Carry out the plan**: Teacher guides the students to solve examples on the board **Problem:-**Find the angles of the triangle with the following dimension a = 12m, b = 11m, C = 9m.  	Students use Pythagoras theorem to derive the two expression for h in terms of a, b, c and x.

		Using the cosine formulae Cos A = $\frac{b2+c2-a2}{2bc}$ $= \frac{11+9-12}{2x11xa}$ $= \frac{12+81-144}{198}$ $= \frac{58}{198}$ = 0.2929 Therefore A = $72^0\ 58^1$ Cos B = $\frac{a2+c2-b2}{2ac}$ $= \frac{12+9-11}{2x102x9}$ $= \frac{144+81-121}{216}$ $= \frac{104}{216}$ = 0.4815 B = $16^0\ 13^1$ Cos C = = $\frac{a2+b2-c2}{2ab}$ $= \frac{12+11-9}{2x12x11}$ $= \frac{144+121-81}{264}$ $= \frac{184}{264}$ = 0.6970 C = $45^0\ 49^1$	
		Step v: Explain: Teacher guides the students to use chart to explain method denoting vertices of triangles by capital letters and for angles by small letters.	
		Step iv: **Look back:-** Teacher leads the students to crosscheck the solution process used in step three to solve other problems.	Students equate the two expressions for b
Evaluation		Find the angles of the triangles with the following dimensions a =5cm. b = 4cm, c = 7cm.	
Conclusion		Teacher concludes the lesson by briefly explaining the main points of the lesson and allowing the students to ask questions based on what has been taught in the class.	

LESSON VI
CLASS: SSSII
Subject: Mathematics
Duration: 40minutes
Topic: Trigonometry
Previous Knowledge:
Students already have knowledge on trigonometric ratio
Learning materials: Clinometers, ruler, protractor
Teaching Approach: Polya's Problem solving strategy

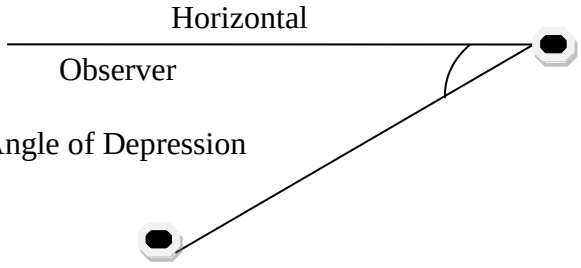
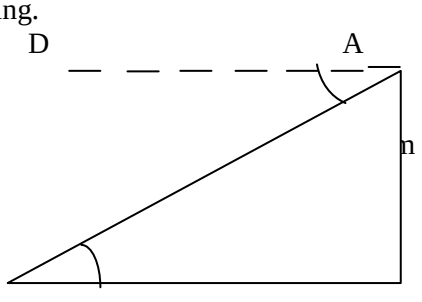
LESSON DEVELOPMENT/PRESENTATION

Topic	**Objectives**	**Teachers 'Activity**	**Students 'Activity**
Angle of elevation	Students should be able to solve problems related to angle of elevation	Teacher presents her lesson based on the following steps:	
		Step i: Understanding the problem: Teacher asks the following questions what are angle of elevation? (ii) where is angle elevation applicable?	Students respond by saying. (i) angles above the horizontal line (ii) right angle triangle
		Step ii: **Devise a plan:** Teacher guides the students to make a sketch on angle of elevation object above the eye Observer Angle of elevation Horizontal line	Students are to draw it in their not books
		Step iii: **Carry out a plan:** Teacher guides the students to solve example on the board. **Problem:** A man is at point 18 many from the foot of a tree from that point the angle of elevation of the top of the trees is 29^0 calculate the height of the tree. T h P 18m Q To calculate the height $\tan 29^0 = \frac{h}{18m}$ Cross multiply	Students respond by saying objects that are above the eye level an angled is formed that angled is called angle of elevation

		h = 18m x tan 29^0 = 18m x 0.5543 = 9.977m = 9.98m	
		Step v: **Look Back:** Teacher leads the students crosscheck the solution process use in step three to solve other problems.	Students are asks to draw and explain diagram and relate their observation on it.
Evaluation		I what is the meaning of angle of elevation Ii the angle of elevation of the top of a tree from a point on the ground is 42^0.if the point is 30m away from the foot of the tree find the height from the tree	
Conclusion		Teacher concludes the lesson by briefly explaining the main points of the lesson and allowing the students to ask questions based on what has been taught in the class.	

LESSON VII
CLASS: SSSII
Duration: 40minutes
Previous Knowledge:
Students already have knowledge on trigonometric ratio
Learning materials: Clinometers, ruler and protractor
Teaching Approach: Polya's Problem Solving strategy

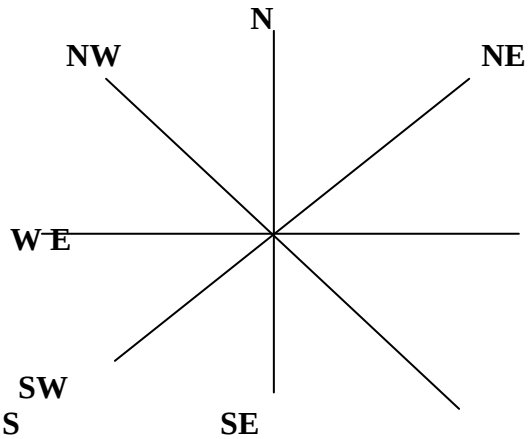
LESSON DEVELOPMENT/PRESENTATION

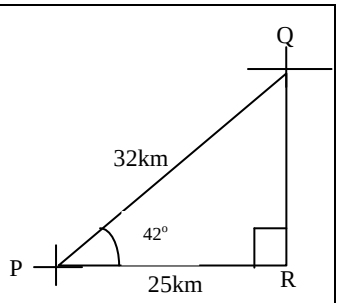
Topic	**Objectives**	**Teachers' Activity**	**Students' Activity**
Angle of depression	Students should be able to solve problems related to angle of depression	Teacher presents her lesson based on the following steps:-	
		Step I: **Understanding the problem:** Teacher presents the topic on the board. Angle of depression, and leads the students to understand what angle of depression.	Students respond by angle of depression is an angle below the horizontal line.
		Step II: **Devise a plan:** Teacher guides the students to make representation of making a sketch of angle of depression.  	Students are to draw it in their note books
		Step III: Carry out a plan: Teacher guides the students to solve problem on angle of depression on the board. **Problem:** The angle of depression from the top of a building of height 30m of a stationary car is 41^0 find the distance between the car and the top of the building.  The distance required is AC (hypotenuse to ABD $\sin 41^0 = \frac{30m}{AC}$ $AC \times \sin 41^0 = 30m$	Objects that can be view when lower the head

		AC = $\frac{30m}{sin\,41}$ = $\frac{30}{0.6561}$ = <u>45.7m</u>	
		Step IV: look back: Teacher leads the students to crosscheck the solution process used in step three to solve other problem.	
Evaluation		An aircraft is circling an airport at height of 600m. The navigator finds that the angle of depression of the control tower of the airport is 12^0 what is the distance between the aircraft and the control tower?	
Conclusion:		Teacher concludes the lesson by briefly explaining the main points of the lesson and allowing the students to ask questions based on what has been taught in the class.	

LESSON VIII
CLASS: SSSII
Subject: Mathematics
Duration: 40minutes
Topic: Trigonometry
Previous Knowledge
: Students most have heard the term Bearing and distance
Learning Materials: magnetic compass, protractor, pencil and ruler
Teaching Approach: Polya's Problem Solving strategy

LESSON DEVELOPMENT/PRESENTATION

Topic	Objectives	Teachers' Activity	Students' Activity
Bearing and distance	Students should be able to solve problems related to bearing and distance.	Teacher presents based on the following step	
		Step i: **Understanding the problem:** (i) what are bearings and distance (ii) what are the four cardinal points use in bearing and distance?	Students respond by saying bearings are the anti-clockwise angular relationships between two distant places measured in degrees (ii) north, south, East and west.
		Step ii: **Device the plan**: Teacher shows the chart of four and secondary cardinal points to the students.  The direction of the secondary cardinal points were showed	Students to copy the diagram in their note books.
		Step III: Carry out a plan: teacher guide the students to solve problem on bearings Example Q is 32km away from P on a bearing $042^0$and R is 25km from P on a bearing of 132^0.Calculate the bearing of R	Sketch the diagram for the above relationship and find angle Q

		from Q.	 QPR=132-42^0=90 Since opposite and adjacent are given, the trigonometric ratio is tanθ Tanθ $=\frac{Opposite}{Adjacent}$ $=\frac{25km}{32km}$ tanθ 0.781 θ =tan^{-1}0.781 θ =37.999^0 The bearing of R from Q =37.999 +42 =79.999 =80^0
		Step iv **Look Back**: Teacher lead the students to check solution process used in step iii,to solve other problems	
Evaluation		A boat sail 6km from a port X on a bearing of 065^0 and thereafter 13km on a bearing of 136^0.What is the distance and bearing of the boat from X?	
Conclusion:		Teacher concludes the lesson by briefly explaining the main points of the lesson and allowing the students to ask questions based on what has been taught in the class.	

APPENDIX M

Lesson Plan for Lecture Method (Control Group)

LESSON I

CLASS: SSS II

Subject: Mathematics

Duration: 40 minutes

Topic**:** Pythagoras theorem

Previous Knowledge:

Students have already known the sides of right angle triangles

Learning Materials

: Chart and poster of right angled triangle and, mathematical set

Teaching Approach: Lecture Method

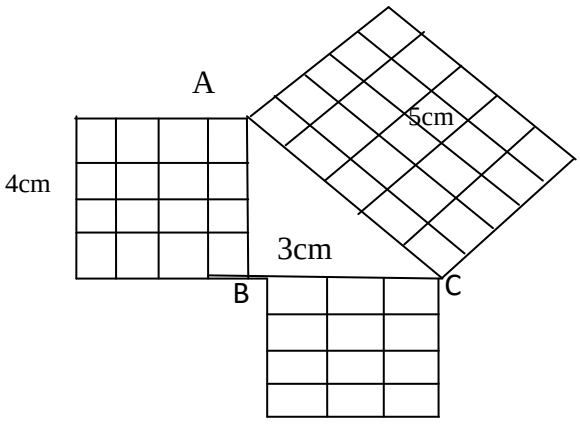
Specific objectives: By the end of the lesson, students should be able to;

(i) recall the Pythagoras theorem
(ii) solve problems related to Pythagoras theorem

Introduction: Teacher introduces the lesson by writing the topic on the board.

Lesson Presentation: Teacher presents the lesson in the following steps

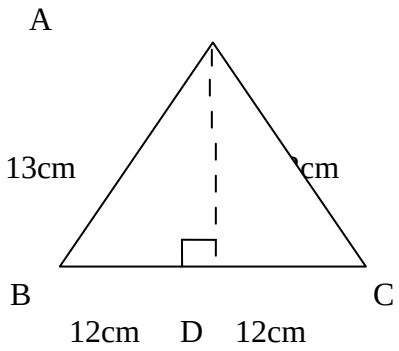
Step I: Teacher draw a right angled triangle on the board.



Step II: Teacher remains the students that the area of the square in the hypotenuse would equal the sum of the areas of the squares on the adjacent sides.

Step III: Teacher solves problems of triangles using Pythagoras.

Calculate the length of the altitude of an isosceles triangle whose base is 24cm long and whose equal side are 13cm long



Evaluation: Teacher evaluates the lesson by asking the students questions based on what has been taught and giving the students class work to measure the success or failure of the lesson

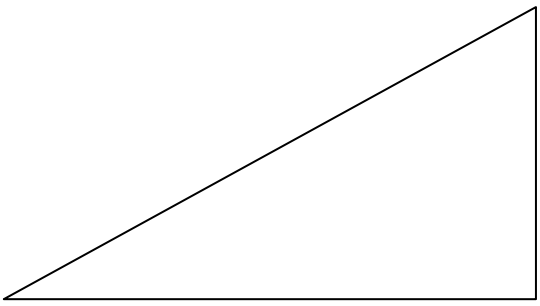
Conclusion: Teacher concludes the lesson by briefly explaining the main points and allowing the students to ask questions base on what they have been taught in the class

Assignments: Teacher assigns the following question to the students to do at home.

In a diagram below, solve for the value of YZ

Y

15cm



X9cmZ

LESSON II

CLASS: SSS II

Subject: Mathematics

Duration: 40 minutes

Topic**:** Trigonometry ratio

Previous Knowledge:

Students have already known the sides of right angle triangles

Learning Materials

: Chart and poster of right angled triangle and, mathematical set

Specific objectives: By the end of the lesson, students should be able to

(i) State the three basic trigonometric ratio sine, cosine and tangent.

(ii) Solve problems involving use of sine, cosine and tangent in right angled triangles.

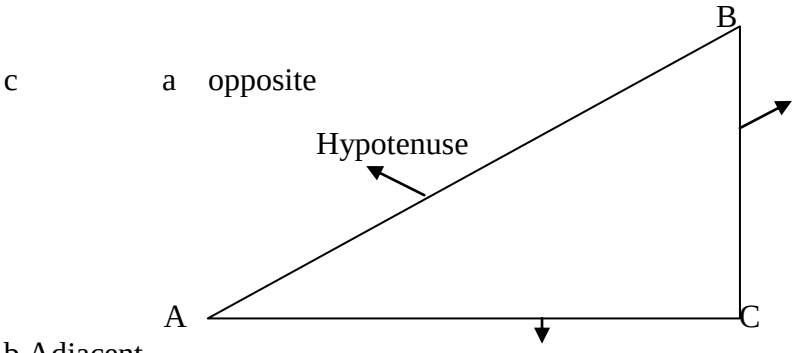
Introduction: Teacher introduces the lesson by writing the topic on the board

Lesson Presentation:Teacher presents the lesson by the following steps

Step I: Teacher state the three basic trigonometric ratios of sine, cosine and tangent of an angle.

$\text{Sin}\theta = \frac{Opposite}{Hypotenuse}$ $\text{Cos}\theta = \frac{Adjacent}{Hypotenuse}$ and $\text{Tan}\theta = \frac{Opposite}{Adjacent}$

Step II: Teacher draws a right angle triangle ABC on the board



Step III: Teacher solves examples on the board

Given that $\text{Sin}\theta = \frac{8}{17}$ calculate the value of (a) Cosθ (b) Tanθ

Solution:

By Using Pythagoras Theorem

$a^2 = b^2 + c^2$

$17^2 = b^2 + c^2$

$b^2 = 17^2 - 8^2$

$b^2 = 289 - 64$

$b^2 = 225$

Take the square root of both sides

$b^2 = \sqrt{225}$

$b^2 = 15$

Adjacent = 15

$\text{Cos}\theta = \frac{15}{17}$, $\text{Tan}\theta = \frac{8}{15}$

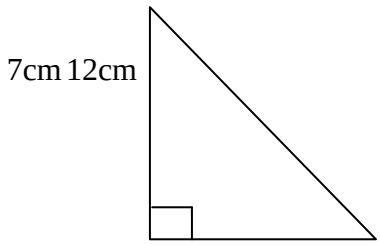
Evaluation: Teacher evaluates by asking the students questions base on that have been taught and giving the students class work to measure their success or failure of the lesson.

Conclusion: Teacher concludes the lesson by briefly explaining the points of the lesson and allowing the students to ask questions based on what has been taught in the class.

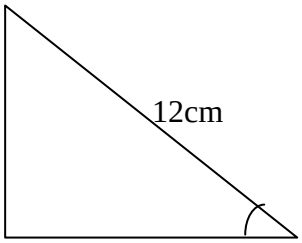
Assignments: Teacher assigns the following questions to the students to do at home.

Find the value of marked angle θ in the figure below

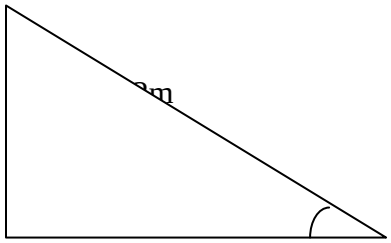
(ii)



(ii) 30cm



(iii) 6m



LESSON III

CLASS: SSS II

Subject: Mathematics

Duration: 40 minutes

Topic: Trigonometric of special Angles

Previous Knowledge:

Students have been taught the three basic trigonometric ratios and are familiar with solving problems involving use of sine, cosine and tangent of angles.

Learning Materials: Chart showing the Sketch of an Equilateral triangles

Specific objectives: By the end of the lesson, students should be able to:

(i) Derived the length of the sides of right angled –Triangle of trigonometric ratios of special angles 30^0, 45^0 and 60^0

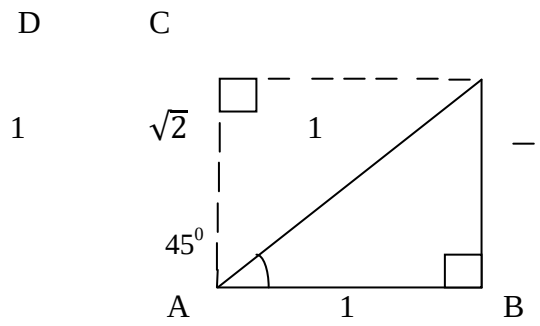
(ii) Apply the use of trigonometric ratio of 30^0, 45^0 and 60^0 to solve problem without the use

Introduction: Teacher introduces the lesson by writing the topic on the board.

Lesson Presentation: Teacher presents the lesson by the following steps

Step I: Teacher asks the students why these angles 30^0,45^0.60^0, and $90^0$are called special angles.

StepII: Teacher draws a square ABCD with sides of length and AC as diagonal to derive trigonometric ratio of special angle of 30^0 and 45^0

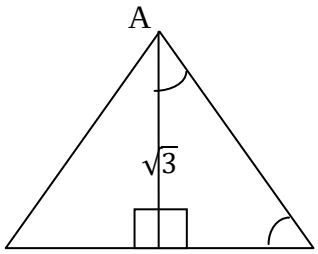


$$\sin 450 = \frac{\text{BC}}{AC} = \frac{1}{\sqrt{2}}$$

$$\cos 450 = \frac{\text{AB}}{AC} = \frac{1}{\sqrt{2}}$$

$$\tan 450 = \frac{\text{BC}}{AB} = \frac{1}{1} = 1$$

Step III: Teacher also guides the students to draw an equilateral triangle ABC of sides 2 units in length, and AD is drawn from A perpendicular to BC with ACD=60^0



B 1 D 1 C

$$\sin 60 = \frac{AD}{AC} = \frac{1}{\sqrt{3/2}}$$

$$\cos 60 = \frac{BD}{AC} = \frac{1}{2}$$

$$\tan 60 = \frac{AD}{CD} = \sqrt{3}/1$$

Using the figure above, where C^AD = 30^0

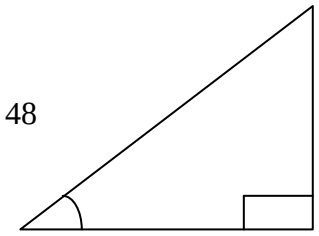
$$\sin 30 = \frac{CD}{AC} = \frac{1}{2}$$

$$\cos 30 = \frac{AD}{AC} = \sqrt{3}/2$$

$$\tan 30 = \frac{CD}{AD} = \sqrt{3}\frac{1}{}$$

Step IV: Teacher guides the students to solve problem involving special angles on the board

Calculate the value of x in the diagram below



$\text{Sin}30^0 = \frac{x}{48}$

Cross multiply

$x = 48\text{Sin}3^0$

But $Sin30^0 = \frac{1}{2}$

$x = 48 \times \frac{1}{2}$

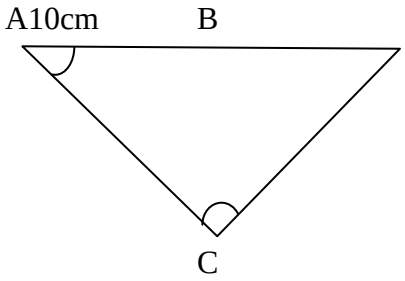
$x = 24m$

Evaluations: Teacher evaluates the lesson by asking the students the questions based on what has been taught and giving the students class work to measure the success or failure of the lesson.

Conclusion: Teacher concludes the lesson by briefly explaining the main points of the lesson and allowing the students to ask questions based on what has been taught in the class.

Assignment: Teacher assigns the following question to the students to do at home.

In the diagram below BAC $=30^0$ and /BA/ = 10cm. find y



LESSONIV

CLASS SSSII

Subject: Mathematics

Duration: 40 minutes

Topic: Sine formula

Previous Knowledge:

Students are familiar with knowledge on the relationship with triangle

Learning Materials: sketches on card board papers showing acute and obtuse angles marker, chalk and duster.

Specific objectives: By the end of the lesson, students should be able to;

(i) Use sine formula
(ii) Find angles

Introduction: Teacher introduces the lesson by writing the topic on the board.

Presentation: Teacher presents the lesson using the following steps

Step I: Teacher state the sine formula and write it on the board.

$$\frac{SinA}{a} = \frac{SinB}{b} = \frac{SinC}{c}$$

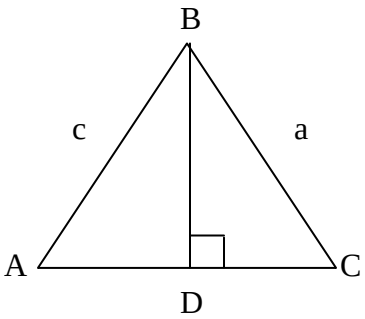
StepII: Teacher also writes the conditions for using sine rule.

I Two sides and one corresponding angle to one of the given side must be given.

Ii One side and two angles of the side to be calculated are opposite the given angles.

Iii The radius of the circle passing through the sides of the triangle must be given.

StepIII: Teacher draws acute and obtuse triangles to derive the sine formulae.



In △BC, draw the altitude h from B.to AC.

Then in right-angled △BD.

$\frac{h}{c}$ =SinA

H = csinA

In right-angled △BD

$\frac{h}{a}$ =SinC

H =asinC

Note h=cSinA=aSinC

CSinA=aSinC

$\frac{C}{SinC} = \frac{a}{SinA}$

Similarly, by drawing the altitude c to BA

$\frac{b}{SinC} = \frac{a}{SinA}$

$\frac{a}{SinA} = \frac{b}{SinB} = \frac{c}{SinC}$

From the △ABC, draw a perpendicular AD to BC in △ABC, $\sin B = \frac{|AD|}{c}$

$\therefore |AD| = c \sin B$ ---------- (i)

In ACD,△$\sin C = \frac{AD}{b}$

$|AD| = b \sin C$ ---------- (ii)

Equating (i) and (ii), we have

$$c \sin B = b \sin C$$

$$\frac{\sin B}{\sin C} = \frac{b}{c} \Rightarrow \frac{sinB}{b} = \frac{sinC}{c}$$

Similarly, $\frac{\sin A}{\sin B} = \frac{a}{b} \Rightarrow \frac{\sin A}{a} = \frac{\sin B}{b}$

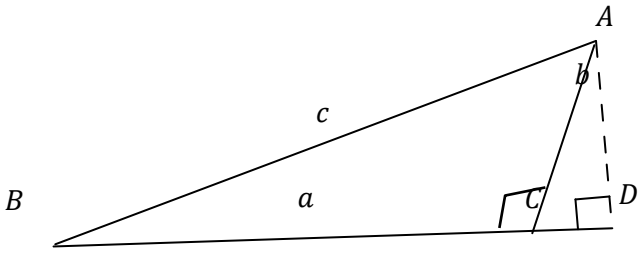
and ,$\frac{\sin A}{\sin C} = \frac{a}{c} \Rightarrow \frac{\sin A}{a} = \frac{\sin C}{c}$

The three deductions are therefore combined as:

$\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$

Or $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

Step II: Teacher also derive the sine formula using obtuse angled triangle sine formula from obtuse angled triangle



From the △ABC, draw a perpendicular AD to BC produced.

In △ABD, $\angle ACB$ and $\angle ACD$ are supplementary

$|AD| = c \sin B$ ---------- (i)

In ACD△

$|AD| = b \sin C$ ---------- (ii)

From above

$$sin\, A\hat{C}D = sin\, A\hat{C}B = \sin C$$

From (i) and (ii)

$c \sin B = b \sin C$

$$\frac{b}{c} = \frac{\sin B}{\sin C}$$

Similarly, $\frac{a}{b} = \frac{\sin A}{\sin B}$

And $\frac{a}{c} = \frac{\sin A}{\sin C}$

Combining the result, we have

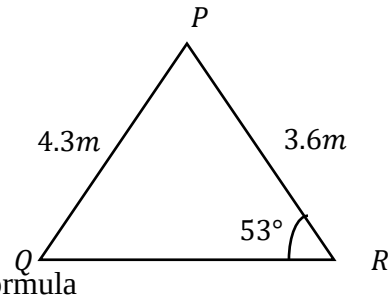
$\frac{sinA}{a} = \frac{sinB}{b} = \frac{sinc}{c}$

Step IV: Teacher solve problem using sine formula

(II) In△PQR, R = 53^0, $q = 3.6m, r = 4.3m$

Find Q

Solution



Using sine formula

$\frac{r}{\sin R} = \frac{q}{\sin Q}$

$\frac{4.3m}{\sin 53} = \frac{3.6m}{\sin Q}$

Cross multiplying

$$\sin Q = \frac{3.6m \times \sin 53°}{4.3m}$$

$$= \frac{3.6m \times 0.7986}{4.3m}$$

$$Sin\ Q = 0.6686$$

$$= \sin^{-1}(0.6686)$$

$$= 41.96$$

$$= 42°$$

Evaluation: Teacher evaluates the lesson by asking students questions based on what has been taught and giving the students class work to measure their success or failure of the lesson.

Conclusion: Teacher concludes the lesson by briefly explaining the main points of the lesson and allowing the students to ask questions based on what has been taught in the class.

Assignments: Teacher assigns the following questions to the students to do at home.

in triangle ABC, if

(i) $A = 38°, B = 27°, b = 17m$, find a and C
(ii) $A = 69°$, $b = 9cm, a = 19cm$, find B and c

LESSON V

CLASS: SSSII

Subject: Mathematics

Duration: 40minutes

Topic: cosine formula

Previous Knowledge: Students are familiar with use of sine formula

Learning Materials: Charts showing acute and obtuse angles, marker, chalk and duster.

Specific objectives: By the end of the lesson, students should be able to;

(iii) Use cosine formula
(iv) Find angles

Introduction: Teacher introduces the lesson by writing the topic on the board.

Lesson Presentation: Teacher presents the lesson by the following steps

Step I: Teacher state the cosine formula and write it on the board.

CosA $=\frac{b2+c2-a2}{2bc}$ CosB $=\frac{a2+c2-b2}{2ac}$ and CosC $=\frac{a2+b2-c2}{2ab}$

StepII: Teacher also writes the conditions for using cosine formula.

i.Two sides and the included angle known.

ii the Three sides known.

Step iii: Teacher draws acute and obtuse angled triangles.

Cosine formula from acute and obtuse angled triangles

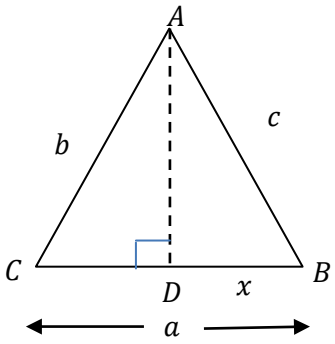


Figure 1.1: Acute angle triangle

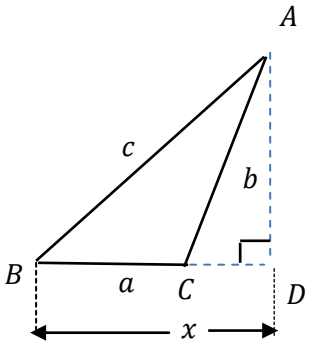


Figure 1.2: Obtuse angled

From figure 1.1, let $BD = x$, then $CD = a - x$, figure1.2, $CD = x - a$

In $\triangle$ABD, $AD^2 = AB^2 - BD^2$ (Pythagoras theorem)

$= c^2 - x^2$……..(i)

In △ACD: $AD^2 = AC^2 - CD^2$ (Pythagoras thereon)

$= b^2 - (a - x)^2$ …….(ii)

$= b^2 - (x - a)^2$

But$(a - x)^2 = (x - a)^2$

By equating (i) and (ii)

$b^2 - (a - x)^2 = c^2 - x^2$

$b^2 - a^2 + 2ax - x^2 = c^2 - x^2$

$\therefore 2ax = a^2 + c^2 - b^2$ ……..(iiii)

but from △ABD

$cos\ B = \frac{x}{c}$

$x = c\ cos\ B$

Substituting for x in equation (iii)

$2ac\ cos\ B = a^2 + c^2 - b^2$

$cos\ B = \frac{a^2 + c^2 - b^2}{2ac}$

Similarly,

$$\cos C = \frac{a^2 + b - c^2}{2ab}$$

$$\cos A = \frac{b^2 + c^2 - a^2}{2bc}$$

$a^2 = b^2 + c^2$ -2bc cosA

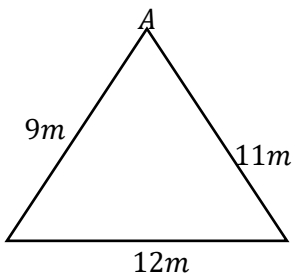
$b^2 = a^2 + c^2$ -2ac cos B

$c^2 = a^2 + b^2$ -2abcos C

Step IV: Teacher solve problem using cosine formula

(i) Find the angle of the triangle with the following dimensions $a = 12m, b = 11m, c = 9m$

Solution



Using $\cos A = \frac{b^2+c^2-a^2}{2bc}$

$$= \frac{11^2 + 9^2 - 12^2}{2 \times 11 \times 9}$$

$$= \frac{121 + 81 - 144}{198}$$

$= \frac{58}{198}$

= 0.2929

$\therefore A = 72.97°$

$$\cos B = \frac{a^2 + c^2 - b^2}{2ac}$$

$= \frac{12^2+9^2-11^2}{2\times12\times9}$

$= \frac{144+81-121}{216}$

$= \frac{104}{216}$

= 0.4815

B = 16.22^0

$$\cos C = \frac{a^2 + b^2 - c^2}{2ab}$$

$= \frac{12^2+11^2-9^2}{2\times12\times11}$

$= \frac{144+121-81}{264}$

$= \frac{184}{264} = 0.6970$

$C = 45\ 491^1$

Evaluation: Teacher evaluates the lesson by asking students questions based on what has been taught and giving the students class work to measure the success or failure of the lesson

Conclusion: Teacher concludes the lesson by briefly explaining the main points of the lesson and allowing the students to ask question based on what has been taught in the class.

Assignments: Teacher assigns the following question to the students to do at home

Find the angles of the triangle with the following dimensions (i)$a = 5cm\ b = 4cm$ and $C = 7cm$

LESSON VI

CLASS: SSSII

Subject: Mathematics

Duration: 40minutes

Topic: Angles of elevation

Learning Materials: clinometers, ruler and protectors measuring tape

Previous Knowledge: Students are familiar with how to measure distance and also angles.

Introduction: Teacher introduces the lesson by writing the topic on the board.

Specific objectives: By the end of the lesson, students should be able to;

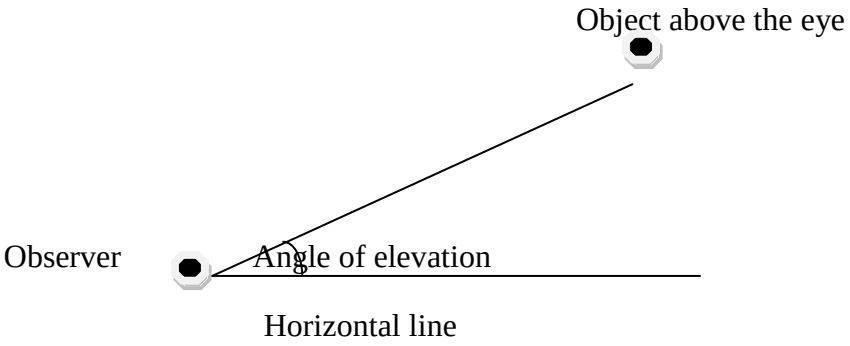
(i) Define angles of elevation
(ii) Identify angles of elevation
(iii) Solve problems related to angles of elevation

Lesson Presentation: Teacher presents the lesson by the following steps

Step I: Teacher define what is an angle of elevation?

The angle of elevation is the angle between normal eye level (horizontal) and the line through which an object is above.

Step II: Teacher draws and explains the term angle of elevation



To look at the top T of a free from M, a man must turn his eyes from the horizontal position through the angles shown and look up.

Step III: Teacher solve some problem on angle of elevation

A man is at a point 18m away from the foot of a tree from that point the angle of elevation of the top of the tree is 29^0. Calculate the height of the tree.

Solution

To calculate the $height\ h$

$tan\ 29° = \frac{h}{18}(tan = \frac{opp}{adj}$

$h = 18m \times tan\ 29°$

$= 18m \times 0.5543$

$= 9.977m$

$= 9.98m$

Evaluation: Teacher evaluates the lesson by asking students questions based on what has been taught and giving the students class work to measure the success or failure of the lesson.

Conclusion: Teacher concludes the lesson by briefly explaining the main points of the lesson and allowing the students to ask questions based on what has been taught in the class.

Assignments: Teacher assigns the following questions to the students to do at home

1 What is the meaning angle elevation
2 The angle of elevation of the top of a tree from a point on the ground is $42°$. If the point is $30m$ away from the foot of the tree find the height from the tree.

LESSON VII

CLASS: SSSII

Subject: Mathematics

Duration: 40 minutes

Topic: Angles of depression

Learning Materials: clinometers, ruler and protectors

Previous Knowledge: Students are familiar with how to solve problem on trigonometric ratio and angle elevation.

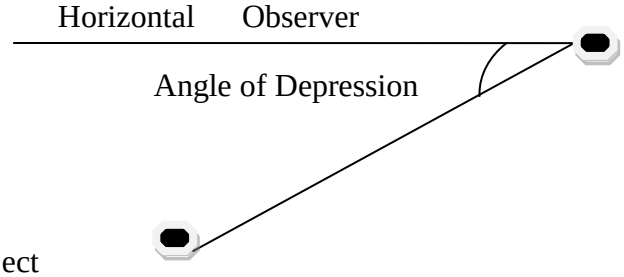
Specific objectives: By the end of the lesson, students should be able to;

(i) Define angles of depression
(ii) Identify angles of depression
(iii) Calculate angle of depression

Introduction: Teacher introduces the lesson by writing the topic on the board.

Lesson Presentation: Teacher presents the lesson by the following steps

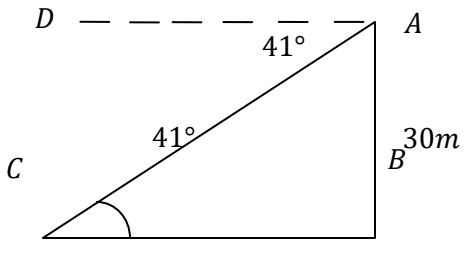
Step I: Teacher define what is an angle of depression?



The angle of depression is the angle between the horizontal line and the line through which the object which is below the observer's eye can be seen

Step II: Teacher solves some examples on the board, and explains to the students.
The angle of depression from the top of a building of height 30m of a stationary car is 41^0 find the distance between the car and the top of the building.

Solution



The diagram shows the height AB and the angle of depression DAC angle BCA is also equal to 41^0 (Alternative to angle DAC)
The distance required is AC (hypotenuse to the DABC)

Sin $41^0 = \frac{30m}{AC}$ = AC sin41^0 = 30m

AC $= \frac{30m}{sin\,41}$

$= \frac{30}{0.6561}$

$= 45.7m$

Evaluation: Teacher evaluates the lesson by asking students questions based on what has been taught and giving the students class work to measure the success or failure of the lesson.

Conclusion: Teacher concludes the lesson by briefly explaining the main points of the lesson and allowing the students to ask questions based on what has been taught in the class.

Assignments: Teacher assigns the following questions to the students to do at home

(i) What do you understand by angle depression?
(ii) An aircraft is Circling an airport at height of 600m. The navigator finds the angle of depression of the control tower of the airport is 12^0. What is the distance between the aircraft and the control tower?

LESSONVIII

CLASS: SSSII
Subject: Mathematics
Duration: 40 minutes
Topic: Bearings and distance
Previous Knowledge:
Students are familiar with solving solution of triangles and sine and cosine formula

Learning Materials: Ruler protractor, pencil and Magnetic compass

Specific objectives: By the end of the lesson, students should be able to;

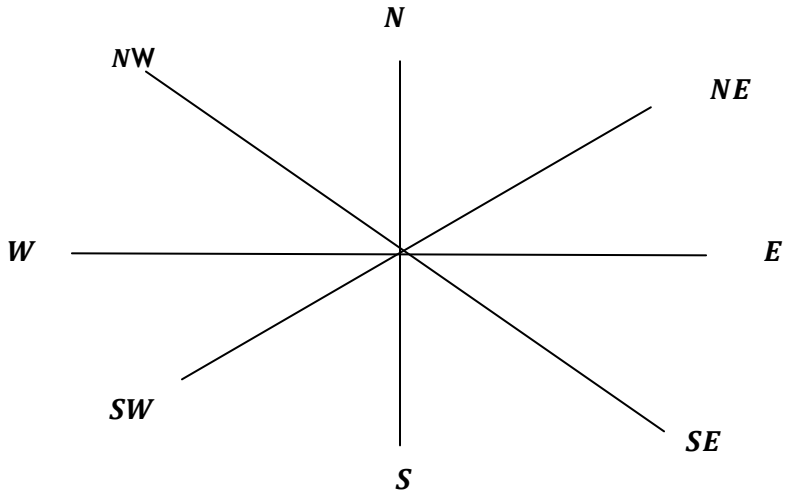
(i) Define Bearing
(ii) Solve problems involving bearing

Introduction: Teacher introduces the lesson by writing the topic on the board.

Lesson Presentation: Teacher presents the lesson by the following steps

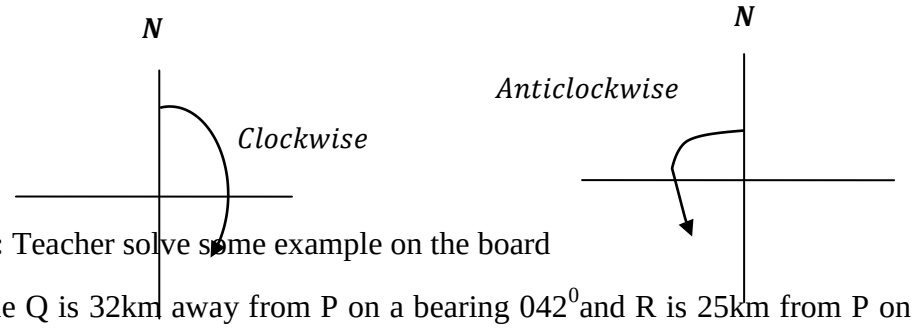
Step I: Teacher defines bearings are the anti-clockwise angular relationships between two distant places measured in desires.

Step II: Teacher draws the cardinal points and shows their direction North East (NE), South-East (SE) South-West (SW) and North-West (NW)



Step III: Teacher informs the students that primary directions divide the angle at a point into four equal part 90° each. While the secondary direction divide each right angle into 45° each. The position or direction of an object is taken from North in a clockwise direction.

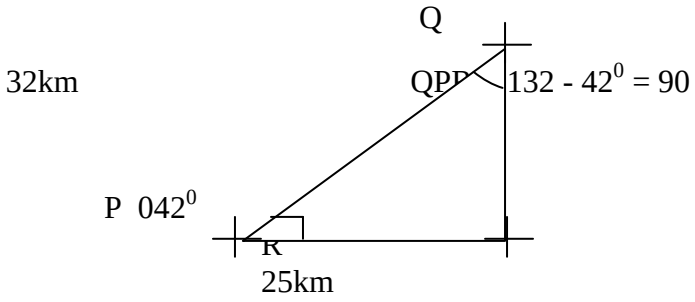
Step IV: Teacher also draw a diagram for more understanding



Step V: Teacher solve some example on the board

Example Q is 32km away from P on a bearing $042^0$and R is 25km from P on a bearing of 132^0.Calculate the bearing of R from Q.

Sketch the diagram for the above relationship and find angle Q



Since opposite and adjacent are given, the trigonometric ratio is tanθ

$\text{Tan}\theta = \frac{Opposite}{Adjacent} = \frac{25km}{32km}$

$\tan\theta\ 0.781$

$\theta = \tan^{-1}0.781$

$\theta = 37.999^0$

The bearing of R from Q

$=37.999 + 42$

$=79.999$

$=80^0$

Evaluation: Teacher evaluates the lesson by asking the students questions based on what has been taught and giving the students class work to measure the success or failure of the lesson.

Conclusion: Teacher concludes the lesson by briefly explaining the main points of the lesson and allowing the students to ask questions based on what has been taught in the class

Assignments: Teacher assigns the following question to the students to do at home

A boat sail 6km from a port X on a bearing of 065^0 and thereafter 13km on a bearing of 136^0.What is the distance and bearing of the boat from X?

APPENDIX N

SPSS RESULTS PRINTOUT

Null Hypothesis One

```
NPAR TESTS
  /K-W=tattitudescores BY teatment(1 3)
  /MEDIAN=tattitudescores BY teatment(1 3)
  /STATISTICS DESCRIPTIVES
  /MISSING ANALYSIS.
```

NPar Tests

```
[DataSet1] C:\Users\umar\Documents\Ganiyat Null One.sav
```

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum
total attitude scores	381	102.3324	5.76084	84.00	119.00
Treatment	381	1.96	.826	1	3

Kruskal-Wallis Test

Ranks

	treatment	N	Mean Rank
total attitude scores	1 inquiry	137	188.98
	2 problem solving	121	176.04
	3 lecture method	123	191.42
	Total	381	

Test Statistics[a,b]

	total attitude scores
Chi-Square	1.445
df	2
Asymp. Sig.	.486

a. Kruskal Wallis Test

b. Grouping Variable: treatment

Median Test

Frequencies

		teatment		
		1 inquiry	2 problem solving	3 lecture method
total attitude scores	> Median	67	51	65
	<= Median	68	70	49

Test Statistics[b]

	total attitude scores
N	370
Median	102.0000
Chi-Square	5.194[a]
df	2
Asymp. Sig.	.075

a. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 56.4.
b. Grouping Variable: treatment

Null Hypothesis Two

```
DATASET ACTIVATE DataSet1.
ONEWAY score BY treatment
  /STATISTICS DESCRIPTIVES
  /MISSING ANALYSIS
  /POSTHOC=SCHEFFE ALPHA(0.05).
```

Oneway

```
[DataSet1] C:\Users\umar\Documents\Ganiyat Null Two.sav
```

Descriptives

Score

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
1 inquiry	137	26.39	5.421	.463	25.47	27.30	11	35
2 problem solving	121	19.88	3.426	.311	19.27	20.50	14	29
3 lecture method	123	17.48	3.166	.285	16.91	18.04	11	24
Total	381	21.45	5.667	.290	20.88	22.02	11	35

ANOVA

Score

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	5574.571	2	2787.286	158.971	.000
Within Groups	6627.576	378	17.533		
Total	12202.147	380			

Post Hoc Tests

Multiple Comparisons

Score

Scheffe

(I) treatment	(J) treatment	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
1 inquiry	2 problem solving	6.503*	.522	.000	5.22	7.79
	3 lecture method	8.907*	.520	.000	7.63	10.19
2 problem solving	1 inquiry	-6.503*	.522	.000	-7.79	-5.22
	3 lecture method	2.405*	.536	.000	1.09	3.72
3 lecture method	1 inquiry	-8.907*	.520	.000	-10.19	-7.63
	2 problem solving	-2.405*	.536	.000	-3.72	-1.09

*. The mean difference is significant at the 0.05 level.

Homogeneous Subsets

Score

Scheffe[a,b]

Treatment	N	Subset for alpha = 0.05: 1	2	3
3 lecture method	123	17.48		
2 problem solving	121		19.88	
1 inquiry	137			26.39
Sig.		1.000	1.000	1.000

Means for groups in homogeneous subsets are displayed.
a. Uses Harmonic Mean Sample Size = 126.615.
b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

Null Hypothesis Three

```
ONEWAY score BY treatmen
  /STATISTICS DESCRIPTIVES
  /MISSING ANALYSIS
  /POSTHOC=SCHEFFE ALPHA(0.05).
```

Oneway

```
[DataSet2] C:\Users\umar\Documents\Ganiyat Null Three.sav
```

Descriptives

Score

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
1 inquiry	137	22.07	4.953	.423	21.23	22.90	14	34
2 problem solving	121	19.83	4.455	.405	19.02	20.63	9	31
3 lecture method	123	18.52	5.530	.499	17.53	19.51	5	34
Total	381	20.21	5.204	.267	19.69	20.73	5	34

ANOVA

Score

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	840.739	2	420.369	16.818	.000
Within Groups	9448.463	378	24.996		
Total	10289.202	380			

Post Hoc Tests

Multiple Comparisons

Score

Scheffe

(I) treatmen	(J) treatmen	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1 inquiry	2 problem solving	2.239*	.624	.002	.71	3.77
	3 lecture method	3.545*	.621	.000	2.02	5.07
2 problem solving	1 inquiry	-2.239*	.624	.002	-3.77	-.71
	3 lecture method	1.306	.640	.003	-.27	2.88
3 lecture method	1 inquiry	-3.545*	.621	.000	-5.07	-2.02
	2 problem solving	-1.306	.640	.003	-2.88	.27

*. The mean difference is significant at the 0.05 level.

Homogeneous Subsets

Score

Scheffe[a,b]

Treatmen	N	Subset for alpha = 0.05	
		1	2
3 lecture method	123	18.52	
2 problem solving	121	19.83	
1 inquiry	137		22.07
Sig.		.117	1.000

Means for groups in homogeneous subsets are displayed.
a. Uses Harmonic Mean Sample Size = 126.615.
b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

Null Hypothesis Four

```
GET
  FILE='C:\Users\umar\Documents\Ganiyat Null Four.sav'.
DATASET NAME DataSet1 WINDOW=FRONT.
NPAR TESTS
  /M-W= tattitudescores BY treatment(1 2)
  /MISSING ANALYSIS.
```

NPar Tests

```
[DataSet1] C:\Users\umar\Documents\Ganiyat Null Four.sav
```

Mann-Whitney Test

Ranks

	treatment	N	Mean Rank	Sum of Ranks
total attitude scores	1	137	132.13	17837.50
	2	121	124.45	15058.50
	Total	258		

Test Statistics[a]

	total attitude scores
Mann-Whitney U	7677.500
Wilcoxon W	15058.500
Z	-.830
Asymp. Sig. (2-tailed)	.406

a. Grouping Variable: treatment

NPar Tests

```
[DataSet1] C:\Users\umar\Documents\Ganiyat Null Four.sav
```

Mann-Whitney Test

Ranks

	gender	N	Mean Rank	Sum of Ranks
total attitude scores	1	137	128.77	17384.50
	2	121	128.19	15511.50
	Total	258		

Test Statistics[a]

	total attitude scores
Mann-Whitney U	8130.500
Wilcoxon W	15511.500
Z	-.063
Asymp. Sig. (2-tailed)	.950

a. Grouping Variable: gender

Null Hypothesis Five

```
UNIANOVA score BY treatment gender
  /METHOD=SSTYPE(3)
  /INTERCEPT=INCLUDE
  /EMMEANS=TABLES(treatment)
  /EMMEANS=TABLES(gender)
  /EMMEANS=TABLES(treatment*gender)
  /PRINT=DESCRIPTIVE
  /CRITERIA=ALPHA(.05)
  /DESIGN=treatment gender treatment*gender.
```

Univariate Analysis of Variance

```
[DataSet3] C:\Users\umar\Documents\Ganiyat Null Five.sav
```

Between-Subjects Factors

		N
treatment	1	137
	2	121
gender	1	137
	2	121

Descriptive Statistics

Dependent Variable:score

treatment	gender	Mean	Std. Deviation	N
1	1	27.26	6.551	73
	2	25.39	3.535	64
	Total	26.39	5.421	137

2	1	20.73	3.965	64
	2	18.93	2.389	57
	Total	19.88	3.426	121
Total	1	24.21	6.378	137
	2	22.35	4.440	121
	Total	23.34	5.622	258

Tests of Between-Subjects Effects

Dependent Variable:score

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	2934.170[a]	3	978.057	47.889	.000
Intercept	136369.625	1	136369.625	6677.192	.000
Treatment	2698.794	1	2698.794	132.144	.000
Gender	216.022	1	216.022	10.577	.001
treatment * gender	.068	1	.068	.003	.954
Error	5187.493	254	20.423		
Total	148635.000	258			
Corrected Total	8121.663	257			

a. R Squared = .361 (Adjusted R Squared = .354)

Estimated Marginal Means

1. treatment

Dependent Variable:score

			95% Confidence Interval	
treatment	Mean	Std. Error	Lower Bound	Upper Bound
1	26.325	.387	25.563	27.087
2	19.832	.412	19.022	20.643

2. gender

Dependent Variable:score

			95% Confidence Interval	
gender	Mean	Std. Error	Lower Bound	Upper Bound
1	23.997	.387	23.235	24.759
2	22.160	.412	21.350	22.971

3. treatment * gender

Dependent Variable:score

				95% Confidence Interval	
treatment	gender	Mean	Std. Error	Lower Bound	Upper Bound
1	1	27.260	.529	26.219	28.302
	2	25.391	.565	24.278	26.503
2	1	20.734	.565	19.622	21.847
	2	18.930	.599	17.751	20.109

Null Hypothesis Six

```
UNIANOVA score BY treatmen gender
  /METHOD=SSTYPE(3)
  /INTERCEPT=INCLUDE
  /EMMEANS=TABLES(treatmen)
  /EMMEANS=TABLES(gender)
  /EMMEANS=TABLES(treatmen*gender)
  /PRINT=DESCRIPTIVE
  /CRITERIA=ALPHA(.05)
  /DESIGN=treatmen gender treatmen*gender.
```

Univariate Analysis of Variance

```
[DataSet4] C:\Users\umar\Documents\Ganiyat Null Six.sav
```

Between-Subjects Factors

		N
treatmen	1	137
	2	121
gender	1	137
	2	121

Descriptive Statistics

Dependent Variable:score

treatmen	gender	Mean	Std. Deviation	N
1	1	24.14	4.860	73
	2	19.70	3.914	64
	Total	22.07	4.953	137
2	1	20.89	4.640	64
	2	18.63	3.944	57
	Total	19.83	4.455	121
Total	1	22.62	5.012	137
	2	19.20	3.949	121
	Total	21.02	4.848	258

Tests of Between-Subjects Effects

Dependent Variable:score

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	1146.451[a]	3	382.150	19.836	.000
Intercept	111201.772	1	111201.772	5772.009	.000
Treatmen	298.345	1	298.345	15.486	.000
Gender	716.806	1	716.806	37.206	.000
treatmen * gender	75.686	1	75.686	3.929	.049
Error	4893.487	254	19.266		
Total	119986.000	258			
Corrected Total	6039.938	257			

a. R Squared = .190 (Adjusted R Squared = .180)

Estimated Marginal Means

1. treatmen

Dependent Variable:score

			95% Confidence Interval	
treatmen	Mean	Std. Error	Lower Bound	Upper Bound
1	21.920	.376	21.180	22.660
2	19.761	.400	18.974	20.548

2. gender

Dependent Variable:score

			95% Confidence Interval	
gender	Mean	Std. Error	Lower Bound	Upper Bound
1	22.514	.376	21.774	23.254
2	19.167	.400	18.380	19.954

3. treatmen * gender

Dependent Variable:score

				95% Confidence Interval	
treatmen	gender	Mean	Std. Error	Lower Bound	Upper Bound
1	1	24.137	.514	23.125	25.149
	2	19.703	.549	18.623	20.784
2	1	20.891	.549	19.810	21.971
	2	18.632	.581	17.487	19.777