IMPACT OF COOPERATIVE LEARNING STRATEGY ON PERFORMANCE AND RETENTION IN GEOMETARY AMONG JUNIOR SECONDARY SCHOOL STUDENTS IN SOKOTO STATE, NIGERIA

BY

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MED/EDUC/07840/2010-2011

A THESIS SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES, AHMADU BELLO UNIVERSITY, ZARIA

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF A MASTER DEGREE IN MATHEMATICS EDUCATION.

DEPARTMENT OF SCIENCE EDUCATION,
FACULTY OF EDUCATION
AHMADU BELLO UNIVERSITY, ZARIA
NIGERIA

MARCH, 2015

DECLARATION

I Aminu ISAH hereby declare that, the work in this thesis entitled "Impact of Cooperative Learning Strategy on performance and Retention in Geometry among Junior Secondary School Students in Sokoto State, Nigeria" has been done by me in the Department of Science Education, Faculty of Education Ahmadu Bello University, Zaria, The information obtained from the literature has been duly acknowledged in the text and a list of references provided. No part of this thesis was earlier presented for another degree or diploma at this or any other institution.

Aminu ISAH	Signature	Date

CERTIFICATION

This thesis entitled "Impact of Cooperative Learning Strategy on performance and Retention in Geometry among Junior Secondary School Students in Sokoto State, Nigeria" by Aminu ISAH meets the regulations governing the award of the master's degree of Mathematics Education of the Ahmadu Bello University and is approved for its contribution to knowledge and literary presentation.

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ACKNOWLEDGEMENTS

In the course of preparing this thesis, I benefited greatly from the generosity of many individuals for which I desire to express my profound gratitude. I am first and foremost grateful to Allah (S.W.A) who gave me the health and the will to undertake this study. I am as well grateful to my supervisors Prof. Y.K. Kajuru and Dr. Mamman Musa, who despite of their academic and social commitments took their time and corrected this work to its completion. I wish to tender my special gratitude to my father Isah Ummar and my mother Fatima Muhammadu Na Mai Gujiya, I am very grateful for your love and assistance for this work.

I would like to express my gratitude to other individuals who contributed immensely to this thesis among them are: Mal. H. I. Haruna, Dr. I.O Ibrahim, Dr. Alh. Isa Usman, Dr. Sani Bichi, Dr. S.B. Olorukooba, Mal. Aminu Umar Ginga all from Science Education Department, Ahmadu Bello University, Zaria. My gratitude also goes to Atese Febian Batoon of Benue State University, Mal. Umar Garba of Sokoto State Polythenic, Mal. Nasiru Anka of Zamfara State College of Education Maru, Abubakar M. Yabo, Mal. Shehu Mohammed Department of English, Chief A. Y. Sayinna, Mal. Aminu Umar Yabo and Mrs. Cristy D. Abdallah all from Shehu Shagari College of Education Sokoto for their academic advice during this work. Mal. Bala Isah, Mal. Murtala Dangula both from Usmanu Danfodio University Sokoto for their contributions in the course of writing this work.

I am also grateful to Director finance Alh. Abubakar Ahmed Walin Gagi, State Universal Basic Education Board Sokoto, Alhaji Sanda Maidubara, Alh. Aminu Dan Malam (Toda) and Abubakar Magaji for their financial assistance. I

am grateful to the Staff of Faculty of Education Library Ahmadu Bello University, Zaria especially Muhammed Suleiman and Muntaka S. Haruna who helped me not only with the hard materials, but with the printing of soft materials.

I am very grateful to my family members such as: Aishatu Isah, Zuwaira Isah, Hanafi Isah, Na'ima Isah, Nasara Isah, Rakiya Isah, Nura Isah, Badamasi Isah and Sambo Isah for their powerful prayers and assistance to the completion of this work. My gratitude also goes to Sufiyanu Salihu whom spared most of his time assisting my children in my absence for this study.

I am very grateful to my wives, Balkisu Amadu Maikanwa and Sa'adatu Abubakar for their love and concern. I am also grateful to all my children. There are other countless individuals who assisted me in the course of this write up, Please admit my gratitude in general. As I acknowledged the assistance issued to me by many people in the course of preparing this thesis, I also acknowledged all the sources of material I used in this study, I wish to point out that I personally bear the responsibilities for any omission in this thesis. This was not intentional.

DEDICATION

This thesis entitled “Impact of Cooperative Learning Strategy on performance and Retention in Geometry among Junior Secondary School Students in Sokoto State, Nigeria” is dedicated to my parents: Isah Umar and Fatima Muhammad Na Mai Gujiya.

OPERATIONAL DEFINITION OF TERMS

Cooperative Learning: means a small group of learners working together to achieve common educational objectives.

Learning: This is any change in activities that is attributed to experiences

Retention: Ability to recall what has been learned within a period of two weeks.

Performance: Ability to construct special angles after five weeks treatment of CLS.

Pretest: This is a type of test given to students before the treatment begin. It was given in order to establish homogeneity among the students.

Posttest: This is a kind of test given to the students after five weeks treatment of GCPT with CLS. It is given in order to determine the significant difference between the students under investigation.

Post--posttest: This is a kind of a test given to students after two weeks of **posttest.** It was given in order to ascertain the retention ability of the students under investigation. Two weeks after administering posttest, post-posttest was re-administered to experimental and control groups, in order to test the retention ability of the students using same instrument GCPT only that the instrument was shuffled as the researcher assumed that after two weeks gaps the students might have forgotten the instrument being administered.

ABBREVIATIONS USED

GCPT:	Geometry Construction Performance Test
CLS:	Cooperative Learning Strategy
CLM	Conventional Lecture Method
GDSS:	Government Day Secondary School
NCTM:	National Council of Teachers of Mathematics
JSS	Junior Secondary School
JSS III:	Junior Secondary School 3

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Abstract

The study investigated the impact of cooperative leaning strategy on performance and retention in geometry among junior secondary school students in Sokoto state, Nigeria. The purpose was to investigate whether or not CLS enhances the performance and retention ability of students in geometry construction of JSS III as against the use of CLM. The study indicates that students' performance in geometry construction is very poor. It also established that using CLS improved performance and retention ability of students in geometry construction. The design of the study was quasi experimental control group design such as: pretest, posttest and post posttest design. 10,103 students formed the population of the study; purposive sampling procedure was used to select 354 students from the study area. GCPT was administered before and after the treatment. Four research questions were asked from which four null hypotheses were developed and tested at 0.05 level of confidence. Independent t-test was used to analyze each hypothesis appropriately. CLS was used to teach experimental group in geometry construction of JSS III while CLM was used to teach control group the same topics. The analysis of the data indicated that students taught with CLS performed and retained significantly higher than students taught with CLM. Male students taught with CLS performed better than the male students taught with CLM. The study found no significant deference between male and female students taught with CLS. Female exposed to CLS did not perform better than the Female exposed to CLM. Female students exposed to CLS did not perform better than female taught with CLM. On the basis of these findings, the study concluded that CLS improved students' performance and retention in geometry construction of JSS III. The study therefore, recommends that CLS should be adopted in the teaching and learning of mathematics in general and geometry construction in particular.

CHAPTER ONE

THE PROBLEM

1.1 Background to the Study

This study attempted to explore the Impact of cooperative learning strategy on performance and retention in geometry among government own junior secondary schools students in Sokoto State, Nigeria. The low performance of pupils in mathematics has become a concern in mathematics education (Kajuru & Kauru, 2010). Yet many students find it very difficult to solve mathematical problems. The reason for these difficulties may vary but this could sometimes be related to the teaching method being used to explain such topics (Chianson, Kurumeh & Obida, 2011). To corroborate the above findings, Peter (2001) asserted that 'the issue of poor performance in mathematics examination was due to the problem of teaching methods'.

In the United States (US) for instance, students' performance in mathematics (specifically in Geometry content area) was the least among the hierarchy of all the countries. Thirty eight (38) countries outperformed the US in geometry with Japan at the top with a score of five thousand seven hundred and five (5705) and international average of four hundred and seventy three (473) in geometry (Unal, 2005). In Nigeria, there is ample evidence of continued poor performance of students in both standardized and teacher made examinations (Benjamin & Agwagah, 2006). Reports from examination bodies such as West African Examinations Council (WAEC) and National Examinations Council (NECO) indicated students' low performance in mathematics as contained in the chief examiner's report (1995; 1996; 2000 & 2005). Considering these reports, Fajemidagba (1998) and Atebe (2008) opined that, high performance in mathematics is a good indication

of high performance in geometry [construction] in particular, the reverse may be true.

Many reasons have been advanced for this poor state of students' performance in mathematics and geometry in particular. Some researchers viewed strategy of teaching as one of the contributing factors to poor performance of students in geometry, some of whom include: Undeinya and Okabiah (1991), Peter (2001) and Chianson *et al* (2011). There has also been an increased awareness by those concerned with mathematics education that the traditional lecture method of teaching mathematics has not been very successful (Chianson et al, 2011). For effective teaching to take place, the skillful mathematics teacher needs to adapt many different strategies of teaching. A well formulated teaching method would yield teaching and learning effective. This study therefore attempts to explore avenues through which teaching of geometry construction in public secondary schools can be made more effective. This implies the use of cooperative learning which according to Chianson et al (2011); is one of the many teaching methods which result in positive impact and retention of information among students. Performance can be defined as the quality of results produced by students as reflected in the quality of their examination scores (Musa, 2000).

Retention on the other hand as defined by Kudu & Tutoo (2002) is a preservative factor of mind. The mind acquires the materials of knowledge through sensation and perception (Chianson et al, 2011). These acquired materials in mind need to be preserved in form of images for knowledge to develop. If a stimulating situation happens retained images are restored to make memorization possible. Hence, geometry construction concepts need to be presented to the learners in a way or method that touches sub-conciousness which can trigger quick recalling of the concepts being taught or learnt (Chianson et al, 2011). According to the authors, using cooperative learning method yield promotive understanding, explanation and retention of geometric concept being learnt by

the students.

1.1.1 Theoretical Frame Work

The theoretical basis of this study is cooperative learning as proposed by Vygotsky. Its roots therefore lie deep in learning theories. Cooperative learning is developed by social constructivists. The proponent of Social constructivist theory is **Vygotsky**. Social constructivist theory is a learning approach which argues that individuals can learn best when they actively construct knowledge and understanding through interaction with others (Cam, 1995; Santrock, 2004). Emphasis in cooperative learning is therefore, given to interactions rather than actions of individuals (Nguuma, 2010). Scholars define cooperative learning in different ways some of these scholars include: Yi-wen (1999) who defined cooperative learning as a kind of learning strategy in which students study together and complete common goals. Each student contributes his/her own efforts in small groups to promote one another's performance. Mckeachie (1999) explains that in a cooperative learning class, students often elaborate on the concept being taught to achieve what is expected. But in this study therefore, cooperative learning strategy is regarded as: a small group of learners working together to achieve common educational objectives.

Elaboration provided from one student to another is a win/ win situation (Chianson et al, 2011). According to the authors elaboration not only enhances the learning of student who receives the explanation but also deepens the understanding of student providing the explanation. Hence, consistent and continues elaboration or explanation of a topic brings complete retention of a topic being learnt for a longer period of time.

Therefore, if this method (**CLS)** is to be adopted to teach students in geometry construction of JSS III there might be good performance and complete retention ability

of the concept been taught. Construction means practical formation of a figure or object by putting together the combinations of lines and arcs. For construction of figure to be effective, the students must to put the following instruments in his position such as: a sharp pencil, a straight ruler, a fresh eraser and a pair of compasses. In every construction of figure there must to be a starting point or a line AB often which a construction may be developed. There is no complex construction in JSS construction contents. The contents of JSS III construction considered in this study include: construction of line, construction of parallel line, construction of perpendicular line, construction of angle 60^0, bisection of angle 30^0, construction of angle 90^0 and bisection of angle 45^0.

In view of this therefore, Cooperative learning was reported as effective in the teaching and learning of mathematics at various part of the world. For instance, a Meta analysis of cooperative learning methods indicated that in the world, one thousand (1000) studies have been conducted in cooperative learning (Iqbal, 2004). Out of these studies only few have been conducted in Nigeria. Specifically, in Sokoto, no single study has attempted to investigate the impact of cooperative learning strategy in geometry construction of JSS III among junior secondary schools. Therefore, this study is designed to justify the application of cooperative learning strategy in Geometry construction, to see if it can facilitate and improve the performance and aids students in retaining the concept of geometry construction.

1.2 Statement of the Problem

Despite the relative importance of mathematics in science and information based courses as well as in medicine and social sciences, students' performance in the subject in both internal and external examinations has remained consistently poor (Adolphus, 2011).

According to him mathematics educators are trying to identify the major problems associated with the teaching and learning of mathematics in the nation's schools. Despite all these noble efforts, the problem of poor performance in mathematics has continued to surface in nation's public examinations. Even though scholars viewed geometry as the most difficult aspect of mathematics such as (Nguuma, 2010; Adolphus, 2011). Researchers also conducted studies in geometry, some of them include Chainson, Krumeh and Obida (2011) who worked in circle geometry at Benue State with cooperative learning as the strategy of teaching and found the strategy very effective.

Yet performance and retention of students in geometry in Nigeria schools is generally poor. Many students especially in the study area have fear and lack of interest for mathematics; they shun away from mathematics classes, paid little or no attention to lessons and as a result, continue to experience difficulties in answering questions, particularly in geometry and Mathematics in general. Therefore, they have very poor performances and retention in terminal and promotional examinations. To corroborate the above statement West African Examination Council (WAEC) Zonal coordinator reported that 80% of candidates that sat for the WAEC examination in the year 2012/2013 failed mathematics. This agrees with the report of registrar and chief executive of National Examination Council (NECO) who said that 71.92% of candidates who registered for further (additional) mathematics in the examination failed the subject. The following table concretized all the above reports about poor performance of students in mathematics in Nigeria.

Table 1.1 Performance of Students in Mathematics in WAEC from 2002-2011

Years	Total	Credit Percentage (A1-C6)	Percentage with pass and bellow (%) (D7-F9)
2002	**9082235**	34.06	65.93
2003	**1024451**	36.83	58.84
2004	**1019524**	33.97	62.63
2005	**1054853**	38.20	59.77
2006	**1149277**	41.12	56.04
2007	**1249028**	46.75	50.96
2008	**1268213**	57.27	41.06
2009	**1348528**	47.04	48.97
2010	**1306535**	41.95	55.05
2011	**1508965**	40.35	59.39

Source: WAEC (2014).

The Table above showed poor performance of students in mathematics through all the years. Indeed, the observed poor performance in mathematics in general and geometry in particular required an effective strategy of teaching (Chainson, et al, 2011). This without any argument cooperative learning was reported as effective strategy of teaching mathematics at various places (Johnson & Smith, 1998). Hence, in an attempt to possibly promote the performance and retention and equally solve the problem of poor performance of students in geometry at JSS III in Sokoto metropolis, impact of cooperative learning strategy on performance and retention in geometry among junior secondary school students in Sokoto metropolis is proposed in our own setting to see if it could address this problem.

1.3 Objectives of the Study

The objectives of the study were to:

1) Determine the impact of cooperative learning on students' performance in geometry construction of JSS
2) Determine the impact of cooperative learning on students' retention ability in geometry construction of JSS;
3) Ascertain the impact of cooperative learning as a teaching strategy on gender among male and female students in geometry construction of JSS students;
4) Assess whether or not cooperative learning improve retention ability of male and female students in geometry construction of JSS;

1.4 Research Questions

The following research questions guided the conduct of this study:

1) Is there any difference between the mean performances scores of students taught geometry construction using cooperative learning strategy and their counterparts taught using lecture method?
2) Is there any difference between the mean retention scores of students taught geometry construction using cooperative learning strategy and that of students taught using lecture method?
3) What is the impact of CLS on the mean performance scores of male and female students taught geometry construction and those taught with lecture method?
4) What is the effect of CLS on mean retention scores of male and female students

taught geometry construction using cooperative learning strategy and those taught with lecture method?

1.5 Research Hypotheses

To achieve the objectives of this study the following null hypotheses were formulated and tested at 0.05 level of significance:

H_{01}: There is no significant difference in the mean performance of students taught geometry construction using cooperative learning strategy and those taught with the lecture method.

H_{02}: There is no significant difference in the mean retention scores of students taught geometry construction with CLS and those taught with the lecture method.

H_{03}: There is no significant difference in the mean performance of male and female students taught geometry construction using CLS and those taught with the lecture method. .

H_{04}: There is no significant difference in the mean retention scores of male and female students taught geometry using cooperative learning and those taught using the lecture method.

1.6 Significance of the Study

The significance of this study lies in its potentiality of addressing key issues to the teaching and learning of mathematics as a compulsory discipline as well as being it prerequisite for further education. This study is significant for the following reason:

This study will be of tremendous assistance to all involved in the teaching and learning process. Specifically, it is hoped that this study would be of help to the mathematics

teachers. It is hoped to provide a more efficient method of teaching mathematics considering the worldwide reports about the capability of cooperative learning strategy. It is hope to promote students personal relationship as they relate with one another during lessons' periods and equally enable the slow learners to learn from the past learners in the group. Others that may find this study significant include: National mathematical Centre who train and retrain mathematics teachers to refresh and update their mathematics teaching and learning skills. In another way, It is hoped that this study would assist the stakeholders in curriculum development and decision making in the area of mathematics curriculum development, in particular, the Nigerian Educational Research and Development Council (NERDC), who are in charge of curriculum development in Nigeria.

The result of this study may also provide curriculum planners necessary information that may be importance when curriculum review is needed. The curriculum planners may use the result to measure students' performance in achieving the set objectives of JSS III mathematics curriculum. On the other hand, professional bodies and associations such as: Mathematical Association of Nigeria (MAN), Science Teachers Association of Nigeria (STAN) and National Mathematical Society of Nigeria (NMS), would also be beneficiaries of this study as their members meet annually to review and update their members' knowledge in current researches in the field of mathematics education.

Fellow researchers might also find the study valuable from the design, method and the research gap been identified for their further study in the field. Text book publishers may also find the study valuable as they consider good methods of teaching when writing text book.

The problem areas of the students identified from this study would serve as a vehicle for further research work, the result of this study may further show how to

overcome the difficulties.

1.7 Scope / delimitation of the Study

In this study, the researcher investigated the impact of cooperative learning strategy on performance and retention in geometry among junior secondary school students in Sokoto metropolis only. Strictly, public junior coeducational secondary schools (JSS) III in Sokoto metropolis were considered during the research. The choice of JSS III was because; they are the students preparing for Junior Leaving Certificate (JLC) examination. Federal government and private junior secondary schools in Sokoto metropolis were also excluded in this study, because they are not under the same regulatory body. Construction contents of JSS III were precisely considered only, these include: construction of line, construction of perpendicular line, construction of angle 60^0, bisection of angle 30^0, construction of angle 90^0, bisection of angle 45^0. The reason for choosing geometry construction was because it was identified as one among many difficult areas in mathematics as a result of these difficulties; students are consistently failing mathematics in general. Johnson and Johnson model of CLS was adopted in this study. The test used in this study was a 30 multiple choice objective questions with options a – d.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This study attempted to examine the Impact of Cooperative Learning strategy on performance and retention in geometry among public senior secondary schools students in Sokoto Metropolis: The focus of this chapter however, was to present a review of literature as well as a theoretical frame work of the study. The literature review was done under the following sub- headings:

2.2 Some Mathematics of Teaching Methods

2.3 Concept of Cooperative Learning as a Teaching Strategy

2.6 Conventional Lecture Method (CLM)

2.7 Retention Ability in Mathematics

2.8 Geometry Construction

2.9 Nature and Teaching Geometry at JSS

2.10 Cooperative Learning and Academic Performance in Mathematics

2.11 Mathematics and Cooperative Learning Strategy

2.12 Researches in Cooperative learning

2.13 Researches Related to Cooperative Learning

2.14 Implication of Literature Reviewed on the present Study.

2.2 Some Mathematics Teaching Methods

The method in any teaching and learning is very important this is because the way teachers present a lesson to the learners may make them to either like or dislike the subject. Teaching method is an approach, procedure or position that a teacher adopt to explain a subject. It is not possible to mention all the mathematics teaching methods in this study but some of them are:

Activity Method: This is a student centered teaching method where students learn by doing. In this method students learnt by doing not just by sitting and listening (Oche, 2012).

Discussion Method: This involves a group of students in a class who come together to exchange ideas, facts, opinions, and expressions orally about a topic of mutual concern and interest under a guide.

Guided Inquiry Teaching method: This is a teaching method which enables students to move step by step from the identification of a problem defining the problem formulation hypothesis, collection of data, verification of results and generalization to the drawing of conclusion.

Mastery learning Approach: this is an instructional learning strategy designed to bring all or nearly all learners to a specific level of mastery on a unit of instruction being allow to progress to the next unit of instruction (Goliath, 2011).

Cooperative Learning: this is a small team of learners each with different ability use a variety of learning activities to improve their understanding on a subject.

Discovery Learning: is a powerful instructional approach that guides and motivates

learners to explore instruction and concept, embrace new knowledge and apply new behavior back on the job (Group, 2014).

Problem Solving: this can be define as a process of working through details of a problem to reach a solution.

Team Teaching: this is generally consider to be an instruction delivered by two or more qualified instructors who together make presentations to audience (Nguuma, 2010).

Lecture Method: this is define as the presentation of ideas in words (Kulbir, 1995).

In this study CLS was used to determine its effectiveness in enhancing retention and performance of students on geometry construction of JSS.

2.3 Concept of Cooperative Learning as a Teaching Strategy

Cooperative learning strategy, due to its early history, capability and positive outcomes has been a spotlight of research in the past century. Several studies indicated that, Cooperative learning strategy covers a very diverse school settings and across a wide range of content areas. It has shown that cooperative learning could be adopted at all level of academic learning. It also revealed that students completing cooperative learning group task tend to have higher academic test, serious higher self esteem, greater numbers of positive social skills, fewer stereo type of individuals of other races or ethnic groups and greater comprehension of the content and skills they are studying. Studies have also revealed that cooperative learning strategy can be applied in many fields and at all academic levels. Among these studies are those of: Vygotsky (1978); Slavin, leavey, & Maden (1984); Johnson & Johnson (1995); Qin, Jenkins & O'connor (2003); and Vermette (2004);

To support the above sources several scholars define cooperative learning strategy such as: Johnson & Johnson (1991); Johnson and Hulubec (1993) describe cooperative learning as 'the instructional use of small groups so that students work together to maximize their own and each other's learning'. At this gesture students are expected to yield an academic activity like communication, observation and support. Yi-wen (1999) defines cooperative learning as a kind of learning strategy in which students study together and complete common goals. Each student contributes his/her own efforts in their small group to promote all students' performance (Chiason et al, 2011). Cooperative learning strategy is also a learning technique that brings students together to lean in small, heterogeneous groups. According to Killen (2007) cooperative learning is [a situation] where students work together in small groups to achieve a common goal.

Lea, et al (2003) reported that regardless of the subject matter, students working in small groups tend to learn more of what is taught and retain it longer than when the same content is presented in other instructional format. Artz and Newman (1990) define cooperative learning as a small group of learners working together as a team to solve a problem, complete a task, or accomplish a common goal. Cooperation can also foster students' growth, develop social and learning skills and help them construct their own knowledge through engaging in exchange of ideas.

Modern constructivist school of thought provides the theoretical basis for cooperative learning, problem learning and other discovery oriented learning – teaching process, all of which support mathematical learning (Alemu, 2010). As students are exposed to their peers' thinking process, they take cognizance of others' ideas and ways of thinking (Slavin, Hurley & ChamberKin, 2003). Therefore, constructivists make extensive use of cooperative learning tasks, as well as peer tutoring believing that students will learn

more reality through dialogue with each other about significant problems (Alemu, 2010). To acquire new information, ideas or skills, students have to work actively with each other in purposeful ways (Alemu, 2010). It is elected to collaborative learning, which emphasizes, the "natural learning "that occurs as a result of the information in the community which students work together in unstructured groups and create their own learning situation (Lea, et al, 2003). In these groups, students work interdependently without constant and the direct supervision from the teacher (Alemu,2010). However, cooperative learning is one of the main active learning approaches, along with collaborative learning (Alemu, 2010). This is agrees with the findings of Slavin, leavey, & Madden (1984); Slavin and Ker weit (1985); Al-Halal, 2001; Tarim & Artut 2004; Artut & Tarim, 2007 Cooperative learning strategy is one of the recommended teaching learning techniques in which students achieve learning goals by helping each other in a school setting, whereas education itself has been regarded as social adjustment of an individual (Iqbal,2004). Cooperative learning is considered to be an effective method to improve teaching and learning process in the classrooms (Johnson & Johnson, 1990; 1999). Cooperative learning is based on the belief that education should be learner-centered and learner-directed, that learners can be teachers and that the teacher is a guide and facilitator rather than the source of all knowledge and direction (Coelho, 1994). This is similar to the teaching perspective developed by Khus and Ball (1986) in that the teacher aids the student by questioning, challenge and offering experiences that revealed the inadequacy of inappropriate conceptions' but refrains from dishing out answers.

Education is the only means with which a society to adjust its needs. Therefore, a society can never exist without education. Through education, the members of a society learn the skills to enrich, transmit and transform cultural heritage as well as social and

scientific knowledge for the continuous advancement of the society. Teaching and learning process has been inspirable to human beings since the ancient times.

Human endeavors to explore the universe and foster economic socio- cultural and needs have resulted in a widespread educational system on the global preview. Every society, every culture and every nation is in race to build up its educational system on profound bases of knowledge, learning and expertise. Today, a nation with developed educational system is superior and dominant. Education cannot be made more effective without effective teaching. An effective teaching technique can insure the effective learning; thus, it is being felt that there should be new technique of teaching and learning. It is now well accepted that, according to the constructivist view of learning of mathematics, students construct their own mathematical knowledge rather than receiving it in finished form from the teacher or textbook. Within this frame work, it means that students create their own internal representations of their Interactions with the world and build their own networks of representations (Hiebert & Carpenter, 1992). However, there is considerable countenance given in the literature to the view that constructivist perspectives of teaching are considerably less developed than their perspectives of learning (Simon, 1995) and that educators are faced with major difficulties when attempting to develop pedagogical implications from the constructivist ideas about learning.

This thesis in exploring ways to implement the constructivist paradigm has been influenced by Piaget's and Glaserfeld's constructivist epistemology that emphasizes the role of cognitive conflict, reflective abstraction, and conceptual reorganization in mathematical learning (Piaget, 1980). The key constructs around which the study is built is an experimental learning circle adapted from Jones and Pfeiffer (1975) which uses principles of cooperative learning and the problem-centered mathematics project (Wood,

Cobb & Yackel, 1993). The study has also been influenced by Vygotsky's (1978) analysis of the crucial role that social interaction plays in learning. Vygotsky has commented on the process whereby intrapersonal language (the language used to appeal to others) becomes interpersonal language (the guiding language of self actualization) through relating to the consequences of behavior, activity, norms, and attitudes. 'When children develop a method of behavior for guiding themselves that had previously been used in relation to another person, they organize their own activities according to a social form of behavior, and succeed in applying the social attitude to themselves' (Cam, 1995, p.9).

2.3.1 Cooperative Learning package

Cooperative learning strategy is seen as a small team each with different ability use a variety of learning activities to improve their understanding on the subject. There are different model of cooperative learning strategy such as: team teaching, Jigsaw, group investigation, Jigsaw III, Johnson and Johnson and so on. For this study Johnson and Johnson was adopted. Because, it is under formal cooperative learning, which can last from one period to several weeks. Five weeks were used to guide students in the cooperative learning strategy, 15 periods were used each with double periods of two hours all together sums up to 30 hours. Steps that followed are:

Step I: introduction

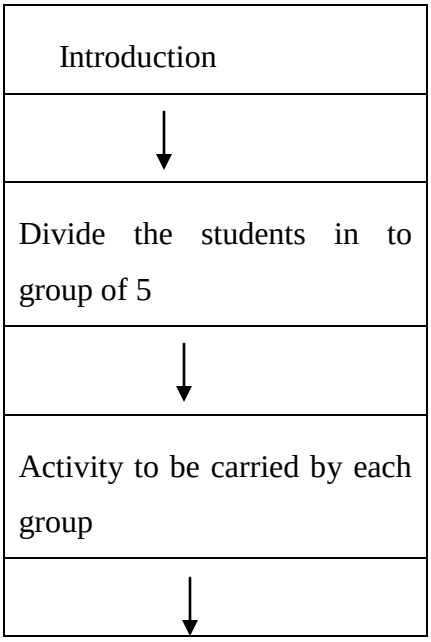
Step II: divide the students in to 5 groups

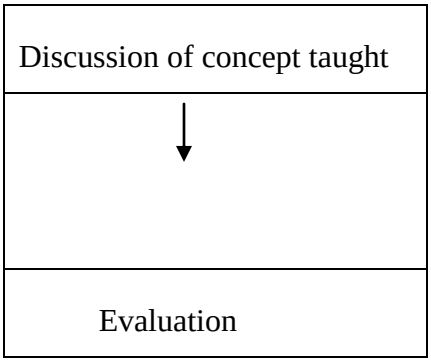
Step III: Activities to be carried by each group

Step IV: Discussion of concept taught

Step V: Evaluation.

The follow chart of the steps was as follows:





Source: Johnson and Johnson (1975).

Figure 2.1 Model of CLS Adopted

Details of the lesson plan are presented on the appendix **D.** A clear explanation of these steps is on the Appendix **F.**

2.3.2 Benefits of Cooperative Learning

Virtually, people know from the experience that a powerful way to learn material at a deep level is to teach it to others (Cohen, Brody & Sapon, 2004; Hoffman, 2001).Studies have shown that the benefits of cooperative learning strategy include increased academic achievement, better communication skills, and successful social, academic group interactions (Artut,2010). These studies agree with the finding of Gillies (2002). Cooperative learning can also produce positive effects on students' achievements (Okebukola 1985; Cohen, 1986; Davidson 1989; Salavin1990; Raid 1992). While according to Ross 1995; Whicker, Nunnery & Bol, 1997; Loning 1993; Watson 1991, academic achievement include enhancing conceptual understanding and achievement in science. While social benefits include more on task behaviors and helping interactions with group members (Barron, James & Ambriosio 1993; McManus & Gettinger, 1996; Gallies & Ashman 1998). In another studies, the benefits of cooperative learning strategy include

high self-esteem, more friends, more involvements in classroom activities and improved attitude towards learning (Lazarowitz, Baird & bolden 1996; Lazarowitz & Baird 1994).

One of the greatest benefits of cooperative learning is that it increases student skills in communicating mathematics (Muniz, 2003). This communication yields understanding in the subject Metter. In fact Johnson and Johnson (1989 p. 235) stated that "if mathematics instruction is to help students think mathematically, understanding the connections among various mathematical facts and the procedures and be able to apply formal mathematical knowledge, flexible and meaningful cooperative learning must be employed in mathematics classes". Cooperative learning promotes learning mathematics in an active way rather than in a passive way (Johnson & Johnson 1989).

Another benefit of cooperative learning according to Muniz (2003) is that 'it allows students to experience working with others toward a common goal'. As a result of working together students can easily relate and intensify their efforts because achievement of one of them is the achievement of all members in the group. According to Whicker, Bol and Nunnery (1997), some of the short-term outcomes include the following: increased learning retention and critical thinking. Without any doubt if a student is able to possess these qualities no doubt, he will solve the problem of mathematical communication. Compared to the traditional individually competitive classroom, cooperative learning experiences promote high level of self-esteem for students (Johnson, Johnson & Hulbec 1984; Johnson & Johnson 1989). Cooperative learning can reinforce a student's feeling of self acceptance, whereas competitiveness can negatively affect self acceptance and individualistic attitudes tend to be related to basic self rejection (Johnson, Johnson & Hulbec 1984).

In some studies, scholars were able to develop some long-term outcomes of cooperative learning, some of those are that of Johnson and Johnson (1989) postulated that

the long-term outcomes of cooperative learning include ‘greater employability as well as career successes. To support this notion scholars like Muniz (2003) says that ‘many employers valued an employee who has skills in verbal communication, responsibility, initiative, interpersonal interaction and decision making. Thus cooperative learning not only helps students with mathematics but also prepares them for life after graduation.

2.3.3 Theoretical Basis of Cooperative Learning and Performance

The theoretical frame work for this study centers on cooperative learning. The most progressive work on cooperative learning has been in to existence from the last three decades of 20th century when total commitment were on learning process. Therefore, the roots of cooperative learning lie deep in learning theories.

According to Anderson and Elloumi (2004) theories are reasoned explanations rather than absolute facts that deal with a particular phenomenon. Learning theories attempt to explain how students think and what factors determine their behavior and learning (Almu, 2010). Learning theories are the raw materials which are applied in the teaching learning process (Alemu, 2010). It is therefore, essential for the teacher to understand learning theories and teaching approaches to design effective teaching activities. Learning itself is any change in behavior that is attributed from experiences. It is a relatively permanent change in behavior as evidenced by a change in performance through practice, training or experiences (Okoye, 1987).

According to Ashman and Conway (1993) learning can be seen as “the thought process that occurs within the brain. A number of scholars define learning, but they all share the same views that learning can only take place if there exist a permanent change in an individual’s knowledge and behavior. With regard to the aforementioned, this study is

based on social constructivist theories.

The proponent of Social constructivist theory is Piaget (Nguuma, 2010). Social constructivist theory is a learning approach which argues that individual can learn best when they actively construct knowledge and understanding through interaction with others (Santrock, 2004; Cam1995). Emphasis is therefore, given to interactions rather than actions of individuals (Nguuma, 2010). In general, social constructivist approaches emphasizes the social context of learning and that knowledge is mutually built and constructed; (Bearing & Dorvan as cited in Santrock, 2004). However, according to Nguuma (2010) involvement with others creates opportunities for students to evaluate and refine their understanding as they are exposed to the thinking of others.

This claim is supported by; Vygotsky (1978) who is another proponent of social constructivist theory and who also advances that 'analysis of the crucial role that social interaction plays in learning [is very significant]. Vygotsky's work implies that learners who experience the processes involved in their own thinking together will come to experience the self actualization of the process involved in their own thinking. If learning from social and interactive experience is important, as social constructivists claim, then we need to change our approach to teaching mathematics and teaching education. Constructivists require of us that we provide our students with appropriate forms of experience. In keeping with such views the study was established with the belief that mathematical learning is just as much an interactive as constructive activity. We endeavored to organize a class room which affords the opportunity for students to interactively constitute their understanding through interpersonal and intrapersonal communication, small and large group discussion, and in a cooperative environment where the teacher cannot prove answers but more importantly encourages and mediates

discussion. This is agreed with the teaching perspective developed by Khus and Ball (1986 p.5) in that 'the teacher aids the students by questioning, challenging, and offering experiences that reveal the inadequacy of inappropriate conceptions' but refrains from dishing out answers'. The approach taken in this study sought to include aspects of national statement on the mathematics for Australian schools (Australian Education Council, 1991, pp.16-20):

Learners construct their own meanings from, and for, the ideas, objects and events which they experienced;

- ✓ Learning happens when existing conceptions are challenged;
- ✓ Learning requires action and reflection on the part of the learner;
- ✓ Learning involves taking risks;
- ✓ Mathematics learning is likely to be enhanced by feedback;
- ✓ Mathematics learning is likely to be enhanced by using and developing appropriate language;

Mathematics learning is likely to be enhanced by challenge within a supportive frame work.

According to the standard (NCTM, 1989p.65) 'Instruction (in mathematics education) has emphasized computational facility at the expense of a broad, integrated view of mathematics and has reflected neither the vitality of subject no the characteristics of the student'. Similar notion also comes from Bandura's theory.

Bandura's learning theory: Albert Bandura is also another proponent of social learning theory who focuses on the learning theory that occurs within social context (Nguuma, 2010). Bandura observed that people learn from one another through the concept

of observation learning, imitation learning, and modeling (Nguuma, 2010). Bandura established attention, reproduction and motivation as necessary components of modeling process (Nguuma, 2010). He was of the view that a human being can learn only if he pays attention, likewise anything that put a damper on attention is going to decrease learning. Likewise you must be able to retain (Nguuma, 2010).

In view of the above therefore, cooperative learning in mathematics is a structured process in which team member work towards accomplishing a common goal, stressing positive interdependence, individual accountability and group accountability (Alemu, 2010). Positive interdependence is a state in which all members must cooperate to accomplish the goal (Alemu, 2010). Cooperative learning can refer to any learning and teaching method which makes students work together in small groups towards [achieving] common goals. The core element of cooperative learning is the emphasis on student's interaction rather than on learning as a solitary activity (Alemu, 2010). According to Slavin, Hurley, and Chambert Lain (2003), Cooperative learning reduces class room anxiety created by new and the unfamiliar situations faced by students.

In a traditional classroom when a teacher calls upon a student, he/she becomes the focus of attention of the entire class (Alemu, 2010). Any mistake or incorrect answer becomes a subject to scrutiny by the whole class (Alemu, 2010). In contrast, with cooperative learning situation, when, students work in a group, the focus of attentions is diffused among the group. In addition the group produces a product which its members, can review prior to presenting it to the whole class, thus diminishing the prospects if mistakes will occur at all. When a mistake is made, it becomes a teaching tool instead of a public criticism of an individual student (Alemu, 2010).

Study of related literature provides a sound theoretical frame work and conceptual

base for cooperative learning such as in Slavin (1996a), Johnson and Johnson (1999) describe cooperative learning on four major theoretical perspectives namely:

- Motivational perspectives
- Social cohesion perspectives, and
- Cognitive perspectives

2.3.4 Elements of Cooperative Learning

Kegan (1994) provided four basic principles to be explicitly structured in each class of cooperative learning namely:

- Positive interdependence
- Individual accountability
- Equal participation
- Simultaneous interaction

Kegan uses the acronym PIES to represent these principles Johnson and Johnson (1999) are in agreement with Kegan's "PIES" principles for cooperative learning and advanced two additional conditions of their own. Firstly, they assert that "Students must learn and frequently uses required interpersonal and small group skills. They also considered "Group Processing". These elements however, have been described as follows:

2.3.4.1 Positive Interdependence

Positive interdependence refer to the improvement of a student is subordinated to the improvement of another students. Students should be graded to understand that; "The

successes of every team member depend upon the success of other members" and if one fails, they all do" (Kegan, 1994).

The discipline for using cooperative groups begins with structuring positive interdependence. Group members have to know that they "Sink or Swim together". It is positive interdependence that requires group members to roll up their sleeves and work together to accomplish something beyond individual success. It is positive interdependence that creates the relation that members have two responsibilities such as: to learn the assigned material and to ensure that all members of their group learn the assign material (Igbal, 2004). When positive interdependence is clearly understood, it highlights the fact that (a) each group member's efforts are required and undependable for group success (i.e. there can be joint effort because of his or her resources or role and taste responsibilities (i.e. there can be no social loafing) (Igbal, 2004).

2.3.4.2 Equal Participation

Equal participation is self explanatory, and refers to the fact that no structure should be allowed to dominate a group, either socially or academically, and that no student should be allowed to loaf, or "hitchhike" on the work of other group members Kegan (1994) continues that equal participation does not occur automatically, and that steps must be taken to ensure that it occurs. In particular, Kegan (1994) pointed two techniques to ensure equal participation. Firstly, there is turn allocation, which means that students are expected to take turn speaking and to contribute to the discussion when their turns come, Secondly there is the division of labor, which means that each group member is assigned to a specific role to play in the group.

2.3.4.3 Individual Accountability

The regulation of using cooperative learning includes structuring group and individual accountability and so on. Group accountability exists when the overall performance of the group is assessed and the results are given back to all group members to compare against the standards of performance and the members are held responsible by group mates for contributing his or her fair shared to the groups' success (Igbal, 2004).

2.3.4.4 Simultaneous Interaction

The rationale for using the cooperative groups includes ensuring that group members meet face-to-face to work together to complete assignment and promote each other's success. Group members need to do real work together promote, interaction as well as encourage and facilitate each other's efforts to complete tasks in order to reach the groups' goals. Through promoting each others' success group members build both an academic and personal support system for each member (Iqbal, 2004).

There are three steps to encourage promotive interaction among group members (Iqbal, 2004). The first is to schedule time for the groups to meet. As simple as this step seems many learning groups are not given sufficient meeting time to meet mature and develop. The second step is to create positive interdependence that requires members to work together to achieve the groups' goals. It is positive interdependence that creates the commitment to each other's success. The third step is to encourage a promtive interaction among group members.

2.3.4.5. Interpersonal and Small Group Skills

Placing socially unskilled students in a group and telling them to cooperate does not guarantee that they are able to do so effectively. We are not born instinctively knowing how to interact effectively with others. Interpersonal and small group skills do not magically appear when they are needed. The whole field of group dynamics is based on the premise

that social skills are the key to group productivity.

Cooperative learning is inherently more complex than competitive or individualistic learning because students have to engage in task work and team work simultaneously. To coordinate efforts that will achieve mutual goals students must (a) get to know and trust each other (b) communicate accurately and unambiguously (c) accept and support each other and (d) resolve conflicts, constructively (Johnson & Johnson, 1999).

2.3.4.6 Group Processing

The final pace of the discipline of cooperative group is structuring group processing. Effective group is influenced by whether or not group reflects on (process) how they are functioning. A process is an identifiable sequence of events taking place over time and 'process goals' refer to the sequence of events instrumental in achieving outcome goals. Group processing may be defined as reflection on a group session to (a) describe what member actions were helpful and unhelpful and (b) make decision about what actions to continue or change. The purpose of group processing is to clarify and improve the effectiveness of the member in contributing to the collaborate efforts necessary to achieve the groups goals.

There are five steps in structuring group processing in order to improve continuously the quality of the group's task work and team works. The steps are as follows:

- To assess the quantity of the interaction among groups members as they work to maximize each others' learning.
- To examine the process by which the group does it work is to give each learning group feedback.

- The third step is for groups to set goals as to how to improve their effectiveness
- To process how effectively the whole class is functioning, and
- To conduct small group and whole class celebrations (Jonson & Johnson 1999).

2.4 Types of Cooperative Learning Group

There are three (3) types of cooperative learning namely: formal cooperative, informal cooperative learning and cooperative base group (Johnson & Johnson, 1998)

2.4.1 Formal cooperative learning:

According to Johnson and Johnson (1998) groups that were formed, last from one class period to several weeks. You may structure an academic assignment or course requirement for formal cooperative learning groups to ensure that students are actively involved in the intellectual work of organizing, explaining, summarizing, and integrating the materials into existing conceptual structures. In formal cooperative learning, the students' are at the heart of the discussion throughout the instructional period.

2.4.2 Informal Cooperative Learning Groups

Informal cooperative learning groups are ad-hoc groups that last from a few minutes to one class periods. The teacher used them during direct teaching (lectures, demonstrations, films, videos) to focus students attention on the material they are to learn, set a mood conducive to learning, help set expectations as to what the class will cover, ensure that students cognitively process the material you are teaching, and provide closure

to an instructional session.

2.4.3 Cooperative Base Group

Cooperative base groups are long term (lasting for at least a year) heterogeneous groups with stable membership whose primary purpose is for members to give each other the support, help, encouragement, and assistance each needs to progress academically. Cooperative base groups provide students with long-term, committed relationships.

2.5 Methods of Cooperative Learning

The application of cooperative learning in the classroom has been the focus for research since early 1970s. Researchers all over the world have been studying practical application of cooperative learning principles and as a results of that many cooperative learning method are in practice today. Slavin (1995) had discussed some of the researched and widely used cooper active learning methods. He divided these methods in the following categories namely:

1. Students Team Learning Methods (STL)
2. Students' Team Achievement Divisions (STAD), and
3. Teams-Games-Tournaments (TGT)

2.5.1 Students Team Learning Methods

Student's team learning methods are cooperative learning techniques developed and researched at John Hopkins University. More than half of all studies of practical cooperative learning involve these methods. All cooperative learning are of the view that students work together to learn and is responsible for their team mates' learning as well as

their own. In addition to the idea of cooperative work, students' team learning methods emphasized the use of team goals and team success, which can be achieved only if all members of the team learn the objectives being taught. Hence, in a student team learning the student's work is to learn something as a team.

Three concepts are central to all students Team Learning methods such as: team rewards, individual accountability and equal opportunities for success. Teams may earn certificate or other team rewards if they achieve above a designated a criterion. Teams do not compete to earn scarce rewards; all (or more) of the teams may achieve the criterion, in a given week. Individual accountability means that the teams' success depends on the individual learning of all team members. Accountability focuses on the activity of the team members on helping one another learn and making sure that everyone on the team is ready for a quiz or any other assessment that students take without teammate help. Equal opportunity for success means that students should contribute to their teams by improving on their own past performance. This ensures that high, average and the low achievers have equal challenge to do their best and that the contributions of all team members are valid (Iqbal, 2004).

2.5.2 Student Team – Achievement Divisions (STAD)

This method was developed by Slavin (1988), it involves competition among groups. Students are grouped heterogeneously by ability, gender, race, and ethnicity. Students learn material and team and take quizzes as individuals. Individual scares contribute to a group are based on a student's improvement over previous quiz performance.

Slavin (1988) considers this method appropriate for a variety of subjects, including

science, if the focus is on the material with single right answers.

2.5.3 Teams – Games – Tournaments (TGT)

This is developed by Slavin and his colleagues; this method involves some use of heterogeneous teams instructional for mate and work sheets, as does STAD, for the learning of information. For the tournament, students from different teams are placed in groups of three students of comparable ability. In TGT the academic game replaces quizzes. Although study teams stay together for six weeks, tournament table composition changes weekly (Iqbal, 2004).

Slavin (1988) advises teachers against using tournament scores for individual quiz grades and suggested that quizzes be used as well as midterm and final examinations. He suggests that TGT can be used two to three days a week in science to learn basic concepts, with laboratory activities taking place on the other two days. It is also possible to alternate TGT with STAD on a weekly basis. Students appear to enjoy the change of the tournaments and, because they compete with others of comparable ability the completion are fair (Slavin, 1988).

2.6 Conventional Lecture Method (CLM)

Conventional lecture method is one among the several teaching methods exist in the world. Lecture is another word for speech and when you are speaking continuously to a class or audience you are considered to be lecturing. According to Paris (2014) a lecture method is convenient and usually makes the most sense especially with the most larger sizes. Lecture methods let the teacher to address the most larger group of students at once in the most general manner while still conveying information that he/she fells is most

important according to the lesson plan. The word lecture comes from the Latin word **Lectus,** from the 14th century, which translate roughly in to **read** it latter proceeds to explain **lecture,** as **that which is read**. It wasn't until the 16th century that the word was used to describe oral instruction given by a teacher in front of an audience or learners (Paris, 2014).

> Today lecture method is a teaching method that involves primarily an oral presentation given by an instructor to a group of students. Many lecture methods are accompanied by some document, an image or a film. Some teachers may even use a white board, chalk board to emphasize important points in their lecture but a lecture doesn't require any of these things in order to qualify as a lecture. As long as there is an authoritative figure in any given context at the front of a class room delivering a speech to a group of listeners this is called a lecture method (Paris, 2014). Only that this method is sound one sided. The total control is dually from the teacher.

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Control group was taught with this method. Students were **pretested** before the treatment to establish homogeneity among the students. Treatment was given for five weeks and then **posttest** was given to ascertain the performance of students after the treatment. Two weeks after the **posttest, post-posttest** was given to find the retention ability of the students. Five weeks were used to guide students in the conventional lecture method, 15 periods were used each with double periods of two hours all together sums up to 30 hours.

2.6.1 **Advantages of Conventional Lecture method**

The conventional lecture method has a few advantages that kept it as the standard approach to teaching mathematics for so long, as explain in the following:

i. **Teacher control**: because the lecture is delivered by one authoritative figure (teacher) that figure has full reign of the direction of the lesson and tone of the class room. The teacher along is able to shape the course and so lectures remain highly consistent when it comes to what kind of information is delivered and how it delivered.

ii. **Effortless**: **T**he lecture method makes the learning process mostly effortless on the part of the students and takes notes when necessary. Because, so little input is require from the students, it is the most clear straight forward uncomplicated way to expose students to quantities of information and in a way that is controlled and time sensitive. Students just need to know how to take good notes.

iii. **New material:** lectures are literally longwinded explanations of information

deemed important by the teacher; as such student can absorb large quantities of new materials.

2.6.2 Disadvantage of Conventional Lecture Method

Many don't see the nature of the lecture method as helpful in the least and you will find the explanation as to why, in the following points:

i. **Passive:** people see lecture method as biased, one way round but they also see it as a wholly passive experience for students if a student has no place to opportunity the course material with person delivering the lecture they will receive only shallow understanding of the subject being discussed. Simply they might even be bored by the material because they will have no opportunity to learn how the subject applies to them on a personal level.

ii. **One way**: people who are against the lecture method see it as a one way street. The teacher dictate information to his students who have little to no opportunity to provide their personal input or protest the information disagree with the teacher will the students just have to sit down and take some times the students will even be forced to agree with the teaching if they want to a passing grade (Paris, 2014).

iii. **Strong Speaker Expectation:** conventional lecture method be disadvantageous to the teacher as well. Not all academics can be expected to have the same level of public speaking skills, what if a teacher is a genius in his / areas knows the materials from every angle and is enthusiastic about the subject but has trouble speaking in front of large groups? The quality of a teacher course should not suffer because they are unable to prepare a decent lecture. Just as being lectured

might not be the learning method of choice for many student many students being the one that is expected to do the lecturing might not be the best way for every. Instructor to presents their course materials. But because the range of academic teaching methods are so limited, they are usually expected to do exactly that potentially losing the element of their lesson plan that makes it so strong (Paris, 2014).

The mathematics teacher when teaching geometry construction of the JSS can use this method of teaching to explain the geometry concept of construction as well as its importance and relevance to other disciplines such as: engineering, architecture, geography and so on. This could motivate the students to generate retention ability and improve the performance of students in geometry construction of JSS. Lecture method has survived in academic as a quick, cheap and efficient way of introducing large number of students to a particular field of study (Tufte, 2006). CLS is therefore, necessary especially as lecture method was identified as passing method of teaching. The more the students are involve in a small team the more they understand the geometry construction of JSS as its justify the saying **two heads are better than one**. CLS was adopted in this study to determine its effectiveness in enhancing gender performance in geometry construction of JSS.

2.7 Retention Ability in Mathematics

Mchealchie (1999) explains that in a cooperative learning class, students often elaborate on the concepts being taught to achieve what is expected. Elaboration provide

from one to another is a win/win situation. Elaboration not only enhances the learning of a student who receives the explanation but also deepens the understanding of the student providing, the explanation (Chainson et al, 2011). Hence consistent elaboration or explanation of a topic would bring forth complete retention of a topic being learnt for a longer period of time (McKeachie, 1999). Retention is defined by several scholars such as Kundu and Tutoo (2002) to them, retention is 'a preservative factor of the mind'. The mind acquires the materials of knowledge through sensation and perception. These acquired materials in the mind need to be preserved in form of images for knowledge to develop. Whenever stimulating situation occurs, retained images are revived or reproduced to make memorization, possible (Kundu & Tutoo, 2002). Hence mathematics concepts need to be presented to the learners in a way or a method that touches their sub consciousness which can trigger quick recalling of the concept being taught or learned. Using such a teaching method as cooperative learning, both higher ability and low ability learners would be able to collaborate in terms of understanding explanation and retaining the concept they have learnt in a mathematics class (Chianson et al, 2011).

2.8 Geometry Construction

Geometry was originated from a point (.) which later extended to one dimension, two dimensions and three dimensions and every object in this world can never exceed three dimensions. According to Osuagwu, Anemelu and Onyeozili (2000) is the study of linear measurements and angular/rotational measurements. It is also the study of shapes and figures bounded by lines and curves (Osuagwu, Anemelu & Onyeozili, 2000). Geometry is an aspect of mathematics which deals with the study of different shapes (Adu, 2004). These shapes can either be plane or solid shapes. a plane shape is a geometrical form such that the

straight lines that joins any two points on its wholly be represented on plane surface. According to Adu (2004) A solid shape on the other hand is bounded by surfaces which may not wholly be represented on a plane surface. Example of plane shape includes: triangle, rectangle rhombus and so on while example of solid shape include those of : cubes, Cuboid, cone, cylinder, sphere and so on.

It deals with the position, shape and size of the bodies but has nothing to do with the physical properties'. Geometry could be divided in to two namely: practical and demonstrative geometry (Nguuma, 2010). Practical geometry covers the construction aspect of geometry while demonstrative geometry deals with the shape, size and the position figures by pure reasoning based on definitions, self –evident and truths (Nguuma, 2010). If you look at these categories of geometry it could be observed while that circle geometry consisted all the two (2) categories because some aspect of its is construction other aspect deals with figures but for the purpose of this study the researcher will only consider demonstratives geometry.

2.9 Nature and Teaching of Geometry Construction at JSS

- **Construction of a Line**: Before a student constructs a line perfectly, there must be the following instruments in place:

  A sharp pencil

  A straight ruler

  A fresh eraser

  A pair of compass

- **Construction of Parallel Lines:** Before a student constructs a parallel line

perfectly, there must be the following items in place.

A sharp pencil

A straight ruler

A fresh eraser

A pair of compasses

A set squire

- **Construction of perpendicular Lines:** Before a student constructs a perpendicular line perfectly, there must be the following items in place.

  A sharp pencil

  A straight ruler

  A fresh eraser

  A pair of compasses

  A set square

- **Construction of angle 60^0:** Before a student constructs an angle 60^0 perfectly, there must be the following items in place.

  A sharp pencil

  A straight ruler

  A fresh eraser

  A pair of compasses

- **Bisection of angle 30^0:** Before a student bisects an angle 30^0 perfectly, there must be the following items in place.

  A sharp pencil

A straight ruler

A fresh eraser

A pair of compasses

- **Construction of angle 90^0:** Before a student constructs a parallel line perfectly, there must be the following items in place.

  A sharp pencil

  A straight ruler

  A fresh eraser

  A pair of compasses

- **Bisection of angle 45^0:** Before a student constructs a parallel line perfectly, there must be the following items in place.

  A sharp pencil

  A straight ruler

  A fresh eraser

  A pair of compasses

1. Construction of Line:

Procedure:

i. Draw a line XY longer then 5cm

ii. Mark off a point A, with centre A and a radius 5cm, draw an arc to cut XY at B.

iii. AB is the required line.

2. Construction of Parallel Line:

Procedures:

i. Construct a line through P, so that it is parallel to AB.

ii. Place a set square so that one edge is exactly along AB.

iii. Place a ruler along one of the other edge of the set square (use the left hand edge if you are on the right hand)

iv. Hold the ruler firmly, slide the set square along the ruler follow P, stop when the edge that was on AB reaches P, draw a line along this edges of the set square through P.

3. Construction of perpendicular Line:

Procedures:

i. Place a ruler along the given line AB

ii. Use the two edges of the set square which contain its right angle. Place one of these edges along the ruler slide, slide the set square along the ruler until the other edges reaches P.

4. Construction of angle 60^0:

Procedure:

i. Draw a straight line AB longer then 6cm.

ii. Use your compass with 5cm length B, and cut an arc C, from the point A to any point between AB.

iii. Take your compass with the 5cm length and place it on point C, and cut another arc D then take your compass again and place on point A, and cut another arc on D.

iv. The required angle 60^0 is now constructed.

5. Bisection of angle 30^0:

Procedures:

i. Use your protractor with 5cm length and cut an arc I from the point G, to

any point between GH.

ii. Take your protractor with the 5cm length and place it on I and cut another arc K.

iii. Place your compass on point I and cut another arc L and the place your compass on the point K, and make another arc on L point

iv. LGH is the required angle.

6. Construction of angle 90^0:

Procedure:

i. Draw a line GH and cut a point I between GH and use a protractor to make a small circle with two points M and N.

ii. Place your compass on the point M with radius 5cm and cut an arc 0, and also use the same radius 5cm, and place your compass on another point N, and cut another arc on the same point 0, and draw a straight line to joint I and 0.

iii. OIH are now the required angle.

iv.

7. **Bisection of angle 45^0:**

Procedures:

i. Draw a line GH and mark a point I

ii. Use your protractor from the point I and make a small circle with two points M and N

iii. Place your protractor on the point M with radius 7cm, and cut an arc O, and also place your compass on the point N and cut another arc on the point O.

iv. Place your compass on the point H, and cut another arc P, and then again place your protractor on the point O, and cut another arc on P with the same radius

v. PIH is the required angle.

2.10 Cooperative Learning and Academic Performance in Mathematics

In a planned program, teachers usually have objectives set out to be achieved by the students. Such achievement could be ascertained through test evaluation or performances assessment (Nguuma, 2010). For this study, achievement is used in the context of test performance. Achievement in the teaching/learning process has to do with set objectives of instruction (Nnaobi, 2007). In science and mathematics, instruction for instance, if a learner accomplishes a task successfully and attains the specified goals for a particular learning experience, he is said to have achieved (Igboegwu, 2012). Performance could be seen as procured ability. They farther described ability as demonstrative knowledge or skill. Performance as one can see in this context is the feedback derived from the program of curriculum and instruction. The most determinant phase in the curriculum process which reviews the extent the learner has mastered the objectives set by the teacher, in any lesson is evaluation. Evaluation is a continuous comprehensive, process which utilizes a variety of procedures and which is inescapable related to the objectives of the educational program through coverage of the process usually yields high achievement on the part of the learners (Granland,1998).

To authenticate the above statement, some studies are reviewed under this heading, most of the studies carried out within and outside Nigeria show that there are generally poor performance in WASC/GCE/SSCE mathematics examinations, and some other science subject (Jegede, 1984). This is equally evident in the memorial mathematics

contests, which recorded the best seven students as scorning within the range of 35% to 40% while the rest scored below 40% In the chief examiner's report (WAEC, 1993), the researcher observed that part of the problems, affecting mathematics performance could be connected to teachers' methods of presenting the content to the learner.

Similar themes emerged in the findings of Udeinya and Okabiah (1991) who blamed poor performance of students in mathematics on poor methods and approaches to teaching which reduced the level of motivation; These studies agree with the findings of Peter (2001) who asserts that the issue of poor performance in mathematics examinations was due to problems of teaching method. For effective teaching to take place, the skillful mathematics teacher, needs to use many different methods and techniques at his/her disposal. Carefully teaching methods can make teaching and learning effective (Chiason in Krumeh & Oplal, 2008).

To buttress the above findings, Adolphus (2011) said ' statistics have shown difficulty in teaching and learning of mathematics, geometry in particular, has resulted in mass failure in examinations, the mass failure in mathematics examinations is real and trend of student's performance has been on the decline. It was also reported that effective methods of teaching helps in teaching and learning of mathematics. One of the many teaching methods proposed by Johnson and Johnson, 1991; Slavin, 1990; Bohlm, 1990; Kings and Adelgasis, 1998; King, 1990; Fantuzzo and Heller, 1992, that results in positive effect on students achievement and retention of information is cooperative learning.

Teachers are hereby employing to advance cooperative learning strategy in the teaching and learning of mathematics. This will equip the teacher to offer the required excellent guide, and this will improve student's performance and retention in mathematics (Slavin, 1990).

2.11 Mathematics and Cooperative Learning

Today, knowledge of mathematics is one of the components that separate people who have a choice from people without a choice. The computer revolution has made mathematics a more integral part of the insurance industry, medical research, government, transportation, manufacturing and construction. Computer programs are used in the clothing industry for creating different size pattern, also, mathematical model of traffic patterns are used to plan road construction. Mathematical literacy leads to muddled personal decision and misinformed governmental policies. Without an understanding of mathematics concepts, news about the billion- dollars deficit or discussion about the probability of contracting a disease is meaningless. Children born today will enter a work force where knowledge of mathematics is crucial to their career opportunities, their participation in society and conduct of their private lives. Any parson who does not have broad understanding of mathematics will have limited career opportunities (Johnson, 1991).

Thus, mathematics has been part and parcel of curriculum up to secondary level; Johson and Johnson (1991) revealed that the goal of mathematics education is to ensure that all students possess a suitable and sufficient mathematics background to become productive citizens in a society that is characterized by complex information and technology (Johnson, 1991). Students must understand mathematics well enough, for example, to comprehend society issues such as environmental protection, nuclear energy, money spending, medical advances, space exploration and taxation. They must understand mathematics well enough to have the knowledge and the skills regarded to work in modern production facilities, and they must understand mathematics well enough to solve problems when in a variety of career, societal and personnel contexts (Slavin, 1991).

They quarry “how a goal can be well accomplished” has been the focus of researchers in many countries. In the United States of America (USA) and some other advanced countries, cooperative learning is well researched and provided with the instructional strategy to promote learning in any subject area (Slavin, 1991). According to Johnson and Johnson (1991) those are considerable evidence indicating that the goals of mathematics instruction will be better achieved when completive learning proceed moves and strategies are employed. The use of cooperative learning will result in student being more cognitively active, more successful in problem solving, more confident in these mathematics abilities, more motivated to take for their mathematics course and better able to transfer what they know about mathematics to carry situations.

Researchers in their study findings of cooperative learning about mathematics achievement have discussed why students using cooperative learning improve their learning situation. According to Slavin (1983), all forms of cooperative learning focus on involving students work together to help others in order to complete their goals.

Native (1994) pointed out that students’ helping behaviors are strongly related to their academic achievement, cooperative learning establishes community in which students can get help and support from other group members immediately in a non computation, learning environment, not just raising their hands and waiting for the right answers. In contrast, giving or receiving answers only without help from others is not positive for student’s achievement Leikun of Zaslearsky (1997) found that most students like receiving help from others or like working together in groups.

In addition to promoting mathematics achievement, there are other findings from the analysis of cooperative learning in mathematics instruction, as increasing social communication changing learning behaviors (i.e. passivity becoming activity) and

increasing self-esteem because of getting help from others. One works alone and struggles to understand the materials or solve the assigned problems. Perhaps it is not surprising that many students and adults are of mathematics and develop mathematics avoidance or mathematics anxiety. They often believed that only a few talented individuals could function successfully in the mathematics realm small group cooperative learning addresses these problems in several ways.

2.12 Researches in Cooperative Learning

Researchers have analyzed the effectiveness of cooperative learning with respect to academic achievement, social adjustment and physiological health. There is excessive empirical support in favor of cooperative learning as an important contribution for higher academic achievement, positive social relations and healthy psychological norms. Most of the study's findings in cooperative learning appear on the researcher on education but belong to USA , Israel, Garman, Japan, UK, Australian and some other developing countries of Africa Asia Pakistan and very few in Nigeria.

In meta-analysis of all the studies that had been completed in the area of social interdependence and achievement, Johnson, Jonshon, Nalson and Skon (1981) reviewed 122 studies conducted between 1924 and 1981 that yielded 286 findings. The three methods of Meta analysis used were voting method, effect size method and 2 – score method. The result indicated that cooperative learning experience tended to promote higher achievement than did competitive and individualistic learning experience. The average person working within a cooperative situation achieved at about the 80^{th} percentile of the students working with a competitive or individualistic situation.

Slanvin (1995) examined ninety-nine studies that lasted for four or more weeks and

that used a variety of cooperative learning, methods. Sixty three (63%) of the ninety nine experimental control comparison favored cooperative learning. Only five percent (5%) significantly favored the control group. Overall, students in cooperative learning groups scored about one-fourth of a standard deviation higher in achievement tests that did students teach competitively (Iqbal, 2004).

In addition to achievement outcomes, researchers have also assessed the impact of cooperative learning on problems solving. Given the complex nature of problem solving and the multiple resources that a cooperative group has at his disposal, one would logically expect cooperative learning to have a positive effect on these outcomes as well. This hypothesis was confirmed by Qin, Johnson and Johnson (1995). After reviewing forty-six students, they concluded that, students of all age levels (elementary, secondary, college, adult) who worked cooperatively out scored students who worked competitively. The average students in a cooperative strategy solved more problems correctly than seventy-one percent of the students who worked competitively.

Sighanayok and Hooper (1998) found that cooperative groups spent more time engaged in the task, checked their concept learning, more often and scored higher on posttest than student working individually.

Kewley (1998) concluded "Peer collaboration, encourages maximum students participation at the idea level, resulting in more flexible thinking, multiple solutions, and a clearer understanding of the steps leading up to those solutions". Cooperative learning strategy also appears to benefit low-achieving students as well as higher-achieving and gifted students. To authenticate this, Slavin (1991b) discovered that gifted students gained just as much from cooperative groups as average or low-achieving students in all areas except language machines. In K-12 setting Slavin (1996b) cited studies that examined the

effect of cooperative learning groups on student at different achievement levels and concluded that most studies" found equal benefits for high, average and low achievers".

Additionally, Kenneth and Young (1999) specially investigated the effect of cooperative learning groups on the academic achievement of higher achieving pre-service teachers and noted that cooperative learning did not enhance their academic performances. Armstrong – Melsar (1999), conducted a study comparing the performance for homogenously grouped gifted students to heterogeneous ability groups that included gifted, average and low performance learners. Both groups exported a comparable, increase in that achievement after working together, with the gifted group performing only slightly higher.

Johnson, John and Scotts (1978), found that cooperative learning leads to more positive attitudes in several areas of cooperative learning which promote and increase motivation feelings of personal importance and control, acceptance of heterogeneity and conflict in groups and better attitude towards the teacher. They also discovered that students began selecting group members based upon previous positive collaboration experience with them. They did not necessarily choose the higher achieving kids. According to Armosrong (1999) gifted student actually experience an increase in self-esteem when heterogeneously grouped with students of varying ability when group with other higher achieving students the self-esteem of the gifted decreases due to the gift competition.

Arab (2003), conducted a study to prove the effect of cooperative learning on general science achievement of ring class students. In the experiment of two weeks duration, she found out the basis of pre-test and post-test scores that cooperative learning had more positive affection on students' general science achievement, as compared to usual method of teaching general science.

Igbal (2004) investigated the effect of cooperative learning on academic achievement of secondary school student in mathematics. He found that, on the whole cooperative learning has more effect as a teaching learning technique for mathematics as compared to traditional method of teaching. He also found that low achiever taught mathematics using cooperative learning retain more material compared to low achievers taught by traditional method of teaching for low achievers.

Ksar (2003) investigated the effects of cooperative learning on social studies achievement among seven class students, the sample comprised forty students of class seven equally phased on experimental group and control groups on the basis of scores obtained in the social studies annual examination. In this experiment of two weeks cooperative learning resulted in higher achievement as compared to routine method of teaching social studies.

Parveren (2003) conducted an experimental study on the effect of cooperative learning on social study achievement among eight grade students. The study sample consisted of 35 students who were distributed among experimental group (N-18) and control group (N 17), matched on the basis of their annual examination social studies score. After a treatment of fifteen days duration on the basis of pretest and posttest scores, cooperative learning was found to be a better instructional strategy than routine method of instruction.

There were very few studies that were conducted in Nigeria using cooperative learning strategy with respect to geometry at the time of this study, impact it was only found during this study, that only one study was conducted at central Nigeria in Benue state. The study is titled Effect of cooperative learning strategy on students' retention in circle geometry in secondary schools at Benue state of Nigeria, conducted by (Chianson et

al, 2011). They found out that cooperative learning is more effective in the teaching of circle geometry in terms of retention; this implies that students in the cooperative learning group performed well then those in tradition method of teaching.

2.13 Researches Related to Cooperative Learning in Mathematics

Davidson and Kroll (1991), found that the effect of cooperative learning of mathematical skills were consistently positive when there was a combination of individual accountability and some form of team goals or team recognition for commendable, achievement. The effects of small group learning were not significantly different from traditional instruction if the teacher had no prior experience in small-group cooperation interdependent.

Johnson and Johnson (1989) reported that in 1989, an extrusive review of the study found seventeen studies that compared cooperative and competitive mathematic learning and contain enough data to compute effect sizes (average effect size = 0.55) and thirty-one studies that compared cooperation and individualistic mathematics learning and contained enough data to compute effect sizes (average effect size 0.68). These results indicated that students at the fifty percentile in the cooperative condition who would perform at the seventy-one percentile in the competitive condition and at the seventy- five percentile of the individualistic, condition.

King (1999) examined the thought processes of eight third graders who were learning mathematics in small group cooperative learning model that paired two higher achieving and low achieving students. Although, low achievers were active in the learning process, high achievers tended to dominate learning activities.

Jacobs, Watson, Sutton and Jones (1996) conducted a study to investigate how well

the positive effect of cooperative learning will generalize to private elementary school, comparing mathematics achievement, friendship, attitudes towards mathematics and self concept outcomes of students taught with and without cooperative learning. Significant increase in mathematics achievement surfaced for cooperative learning groups but only differential effects for cooperative learning with the three effective student's outcomes.

Leikin and Zaslasky (1997) investigated the effects of learning mathematics in a cooperative small-group setting on different types of student's interaction in low-level ninth-grade class. Their findings indicated an increase in student activity, in mathematics..

Whicker, Bol, and Nunnery (1997) investigated the effects of cooperative learning on student's achievement and attitudes in secondary mathematics class room. They found that students in the cooperative learning group had increasingly higher test scores than students in the comparison group. .

Feglengve and Grabosk, (2006) investigated the effect of cooperative learning in game playing for mathematics, cooperative or not? Their finding has showed that mathematics game playing context using cooperative learning strategy promote understanding and retention in the learner.

Toumasis (2004), Investigated the effects of cooperative learning, in study teams in mathematics. He was however, convinced that cooperative learning helped effectively. Artut (2010) investigated the effect of cooperative learning in a parameter evaluation of the effects of cooperative learning on kindergarten children mathematics ability. His findings showed that cooperative learning methods can be applied to any academic level in mathematics concept from kindergarten to colleges and it promotes positive effect in the learner.

Chiason, et al (2011) investigated the effects of cooperative learning strategy on

student's retention in circle geometry in secondary school in Benue State Nigeria. They found that cooperative learning was found to be more effective in the learning of circle geometry in terms of retention; this implies that the student in the cooperative learning group maximized the rules binding on the successful implementation of cooperative learning. Kenneth and Young (1999) specifically investigated the effect of cooperative learning groups on the academic achievement of higher achieving pre-service teachers and found that cooperative learning did not enhances their academic performance.

Terwel (2011) investigated the effects of cooperative learning and mathematics education: from his study titled happy marriage he concluded that cooperative learning and guided co-construction are feasible and effective instructional approaches in mathematics education. Amiripour, et al (2011) investigated the effects of cooperative learning in the study of the effect of efficiency and teachers opinions about cooperative learning on perception of mathematical concepts for blind students. In comparing traditional instruction versus cooperative learning students, have the highest academic achievement, insolubility in academics skill critical thinking high reasoning level, deepest teaching material and the least moral behaviors in class and the most focusing on task, the least stress level, the most informal motivation in leaving and the improvement, the most capacity in reviewing situation through the views of other, the most positive and supporting communication with peers and have high self-esteem than those in traditional method.

In the past Ninety years, nearly one thousands studies have been concluded on cooperative learning methods as appeared in different analysis (Iqbal, 2004). These studies have been mostly conducted and experimented in the Western countries and some in the South East Asia and only few in central Nigeria.

Furthermore, no study of which I am aware during this study has investigated the

effects of cooperative learning strategy on academic performance and retention in geometry in government owns schools. If you look at all the studies reviewed in this study, there is no even single study carried out in the north central zone. Considering various studies conducted in cooperative learning in various countries in the world.

Virtually, all the above reviewed literatures claimed that cooperative learning promote academic performance in mathematics. Despite this, there is also mathematical phobia statement among the students. This is all what aroused the researcher's attention to examine the effectiveness of cooperative learning in mathematics. Thus, these studies will be carried out in government owns schools. This study is therefore, intended to further investigate these claims with regard to mathematics at government owns schools. Therefore, the aim of this study is to investigate the impact of cooperative learning strategy in performance and retention in mathematics among junior public secondary school students". To see which of the two strategies is more effective.

2.14 Implication of the Literature Reviewed on the Present study

From the literature examined, some significant observations that have implication to this study were made thus: the literature reviewed in this study indicated that cooperative learning method can be apply in any academic level from kindergarten to colleges and it promote positive effect to the learner (Artut, 2010). The literature also revealed that all cooperative learning shared the idea that students most work together to learn and each member is responsible for their team mates, success as well as his own. It has also been revealed from the literature that consistent and continues elaboration or explanation of a topic brings about forth complete retention of a topic being learnt for a longer period of time. The reviewed literatures also revealed that the poor performance of students in mathematics is worldwide, thus, required an effective method of teaching the subject, so as

to improve the performance of students in the subject.

It has also been revealed in this literature that the average person in cooperative learning achieved at about 80^{th} percentile of the student working with lecture method. The examined literatures have indicated that performance and retention of students in mathematics were full of apathy. That is, the students' performance and retention in both terminal, promotional, junior and senior secondary school certificate examination is in a sorry state. This implies that the laudable objectives of the mathematics curriculum at JSS III level have not been attained. But on the other hand most of the literatures reviewed here indicated that cooperative learning improves students' performance and retention in mathematics and geometry in particular at various places but a very few in Nigeria and non from the area of this study at the time of conducting this study. This calls for a shift from the conventional lecture method to the adoption of cooperative learning strategy as this may improve students' performance and bring complete retention ability which had already been identified as low globally, nationally and locally. It has been discovered in this literature that cooperative learning strategy with respect to geometry construction of JSS was not conducted in sokoto metropolis. As far as the researcher is concerned from the literature available, this study might be number one in Sokoto metropolis, therefore, this study was filled the gap that no single study of its kind have been conducted in Sokoto metropolis.

In view of this therefore, literatures also indicated that if cooperative learning is applied properly there is going to be a good performance and complete retention from the students in learning of mathematics in general and geometry construction of JSS in particular. The researcher therefore, wishes to make efforts to employ cooperative learning to teach JSS III students in Sokoto metropolis on geometry construction of JSS, to see if it could improve their performance and retention in mathematics.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This study attempted to examine the impact of Cooperative Learning strategy on Performance and Retention in Geometry among Public Junior Secondary School Students in Sokoto State, Nigeria. The focus of this chapter however, was discussed in the following sub-headings:

3.0.2 Research Methodology

3.0.3 Population of the Study

3.0.4 Sample and Sampling Procedure

3.0.5 Instrumentation

3.0.6 Validity of the Instrument

3.0.7 Reliability of the Instrument

3.0.8 Treatment Administration

3.0.9 Data Collection

3.0.10 Procedure for Data Analysis.

3.0.11 Pilot Testing

3.0.2 **Research Methodology**

The design for this study was qausi-experimental-control group design adopting Pretest, post-test, and post posttest. According to Tuckman (1975) Quasi experimental design is partly but not fully true- experimental design it controls some but not all of the sources of internal validity. Quasi experimental design involves selecting groups, upon which a variable is tested i.e. intact class (Shuttleworth, 2008). It is possible that school system may not accept new programs for testing on an experimental basis, may not allow intact classes to be disrupted or divided to provide for random or equivalent samples, may not allow for a treatment to be given to some and withheld from others. Pretest-posttest and post posttest were given to both experimental and control groups only that it was the experimental group that was exposed to cooperative learning strategy while control group was taught with lecture method. The same instrument Geometry Construction Performance Test (GCPT) was used for pretest, posttest and post-posttest. . This was diagrammatically illustrated as follows:

EG = $\mathbf{O_1} \longrightarrow \mathbf{X_1} \longrightarrow \mathbf{O_2} \longrightarrow \mathbf{O_3}$

CG = $\mathbf{O_1} \longrightarrow \mathbf{X_0} \longrightarrow \mathbf{O_2} \longrightarrow \mathbf{O_3}$

Figure 3.1: Research Design illustration

Key:

EG = Experimental Groups

CG = Control Groups

$\mathbf{O_1}$ = Pretest

$\mathbf{O_2}$ = Posttest

$\mathbf{O_3}$ = Post-posttest

$\mathbf{X_1}$ = Treatment (cooperative learning strategy)

$\mathbf{X_o}$ = No treatment (conventional lecture method)

3.0.3 Population of the Study

The study area consisted 34 public coeducational junior secondary schools in Sokoto State, which together sums up to a total of ten thousand one hundred and three (**10,103**) JSS III students. The average age of the population was 15 years. Six thousand and twelve (**6012)** male and four thousand and ninety one **(4091)** were female which all together sums up to ten thousand one hundred and three (**10,103)** JSS III students. Sokoto State is made up of three geopolitical zones. Schools from these zones which made the Sokoto metropolis were of interest for this study. Sokoto metropolis cut across five local government areas of Sokoto state namely: Sokoto South, Sokoto North, Kware, Dange Shuni, and Wammako local governments. The reason for using coeducational schools was because the researcher was looking for the significant difference between male and female students in geometry construction. Table 3.1 shows the details of population in their representative schools.

Table 3.1: Table 3.1: Population of JSS III Students

Schools	Females	Males	Total

Army Day	208	220	428
GD**SS** Mabera	133	269	402
JSS Gagi	53	128	181
GDSS T/ Wada	465	601	1066
JSS Minanata	69	117	186
GDSS Arkilla	100	140	240
JSS Asada	208	220	428
GDSS R/Sambo	345	365	710
GDSS Low cost	65	286	351
JSS More	9	57	66
GDSS Tambuwal	134	300	434
GDSS Achida	100	104	204
GDSS Binji	100	105	205
GDSS Dange	177	200	377
GDSS Gwadabawa	200	255	455
GDSS Illela	200	273	473
GDSS Kuchi	79	100	179
GDSS Kurawa	100	138	238
GDSS Raba	80	107	187
GDSS Salame	30	54	84
GDSS Shagari	100	147	247

GDSS Wamako	52	100	152
GSS Gida Madi	100	108	208
GSS Isa	100	157	257
GSS Kebbe	106	120	226
GSS Kware	100	156	256
GSS Sabon Birni	288	500	788
JSS Badon Barade	100	196	296
JSS Cimola	22	50	72
JSS Tsamaye	20	70	90
JSS Tureta (Town)	100	109	209
JSS Wababe	16	60	76
Shehu Malami JSS Wurno	74	100	174
Yahaya Abdualkari JSS	58	100	158
TOTAL	**4091**	**6,012**	**10,103**

Source: Ministry of Education Sokoto (2014)

3.0.4 Sample and Sampling Procedure

Out of 34 schools in the population, two schools were purposively selected. Purposive sampling technique was used here to enable the researcher to reach the targeted sample quickly. The sample schools include: GDSS Mabera with 402 students and GDSS

Arkilla with 240. Allocation of schools in to experimental and control groups were done by the flip of a coin (Abakpa & Igwue, 2013). All the teachers that chose head became experimental group while teacher that chose tail remained control group; this was merely for the convenience of the researcher. Hat and draw sampling technique was used to draw one class from each school, to serve as **Experimental** and **Control** groups which all together sums of to three hundred and fifty four (354) students, 207 males and 147 females students out of **10,103** students from the population which correspond to (Krejecie & Mogan, 1970). The following Table 3.2 shows the presentation of sampled students in their respective schools.

Table 3.2: Distribution of Size by Gender

S/N	Name of School	Male	Female	Total	Group
1	GDSS Mabera	100	77	177	Experimental
2	GDSS Arkilla	107	70	177	Control
Total		207	147	**354**	

3.0.5 Instrumentation

An instrument was developed by the researcher which was used to collect data for the study. The instrument is Geometry Construction Performance Test (GCPT). GCPT is a 30 items multiple choice objective test with four options (A,B,C and D) as shown in (Appendix A). During the formulation of the instrument, deferent JSS III text books such as Mathematical Association of Nigeria (MAN), New General Mathematics, Science Teachers Association of Nigeria (STAN), Comprehensive mathematics, New school

mathematics and so on were consulted, after the completion of each topic, questions were developed base on knowledge, comprehension and application as shown in Table **3.3** Table of Specification of GCPT until the questions reached 30 items, which was later taken to the experts in science education department, faculty of education Ahmadu Bello university Zaria and validated the content validity of the instrument. GCPT was used in the pretest before the treatment, the same instrument was re-administered as posttest after five weeks treatment of CLS, two weeks after posttest, post-posttest was re-administered using the same instrument only that the instrument was shuffled. GCPT is based on the junior secondary school JSS (III) mathematics curriculum content broken down in to scheme as follows:

3.5.1 Angle Construction

- Construction of a Line:
- Construction of a Parallel Lines
- Construction of perpendicular Lines:
- Construction of angle 60^0
- Bisection of angle 30^0:
- Construction of angle 90^0
- Bisection of angle 45^0:

GCPT was structured according to bloom taxonomy based on knowledge, comprehension and applications, the reason for restricting to only three out the six bloom taxonomy was because they are just at lower level of education (JSS III),

their knowledge is not exposed to the remaining bloom taxonomy of education as shown in the following table of specification of (GCPT).

Table 3.3 Table of specifications (GCPT) Based on Bloom Taxonomy of Education

S/N	Topics (contents)	K	C	A	T
1.	Construction of line	1	1	1	3
2.	Construction of parallel line	1	2	1	4
2.	Construction of perpendicular line	1	1	2	4
3.	Construction of angle 60^0	2	1	2	5
4.	Bisection of angle 30^0	2	2	1	5
5.	Construction of angle 90^0	2	1	2	5
6.	Bisection of angle 45^0	1	2	1	4
Total		**10**	**10**	**10**	**30**

Key:

K= knowledge

C= Comprehension

A= Application

T= Total

3.0.6. Validity of Geometry Construction Performance Test (GCPT)

The content and face validity of the geometry construction performance test (GCPT) was further validated by subjects experts in the unit of Science Education Ahmadu Bello University Zaria, such as: Senior lectures in mathematics education and some experts with degree and masters with averagely 30 years of teaching mathematics at secondary schools from Sokoto state. One of them is a subject master of mathematics education. He possessed degree in mathematics and have 30 years of working experience in teaching mathematics. Another one of them obtained degree and masters in mathematics education and has 20 years of teaching mathematics as well as marking mathematics in WEAC and NECO; he is presently a team leader of the two professional bodies of examinations. Others among them include a head master of one primary school in Sokoto who has the experience in the field of mathematics and also a team leader of NECO mathematics examination. Another one is a mathematics teacher who has degree and 25 years in teaching secondary school mathematics in Sokoto state; he is an experience NECO examiner. The content of GCPT is shown in (Apendix A). Lesson plans of both cooperative learning and lecture method groups were also validated by the same experts as shown in (Appendices **D and E**). Their observations were incorporated in modifying the instrument for data collection and lesson plans. These experts assessed the suitability of the instrument to ascertain whether or not the instrument is related to the objective of the study. After the validation of the instrument, it was suggested that content of the instrument was appropriate and relevant to the objectives of the study.

3.0.8 Reliability Coefficient of Construction Geometry Performance Test (CGPT)

The reliability coefficient of a test is the consistency to which the test repeatedly

measures what it is intended to measure. Reliability of an instrument could be ascertained using different techniques, in this study therefore, test retest was used. A pilot study was carried out in one secondary school within Sokoto metropolis; this was to test the reliability coefficient of the instrument used in the study. The result obtained was 0.63. This indicated that the internal consistency of the instrument is within the acceptable region.

3.0.9 Treatment Administration

Two teachers of mathematics at government own secondary schools in Sokoto metropolis were randomly selected for the study. The teachers were selected from the list of mathematics teachers having equal qualification, equal teaching experience and considerably equal teaching potential in the metropolis. The selected teachers were grouped into the control (C) and experimental (E) groups. The control group was exposed to the lecture method while the experimental group was put into one week training about cooperative learning. Students from the following two schools such as: GDSS Arkilla and GDSS Mabera from the ten (10) junior secondary schools in the study area were purposively selected. The diagrammatic presentation of this selection is indicated in Table 3.2. The two schools were divided in to experimental and control groups. Both of them were pretested in order to establish homogeneity among the groups. Treatment were then administered to experimental group by exposing the students to cooperative learning strategy, while the control group students were taught using lecture method. At the end of the five weeks treatment period posttest was administered to both (experimental and control groups) to see the significant difference between two groups, two weeks after posttest, post-posttest was administered to see the retention ability of the students. The contents of the

training for the teacher of experimental group covered the following sub-headings:

- The concept and meaning of cooperative learning
- Team- Building Techniques
- Lesson plan
- Lesson sharing and social skills (Iqbal,2004).

3.10 Data Collection Procedure

The selected volunteering teacher for experimental group, having gone through the one week training about cooperative learning was assigned to guide the selected students for a period of five (5) weeks. The teacher in the control group was also assigned to teach the students in the control group using the lecture method while the teacher in the experimental group was assigned to guide the students in the experimental group using cooperative learning strategy. At the end of the five weeks exercise, the data collection instruments Geometry Construction Performance test (GCPT) were administered to both experimental and control groups to test the performance of the students.

Two weeks after the posttest, post-posttest was administered to both experimental and control group students, the post-posttest was to test the student's retention ability after the topic had been taught to them. The two weeks gap was allotted between the tests because the researcher might have assumed that after two weeks, the students might have forgotten the questions of the GCPT as opined by (Usman, 2012).

3.0.11 Procedure for Data Analysis

The data in this study was analyzed using inferential statistics such as: independent

t-test statistics because the study is comparing the mean significant deference of two groups and the population is normally distributed. The flowing are null hypotheses with their respective statistical tools.

H_{01}: There is no significant difference in the mean performance of students taught geometry construction using cooperative learning strategy and those taught with the lecture method. Independent t-test was used to analyse the hypothesis.

H_{02}: There is no significant difference in the mean retention scores of students taught geometry construction with CLS and those taught with the lecture method. Independent t-test was used to analyse the hypothesis.

H_{03}: There is no significant difference in the mean performance of male and female students taught geometry construction using CLS and those taught with the lecture method. Independent t-test was used to analyse the hypothesis.

H_{04}: There is no significant difference in the mean retention scores of male and female students taught geometry using cooperative learning and those taught using the lecture method. Independent t-test was used to analyse the hypothesis.

3.0.7 Pilot Study Testing

A pilot study was carried out in Kaukabo junior secondary school in Sokoto metropolis with thirty (30) students **(15 Male and 15 Female)** to ascertain the validity and reliability of the instrument. One hour was given to students which enabled them to answer the items. The researcher later marked the scripts and split half was used to analyze the data, employing test- retest method, **0.63** was obtained which shows that the instrument is within the acceptable region, reliable and consistent.

CHAPTER FOUR

RESULTS, ANALYSES AND DISCUSSIONS

4.1 Introduction

The aim of this study was to investigate the impact of cooperative learning strategy on performance and retention in geometry among junior secondary schools students in Sokoto State. In this chapter, data collected were analyzed as follows: The pre-test was employed to establish the homogeneity among the students before the treatment. Descriptive statistics inform of mean and standard deviation was used to analyze the data and inferential statistics such as independent t-test was used to test the research hypotheses. The chapter was discussed under the following sub-headings.

Data Presentation

Hypotheses Testing

Summary of the Major Findings

Discussions

4.2 Data Presentation

The data collected using geometry construction performance test (GCPT), in this study was analyzed. Descriptive statistics employing Mean and standard deviation were used and answered the research questions, while at 0.05 level of confidence, inferential statistics adopting unmatched t-test statistics was used to test the research hypotheses of the study.

Pre-test posttest Analysis of Boys and Girls

Group	N	$\overline{X}$	S	Mean Diff.
EXP.	139	18.50	6.37	0.64
Cont.	125	19.14	7.78	

Table 4.1 shows that the pre-test mean and standard deviation of students in the experimental Group were 18.50 and 6.37 and control group were 19.14 and 7.784. The pre-GCPT mean performance difference was 0.64. This implies that the two groups are equivalent at the entry level of academic performance.

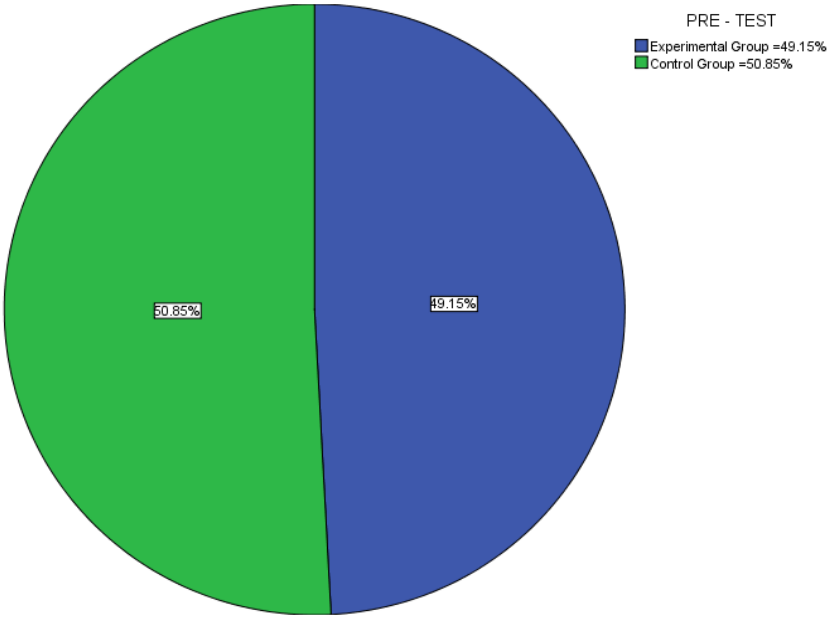

Figure 4.1: A Diagrammatical Presentation of Pretest Data

The diagram shows that the performance of students in the entry level was equivalent.

Posttest Analysis of Performance Scores of Experimental and Control Groups

Group	N	$\overline{X}$	S	Mean Diff.

EXP.	121	22.35	7.24	2.22
Cont.	128	20.13	7.73	

Table 4.2 reveals that the mean and S.D of students in retention scores of the experimental group was 22.35 with the standard deviation of 7.24 while control group had a mean of 20.13 with standard deviation of 7.73 respectively. Mean difference between the two groups is 2.22 which shows that the two groups ware different in cognitive level, this table also showed that, the experimental group performed better than the control group. Even though, all groups performed better than they did in the pre-test. The pre-test of experimental was 18.50 with the standard deviation of 6.37, and in the post-post-test the mean and standard deviation were 22.35 and 7.24 which had mean difference of 3.84 and 0.87, this shows that there is different in retention between the two groups it also shows that, all the two groups improved in performance. In general, experimental group performed better than their counter part control group.

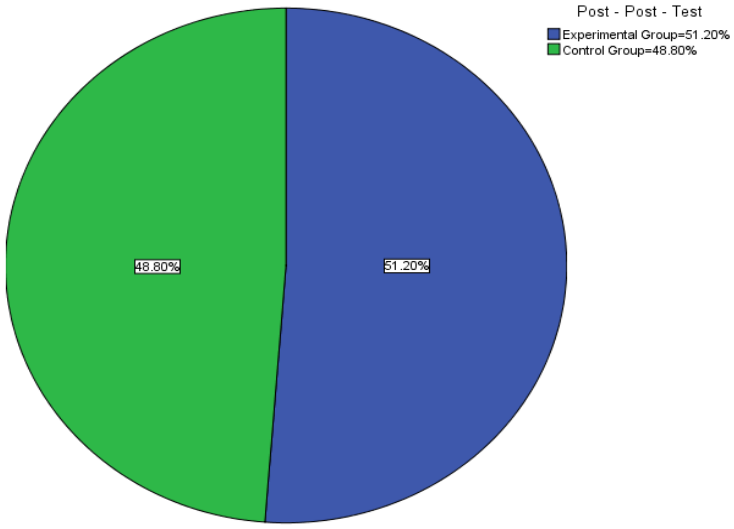

Figure: 4.2 A Diagrammatical Presentation of Post test Data

The diagram shows that the retention scores of experimental group is higher than those of control group in the post posttest. This shows that, students that students who were guided with cooperative learning retained geometry construction knowledge than those taught using conventional lecture method.

Posttest Analysis Performance Scores of Male and Female Students in Experimental Group

Gender for Exp.	N	$\overline{X}$	S	Mean Diff.
Male	67	18.66	5.94	0.33
Female	66	18.33	6.81	

Table 4.4.1 shows the mean and standard deviation scores of male and female of experimental Group in post-test as 18.66 and 5.94, as well as the mean and standard deviation of female as 18.33 and 6.81, and their mean difference is 0.33. This shows that

both the groups performed more than they do in the pr-test. Only that the male performed better than their counterpart female.

Post-posttest Analysis of Retention Scores of Male and Female Students in Experimental Group

Gender for Exp.	N	$\overline{X}$	S	Mean Diff.
Male	67	24.21	9.16	2.24
Female	66	21.97	5.91	

Table 4.4.3 Shows the mean and standard deviation retention scores of male and female students in post posttest as 24.21 and 9.16 for male and 21.97 and 5.91for female in experimental group. This shows that, male students who were guided with cooperative learning strategy retained higher than their counter part females students taught with the same method. This shows that male students were guided with cooperative learning strategy retained higher than their counterpart female.

Looking at the descriptive statistics on the table 4.2, 4.3 and 4.4, it was noticed that there exist a deference between the two groups, to state whether the deference is significant, inferential statistics such as independent t-test statistics was used at 0.05 level of confidence to test the null hypotheses which stated that there was no significant deference between students taught using cooperative learning strategy and those taught using conventional lecture method.

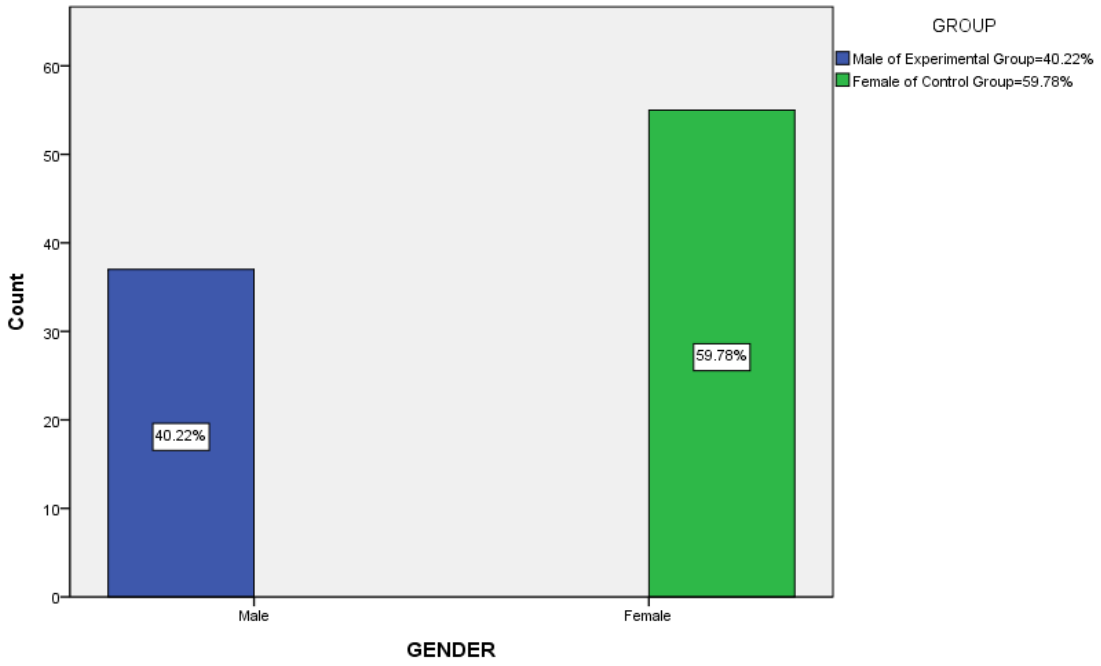

Figure 4.3: A Diagrammatical Presentation of Post Posttest Data

The diagram shows that the retention scores of female is higher than their counterpart male in the post posttest. This shows that, female students that were taught with conventional lecture method retained geometry construction knowledge more than their male counterpart.

4.3 Hypotheses Testing

At 0.05 level of significance, four null hypotheses were tested in this study, one tested the significant difference of the mean performance scores of students taught geometry construction using cooperative learning and students taught with the lecture method. Two tested the significant difference of the mean retention scores of students taught geometry construction using cooperative learning and those taught with the lecture method. Three tested the significant difference of the mean performance of male and

female students taught geometry construction using cooperative learning and those taught using the lecture method. Four tested the significant difference of the mean retention scores of male and female students taught geometry construction using cooperative learning and those taught with the lecture method. Inferential statistics such as: Independent t-test statistics was adopted and analyzed the data as shown bellow.

4.3.2 **Hypothesis One**

Ho_1: There is no significant difference in the mean performance scores of students taught geometry using cooperative learning strategy and those taught using lecture method. The results of t-test are shown in the Table 4.5

Summary of t-test Analysis

Table 4.1.: t- test analysis of Mean Performance Scores of Students Exposed to CLS and Lecture methods.

Post-test	**N**	$\bar{x}$	**S**	**df**	t_{cal}	t_{crict}	**P**	**Remark**
Exp. Group	132	23.10	7.77					
				260	4.33	1.66	0.00	Significant
Cont. Group	130	19.02	7.54					

- Significant at $P \leq 0.05$

Result of Table 4.5. shows t_{cal} = 4.33 and $t_{crit.}$ = 1.66. At 0.05 level of significance, $t_{cal.}$ = 4.33 > t_{crict} = 1.66., at df= 260, this shows that there is significant difference in the mean performance scores of students taught geometry using cooperative learning strategy, and those taught using lecture method. The null hypothesis of no significance difference in mean performance scores of students taught geometry using cooperative learning and

students taught using lecture method was therefore rejected.

4.3.3 Hypothesis two

Ho_2: There is no significant difference in the mean retention scores of students taught geometry using cooperative learning strategy, and those taught with lecture method.

Table 4.2: t-test Analysis of Mean Retention Scores of Students Exposed to CLS and Conventional Lecture Method

Post-post test	N	$\bar{x}$	S	df	t_{cal}	t_{crict}	P	Remark
Exp. Group	121	22.35	7.27					
				247	2.32	1.64	0.02	Sign.
Cont. Group	128	20.13	7.73					

- Significant at $P \leq 0.05$

Results of Table 4.6 showed that at $\alpha = 0.05$ level of significance, $t_{cal.} = 2.32 > t_{crict.} = 1.64$, at df = 247, this shows that there is significant difference in the mean retention ability scores of students guided geometry construction using cooperative learning strategy and those taught with lecture method. The null hypothesis of no significance difference in the mean retention ability scores of students guided geometry using cooperative learning strategy and those taught with lecture method is therefore rejected. Therefore, the use of CLS enhanced the retention ability of students in geometry construction of JSS III.

Table 4.3: t- test analysis of Mean Retention Scores of Male and Female Exposed to CLS.

Post-post test	N	$\bar{x}$	S	df	t_{cal}	t_{crict}	P	Remark

Male	67	24.21	9.16					
				131	1.67	1.64	0.01	**Significant**
Female	66	21.97	5.91					

- Significant at $P \leq 0.05$

Results of Table 4.8.1 shows that, at α = 0.05 level of significance, $t_{cal.} = 1.67 > t_{crict.} = 1.64$, at df = 133, this shows that there is significant difference in the mean retention ability scores of male students guided geometry construction using CLS over their counterpart female guided with the same CLS. The null hypothesis of no significant difference in the mean retention ability scores of male student guided geometry using CLS and their counterpart female guide with the same CLS, is therefore rejected. Therefore, the use of CLS enhanced the retention ability of male students in geometry construction of JSS III over their counterpart guided with the same CLS at JSS III geometry construction.

4.3.4 Hypothesis Three

Ho_3: There is no significant difference in the mean performance Scores of male and female taught geometry construction using cooperative learning strategy and those taught with lecture method.

Table 4.4: t- test analysis of Mean Performance Scores of Male and Male Exposed to CLS and Conventional Lecture Methods.

Post- test	**N**	$\bar{x}$	**S**	**df**	**t_{cal}**	**t_{crict}**	**P**	**Remark**
Male. Exp.	66	24.36	9.14					
				160	5.05	1.96	0.01	Sign.
Male Cont.	96	18.25	6.23					

- Significant at $P \leq 0.05$

Results of Table 4.7.1 shows that, $t_{cal.} = 5.05 > t_{crict.} = 1.96$. At $\alpha = 0.05$ level of significance, $t_{cal} = 5.05 > t_{crict.} = 1.96$, at df = 160. This shows that there is significant difference in the mean performance scores of male guided geometry construction using CLS over male taught geometry construction using conventional lecture method. The null hypothesis of no significant difference in performance scores of male students taught geometry construction using CLS over male students taught using lecture method, is therefore, rejected, hence the use of CLS enhances the performance of male students, over male students taught geometry constructions using lecture method.

Table 4.5: t- test analysis of Mean Performance Scores of Male and Female Exposed to CLS.

Post-test	**N**	$\bar{x}$	**S**	**df**	**t_{cal}**	**t_{crict}**	**P**	**Remark**
Male	67	18.66	5.94					
				131	0.29	1.64	0.7	Not.Sign.
Female	66	18.33	6.81					

- Significant at $P \leq 0.05$

Results of Table 4.7.2 shows that, $t_{cal.} = 0.29 < t_{crict.} = 1.64$. At 0.05 level of confidence, $t_{cal.} = 0.29 < t_{crict.} = 1.64$, at df = 131. This shows that there is no significant difference in the mean performance scores of male over the female guided geometry construction using CLS. The null hypothesis of no significant difference in performance scores of male and female students taught geometry construction using CLS is therefore, accepted, hence the use CLS did not enhance the performance of male over the female students in learning geometry constructions.

Table 4.6: t- test analysis of Mean Performance Scores of Female and Female Exposed to CLS and Lecture Method.

Post-test	N	$\bar{x}$	S	df	t_{cal}	t_{crict}	P	Remark
Female(Exp.)	66	21.97	5.91					
				95	0.60	1.96	0.54	Not.Sign.
Female(Cont.)	31	21.03	10.01					

- Significant at $P \leq 0.05$

Results of Table 4.7.4 show that, $t_{cal.} = 0.60 < t_{crict.} = 1.96$. At 0.05 level of confidence, $t_{cal.} = 0.29 < t_{crict.} = 1.96$, at df = 95. This shows that there is no significant difference in the mean performance scores of female and female guided geometry construction using CLS and lecture methods. The null hypothesis of no significant difference in performance scores of female and female students taught geometry construction using CLS and lecture method is therefore, **accepted**, hence the use of CLS methods did not enhance the performance of female and female students in learning geometry constructions.

4.3.5 Hypothesis Four

Ho_4: There is no significant difference between the mean retention scores of male and female students taught geometry using cooperative learning strategy and those taught using lecture method.

Table 4.7: t- test analysis of Mean Retention Scores of Male and Male Exposed to CLS and Conventional Lecture Methods.

Post-post	N	$\bar{x}$	S	df	t_{cal}	t_{crict}	P	Remark
Male(Exp.)	66	21.97	5.91					
				101	0.60	1.96	0.54	**Not. Sig**

Male(Cont.)	31	21.03	10.01

- Significant at $P \leq 0.05$

Results of Table 4.8.3 show that, $t_{cal.} = 0.60 < t_{crict.} = 1.96$. At $\alpha = 0.05$ level of significance, $t_{cal.} = 0.60 < t_{crict.} = 1.96$, at df = 101. This shows that there is no significant difference in the mean performance scores of male guided by CLS in geometry construction over male taught geometry construction using conventional lecture method. The null hypothesis of no significant difference in retention scores of male students taught geometry construction using CLS and male students taught using lecture method, is therefore, accepted, hence the use of CLS did enhances the performance of male students, over male students taught geometry constructions using lecture method.

Table 4.8: t- test analysis of Mean Retention Scores of Female and Female Exposed to CLS and Conventional Lecture Methods.

Postpost-test	**N**	$\bar{x}$	**S**	**df**	**t_{cal}**	**t_{crict}**	**P**	**Remark**
Female Exp.	66	23.36	7.82					
				119	1.69	1.96	0.09	Not.Sign.
Female Con.	55	21.13	6.41					

- Significant at $P \leq 0.05$

Results of Table 4.8.4 show that, $t_{cal.} = 1.69 < t_{crict.} = 1.96$. At 0.05 level of confidence, $t_{cal.} = 1.69 < t_{crict.} = 1.96$, at df = 119. This shows that there is no significant difference in the mean retention scores of female and female guided geometry construction using CLS and lecture methods. The null hypothesis of no significant difference in the mean

retention scores of female and female students taught geometry construction using CLS and lecture method is therefore, **accepted**, hence the use of CLS did not enhance the performance of female students over their female students taught geometry construction using lecture method.

4.4 Summary of the Major Findings

The following were the findings of this study:

1. Students who were taught with CLS performed significantly batter then student who were taught using conventional lecture method. It is significant.
2. Students who were taught with CLS retained higher then students who were taught using conventional lecture method. It is significant.
3. Male students exposed to CLS performed batter then the male students taught using conventional lecture method. It is significant.
4. Male students exposed to CLS performed not batter then the female students taught with CLS. It is not significant.
5. Male and female exposed to lecture method, male performed significantly than the female. It is significant.
6. Female exposed to CLS did not performed better than female in the lecture method.
7. Male students exposed to CLS retained higher than the female students taught with CLS. It is significant.
8. Female students who were taught using conventional lecture method retained higher then male taught using the same method. It is significant.
9. Male exposed to CLS did not done better than the male in the lecture method. It is not significant

10. Female exposed to CLS did not done better than the female taught with lecture method. It is not significant.

4.5 Discussions

A t-test analysis was conducted to assess the impact of cooperative learning strategy in learning geometry construction. The independent variable was the method of teaching and the dependent variable was the scores on Geometry Construction Performance Test (GCPT), which were administered before and after the completion of treatment, scores from pre -GCPT was used to establish homogeneity among the students.

The result of this study was discussed under three major paragraphs as: The treatment on students' performance in geometry construction, the impact of treatment on students' retention in geometry construction and the impact of treatment on gender. Impact of Treatment on Students Performance in Geometry Construction, the findings indicated that the two groups of students were equivalent before the treatment. But after the treatment of five (5) weeks, the findings have shown that, students in the experimental group had a higher post-test mean performance scores in geometry construction than the control group, this shows that there is significant difference between the two groups in terms of performance scores.

The reasons for the good performance of the experimental group when comparing the general performance of experimental group and control group is that the students in experimental group were stimulated to learn by seeing themselves in a group and also feel free to communicate and find the solution to their problems themselves this prompted more attention by the students. The opportunity for them to ask themselves questions generated interest, excitement total involvement and enjoyment of the lesson. Hence, the result of the

study revealed that the adoption of cooperative learning in mathematics in general and geometric construction in particular enhances the performance of students in mathematics. The findings of this study concretized the earlier findings of Davidson, and Kroll (1991) who worked with cooperative learning and concluded that cooperative learning improve students' academic performance. This is agrees with the findings of the following researchers whom discovered that students engaged in cooperative learning strategy performed significantly higher than their counter part been exposed to conventional lecture method among them include: Watson, Sutton and Jones (1996), Leikin and Zesty (1997) who investigated the effect of cooperative learning in learning mathematics. Their finding indicated that students been exposed to cooperative learning method have a higher scores than their counterpart. Whickers, Jacob, whickers, Bol and nunnery (1997) and King (1999), their studies have shown that students in cooperative learning strategy have greater performance scores than their counterpart. The findings also agrees with the findings of Feglengre and Gabosk (2006) who conducted the study on the effect of cooperative learning strategy on game playing for mathematics. Their findings have shown that learning of game playing in mathematics using cooperative learning enhances student performance. Muniz (2013), who asserted that students taught via Cooperative learning strategy performed better than students taught using lecture method, cooperative learning strategy could be adopted as strategy for effective teaching of construction, so as to improve the performance of students in mathematics. Impact of treatment on students retention in geometry construction, the findings of this study base on the retention in geometry construction revealed that students taught using cooperative learning strategy gained retention more than the control group taught using lecture method. This was also confirmed by the result of table 4.3, which showed that method is a significant factor on students

retention in mathematics in general and geometry construction in particular. The findings of this study buttressed the earlier findings of Slavin (1990) ; Johnson and Johnson (1991); Krumeh etal (2011), whom earlier suggested that cooperative learning could sustain students retention in mathematics in general and geometry construction in particulars, they also posited that cooperative learning strategy encourage students participation in lessons and help them to retain what they learnt. This study also support the earlier findings of Chianson , et al (2011) who conducted a study on a topic entitled effect of cooperative learning strategy on students retention in circle geometry in secondary schools in Benue state Nigeria. They found that the use of cooperative learning strategy in the study of mathematics in general and geometry in particular enhanced students retention of what has been taught. This study, thus asserted that, the adoption of cooperative learning strategy would lead to a high performance and retention of knowledge, which in turn enhances meaningful recalling of what has been learnt after the period of two weeks. Impact of treatment on gender on geometry construction, the finding of this study shows that male taught using cooperative learning strategy performed better than the female taught using lecture method in terms of performance in mathematics. in this table it shows that male in the experimental group who taught using cooperative learning strategy retained more than the female student taught using lecture method. The findings that students did not performed significantly different with reference to sex, for example indicated the relative impact of strategy of teaching on performance is not based on gender taught (Eze, 2000). Jahun and Monoh (2001) and Harbon peter (2002). This is sported by the finding of Gbodi and Laleje (2006) who stated that some other studies indicate gender differences, in the impact of method of teaching on student's performance. In view of this assertion mbakwen (2007) disclosed that the extent to which instruction, and learning strategy is dependent of

gender appear not to have been resolved. Even though the study above did not stressed cooperative learning strategy, it restricted to instructional strategies and without no doubt therefore, related to cooperative learning. Thus, cooperative learning could be an effective strategy to close the gap in the retention of male and female students in geometry construction.

As an effective teaching strategy, it is likely that cooperative learning strategy, faced a lot of challenges. Some of these challenges include: its acceptability by the students, inadequate class rooms or halls for whole class use, careful planning, dedication, commitment and discipline of the group members and so on (Yanamandram and Noble, 2005). According to Mbukwem (2007) it will be more effective to focus on overcoming the negative pressure rather than debating on which sex stands to gain more in the classroom. It has also shown in this study that, the involvement of more than one student in a group enhanced student's performance in mathematics, and should therefore be of paramount important than which sex gained more in the course of teaching and learning of mathematics.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS,

5.1 Introduction

This study investigated the impact of cooperative learning strategy in performance and retention in geometry among junior secondary school students in Sokoto State. In this chapter thus, the summary of the entire work and conclusions were given. Recommendations and suggestions for the further studies were made for other researchers who may wish to conduct similar studies.

5.2 Summary

This study was carried out on the impact of cooperative learning strategy on performance and retention in geometry among junior secondary schools in Sokoto State. The significance of the study was to provide solutions for students who faced a lot of difficulties in understanding and retaining the concept of mathematics in genera and geometry construction in particular. Educators and administrators are to consider cooperative learning strategy as another substantial method of teaching mathematics, where students can benefit from the contributions of other members in the group.

Literature on cooperative learning shown that cooperative learning occurred when more than one students comes together to solve a common problems. It was discovered that cooperative learning in mathematics has its applications rooted in the social constructivist theory which states that an individual understand more when he/she actively construct knowledge by his/her interaction with other persons in the class. The proponents of social constructivist, theory used in this study were Piaget, vygotsky, Bandera and so on.

All coeducational public own junior secondary schools 3 (JSS3) in Sokoto State

formed the population of the study. The schools were later categorized in to three (3) geopolitical zones and later to Sokoto metropolis from these, two schools were selected out of 34 schools from which became the sample of population. The schools were grouped in to experimental and control groups. Their academic performance and retention in geometry construction were measured before and after the treatment to see the impact of cooperative learning strategy. For the purpose of this study, the content of mathematics considered was geometry constructions content of JSS 3. Geometry was considered because of it difficulties which lead to students poor performance in mathematics in general as well as been it important to humanity and its application in different areas such as in engineering, geography, architecture, survey, physics, industries and so on.

Literatures were revealed on cooperative learning, performance, and retention in mathematics. An instrument called GCPT was designed by the researcher for the conglomeration of data for the study; quasi experimental design employing pretest, posttest and post-posttest was adopted in this study. Data accumulated was classified into pre-test, post-test and post-post-test, t-test statistics was used and analyzed four null hypnoses and descriptive statistics employing mean and standard deviation was used to answer research questions. In the same way, findings of this study revealed that students in experimental group performed significantly better than their counterpart in the control group. This shows that students who engaged in cooperative learning benefited more than their counterpart who were taught using lecture method. A comparison of male and female performance in the experimental group revealed that the difference is not significance, but comparison of male taught using cooperative learning and female taught using lecture method in terms of retention is significant. From these, it has been found that 1. Students who were taught with CLS performed significantly batter then student who were taught using conventional

lecture method. It is significant. 2. Students who were taught with CLS retained higher then students who were taught using conventional lecture method.

5.3 Conclusions

The findings of this study support much of the existing knowledge on cooperative learning strategy. However, any cooperative learning program customized to suit the curriculum, teachers and students. It has been found in this study also, as a result of student interaction in the group, students were able to create a new learning experience for themselves. Through the study, the researcher was able to notice that for a successful cooperative learning strategy, the following points are of paramount importance:

1. Adequate class rooms for conducive learning
2. Enough time for wider discussion of topics
3. Shared equal delegation of power

Based on the empirical evidences presented, cooperative learning strategy has gained more than the lecture method and enhances the performance and retention of students in mathematics. Despite the treatment given, many problems were noticed and further recommendations were suggested. In summary therefore, this study has shown that, cooperative learning strategy has a very formidable role to play in learning of mathematics in general and geometry in particular. My future researchers would surely benefit from this study carrying out more investigations that would improve the teaching and the learning of mathematics. Conclusively this study has shown that cooperative learning strategy is effective and enhances a positive impact on students' academic performance and retention in geometry construction. it has significantly proven that cooperative learning yield the following:

i. Enhance the performance of students and improve students' retentions in mathematics.

ii. enable students to reach consensus and take a decision making

iii. Gives an opportunity for students to apply knowledge and solve a problem.

iv. Allow students to discuss issues and take their decisions

v. Cooperative learning has shown to increase professionalism and moral among students

vi. Both low achiever and high achiever may have equal benefit in the cooperative groups

vii. Cooperative learning is time consuming and require the teacher guider to be per beaver

5.4 Contribution to Knowledge

This study was able to establish that:

1. Geometry construction performance Test (GCPT) was developed by the researcher
2. The adoption of CLS improved students performance in learning geometry construction at JSS III level.
3. Use of CLS enhances the teaching of geometry construction at JSS level other researches were done on SS level and mostly influences GCPT
4. It has been established by the researcher that CLS can be used to promote retention ability in the learning of geometry construction of JSS level
5. On the area of study sokoto metropolis sokoto state, much work have been done

using CLS in their secondary school, more especially in geometry. This may happen to be the first one in mathematics education.

5.5 Limitations of the study

Implementation procedure of CLS was the basic setback this study encountered, mostly, the team building and sharing of responsibilities among the sub-groups, which was completely associated to the instructor. Despite one week training, the instructor was not comfortable with the activities of cooperative learning. Due to this problem, the researcher had to against his interest make continues and persistent monitoring and constant supervision to control the occurrence of such problem.

Secondly, students with little or no knowledge of geometry construction were identified especially during the pretest. They were identified because of their inability to construct figures, they all scored zero. However, these students were helped by assigning them among various teams of the experimental groups to enable them to improve their performance in geometry construction.

Thirdly, as mathematics periods are always in the morning hours, persisted behavior of students coming late to school, prevented the researcher from getting the total sample of the study from the pretest to post-posttest.

Fourthly, selection of two (2) schools to represent thirty four (34) schools was also another shortcoming of the study, because the results could not be use to generalize the whole population.

Finally, due to the lack of sufficient learning environment, such as: classes, chairs, learning materials and so on for effective activities of CLS. Due to these limitations, the outcomes of this study could not be generalized but serves only to raise additional

questions and give suggestions for further reading.

5.6 Recommendations

This study shown that cooperative learning strategy, found effective and has a positive impact on students academic performance and retention in mathematics, therefore, the following points are recommended:

1. Cooperative learning strategy should be adapted by mathematics teachers, to teach concepts in mathematics and ensure that the best requirement of cooperative learning is utilized towards the teaching of mathematics.
2. In view of the population explosion in our secondary schools and inadequate learning environments, government shall provide conducive learning atmosphere that can accommodate cooperative learning activities.
3. School authorities should encourage their teachers to use cooperative learning strategy in their schools.
4. Curriculum planers should incorporate cooperative learning strategy in their curriculum design and implementation to simplify the identified difficulties in teaching and learning of mathematics.
5. MAN, STAN and NMS should make a workshop about the cooperative learning strategy as their members met annually to update their knowledge about the problems in teaching and learning of mathematics.

6. Students should be guided to appreciate the gains in cooperative learning as an important instructional delivery that exposé them to potentialities and competences of the teaming students.
7. Text book authors should be encouraged by federal ministry of education and state ministry of education to incorporate CLS as an innovate and efficacious strategy of teaching mathematics.

5.7 Suggestions for Further Studies

From the findings of the study, the following suggestions were made:

1. Similar studies should be carried out on the area of trigonometry
2. Similar studies should be carried out at NCE level or undergraduate level
3. Related studies should be carried out in the rural area
4. The same studies should be carried out in the urban area
5. Similar studies should be conducted at the ply technique level
6. Similar studies should be carried out in the whole sokoto state
7. Similar studies should be carried out in circle geometry
8. The same studies should conducted in nursery level
9. The same studies should carried out in school of nursing level
10. Similar studies should be investigated in statistics aspect of mathematics

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APENDIX A

Faculty of Education

Department of Science Education

Ahmadu Bello University Zaria

Geometry Construction Performance Test (GCPT)

Pre-test Study

Name:----------

School:----------

Gender: male [ ] female [ ] **Time Allowed**: 1 hr

Instructions: select from the options a-d what you believe to be the correct answer of each question. You are to answer all the questions and all questions carry equal marks

1. …….. is the measures of rotation

1. radius b. right angle c. parallel line d. Angle

2. One of the following is not necessary in construction

   a. graph b. pair of compasses c. fresh eraser d. sharp pencil

3. In construction of …….. a straight line must be drawn

   a. Graph b. Angle c. drawing d. Compasses

4. In construction of a …….. a set square is need

a. perpendicular line b. Angle c. parallel line d. straight line

5. When an angle is less than 90^{0}, is called

a. Acute angle b. Obtuse angle c. right angle d. reflex angle

6. When two line met, and at the point of their contact they produced a 90^0 angle it is called ……..

a. Obtuse angle b. right angle c. acute angle d. complete angle

7. When …….. Is constructing, there must to be two points.

a. line b. Angle c. radius d. parallel line

8. When angle is constructed we use ……. To measure whet degree it is.

a. protractor b. set square c. compasses d. ruler

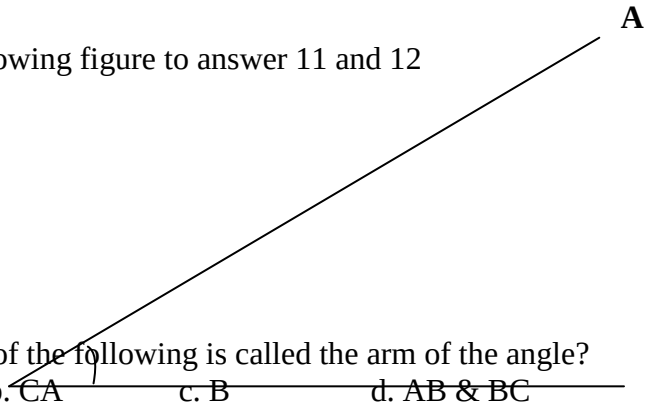
9. …….. Are two lines moving on the same direction without meeting at any points?

a. angle b. Line c. protractor d. parallel line

10. …….. Is name according to its size?

a. line b. Circle c. angle d. parallel line

Use the following figure to answer 11 and 12



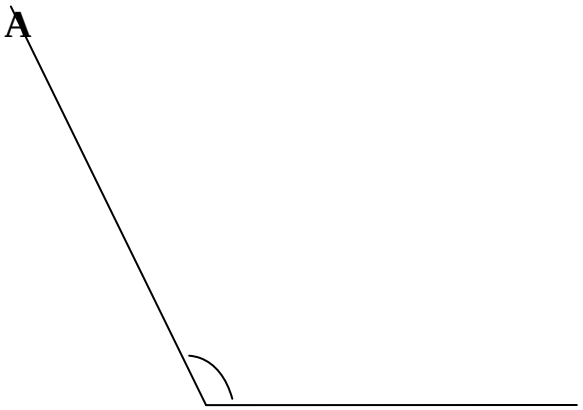
11. Which of the following is called the arm of the angle?

a. AC b. CA c. B d. AB & BC

12. The angle is called ……..

a. Obtuse b. acute c. reflex d. complete angle

13. In the following figure <B is called ……



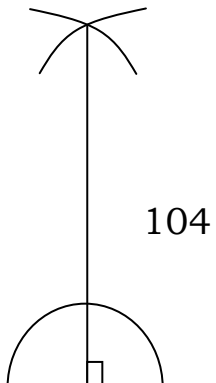
a. complete angle b. Acute angle c. reflex angle d. obtuse angle

14. One of the following is not an instrument for construction
a. pair of compasses b. Pencil c. ruler d. Biro

15. To constructs an angle of …… it would be easier if an angle of 900 is constructed.
a. 300 b. 450 c. acute angle d. obtuse angle

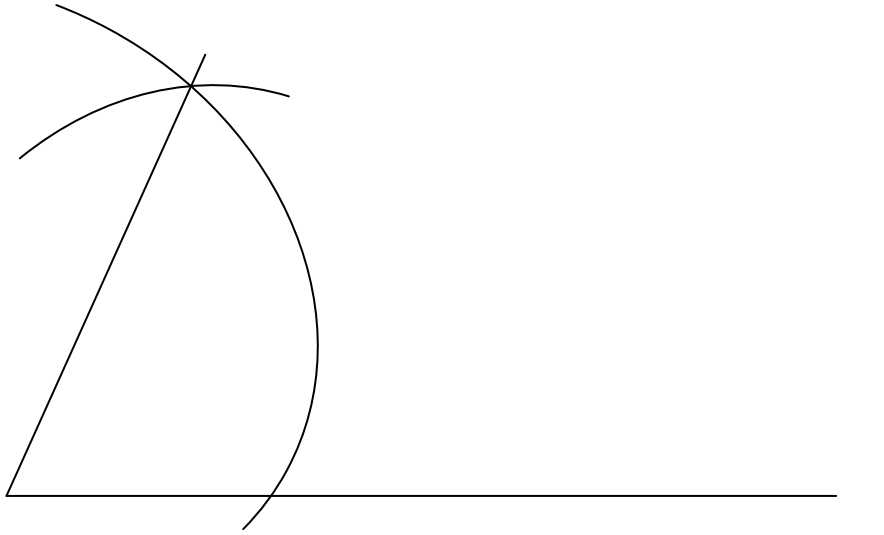
16. Construction of an angle of ……. Would be simple if an angle of 600 is constructed
a. 900 b. 1800 c. 3600 d. 300

17. The following figure shows an angle of ……



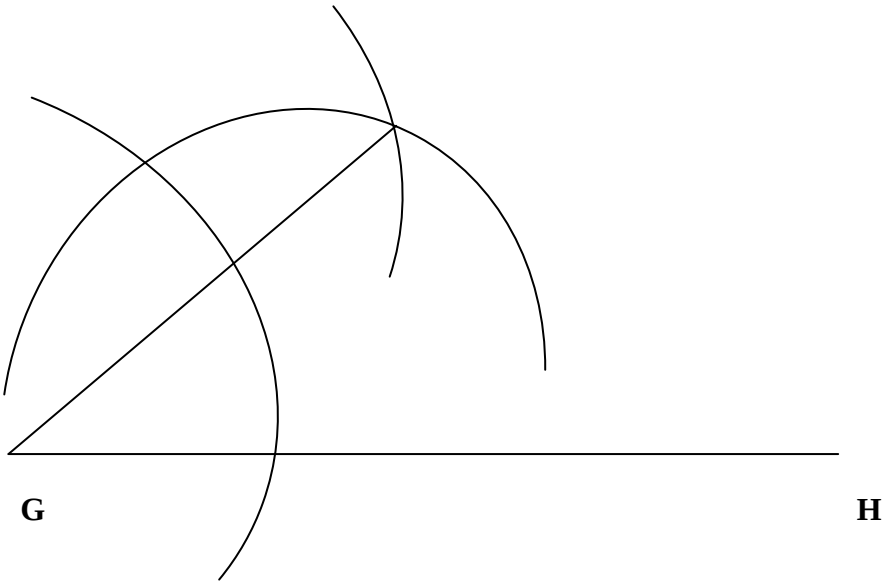
a. 90^0 b. 60^0 c. 45^0 d. 30^0

18. The following figure shows an angle of



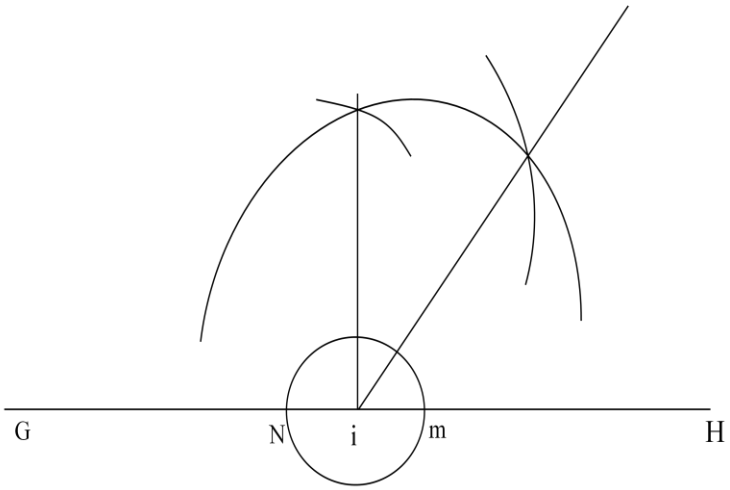
a.30^0 b. 45^0 c. 60^0 d. 90^0

19. The following figure shows an angle of …….



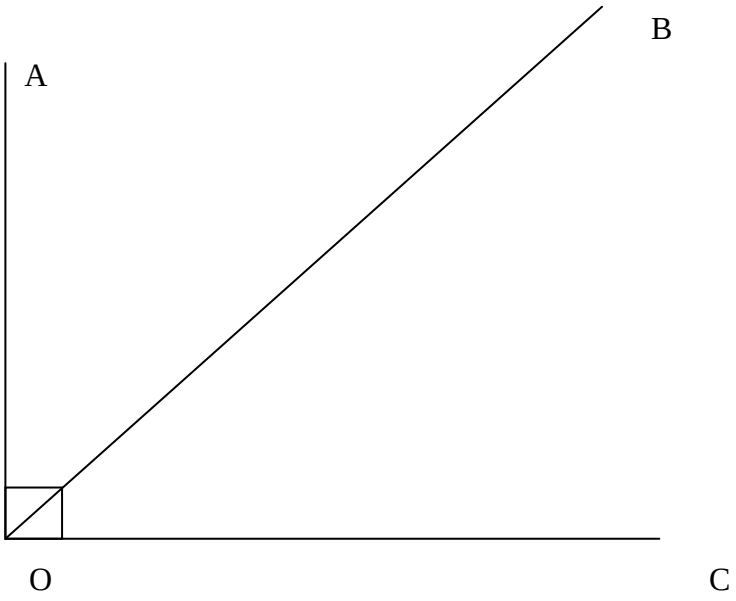
a.30^0 b. 45^0 c. 60^0 d. 90^0

20. The following figure shows an angle of ……..



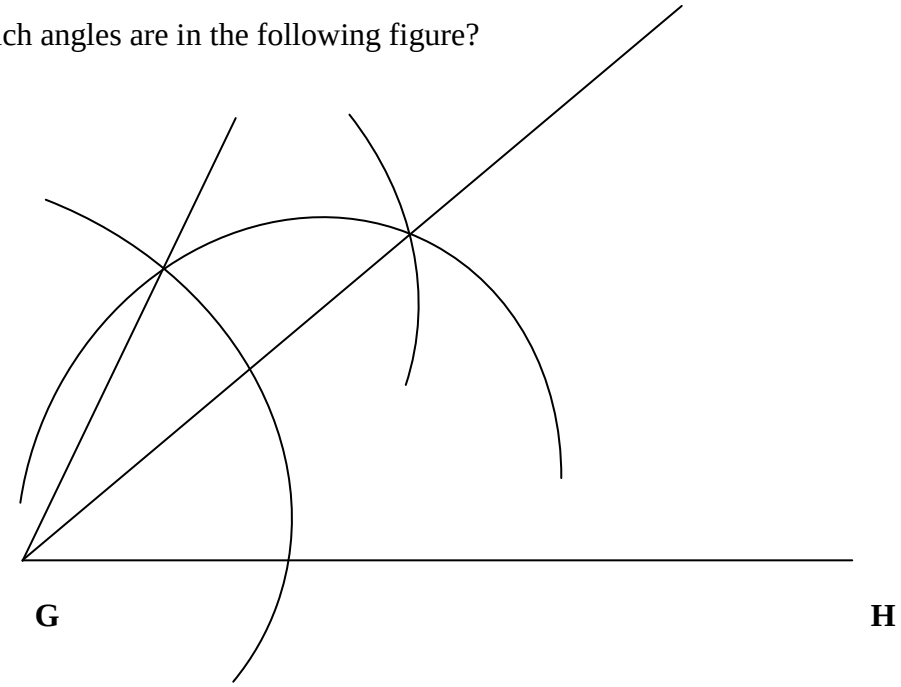
a.30^0 b. 45^0 c. 60^0 d. 90^0

21. In the following figure, one of the following is called right angle



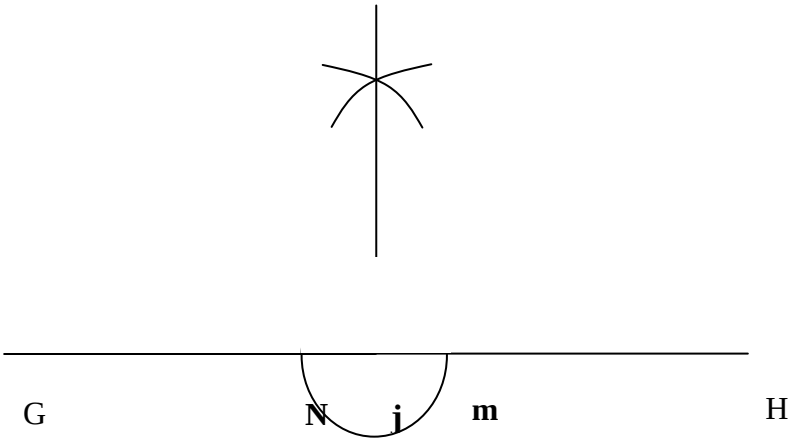
a. OB b. <BOC c. <OB d. AOC

22. Which angles are in the following figure?



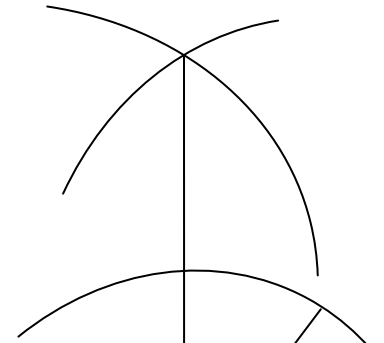
a. 60^0,30^0 b. 60^0,60^0 c. 90^0,45^0 d. 30^0,45^0

24. Which angle is in the following figure?



a.90^0 b. 180^0 c. 45^0 d. 120^0

25. Which angles are in the following figure?



a.90^0, 60^0 b. 90^0,30^0 c. 90^0,45^0 d. 90^0, 120^0

26. The following are several ways of constructing angles accept.

a. Using combination of set squares b. using protractor c. using biro d. using a pair of compasses

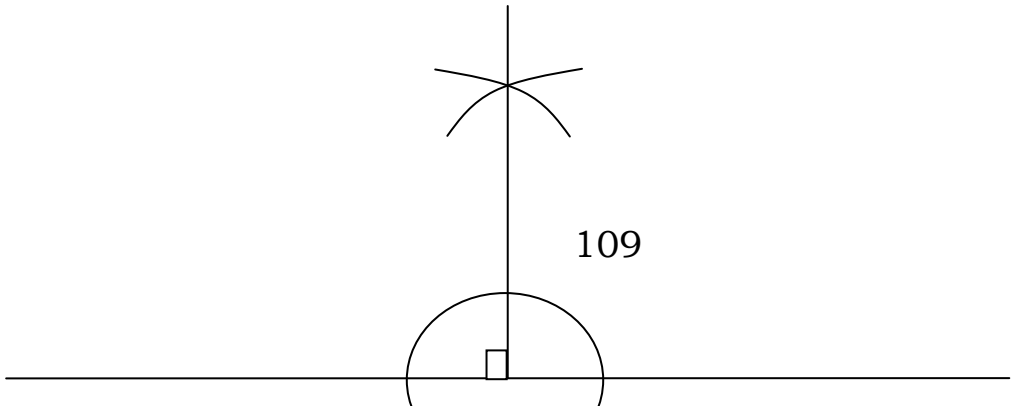
27. We use ……. To measure the number of degree in an angle

a. protractor b. set square c. fresh eraser d. sharp pencil

28. When two straight lines meet, we say that ……. Is formed

a. parallel line b. perpendicular line c. angle d. line

29. Which angles are in the following figure?



a. 360^0, 45^0 b. 360^0,90^0 c. 30^0, 360^0 d. 45^0,90^0

30. Which of the following is not the type of angle?

a. acute b. obtuse c. parallel d. reflex

APENDIX B

Faculty of Education

Department of Science Education

Ahmadu Bello University Zaria

Geometry Construction Performance Test (GCPT)

Post-test Study

Name:----------

School:----------

Gender: male [ ] female [ ] **Time Allowed**: 1 hr

Instructions: select from the options a-d what you believe to be the correct answer of each question.

You are to answer all the questions and all questions carry equal marks

1. …….. is the measures of rotation

2. radius b. right angle c. parallel line d. Angle

2. One of the following is not necessary in construction

a. graph b. pair of compasses c. fresh eraser d. sharp pencil

3. In construction of …….. a straight line must be drawn

a. Graph b. Angle c. drawing d. Compasses

4. In construction of a …….. a set square is need

a. perpendicular line b. Angle c. parallel line d. straight line

5. When an angle is less than 90^0, is called

a. Acute angle b. Obtuse angle c. right angle d. reflex angle

6. When two line met, and at the point of their contact they produced a 90^0 angle it is called ……..

a. Obtuse angle b. right angle c. acute angle d. complete angle

7. When …….. Is constructing, there must to be two points.

a. line b. Angle c. radius d. parallel line

8. When angle is constructed we use ……. To measure whet degree it is.

a. protractor b. set square c. compasses d. ruler

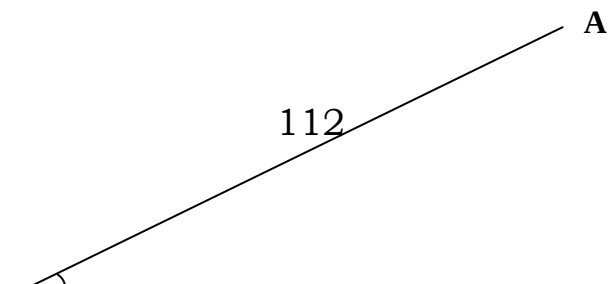
9. …….. Are two lines moving on the same direction without meeting at any points?

a. angle b. Line c. protractor d. parallel line

10…….. Is name according to its size?

a. line b. Circle c. angle d. parallel line

Use the following figure to answer 11 and 12



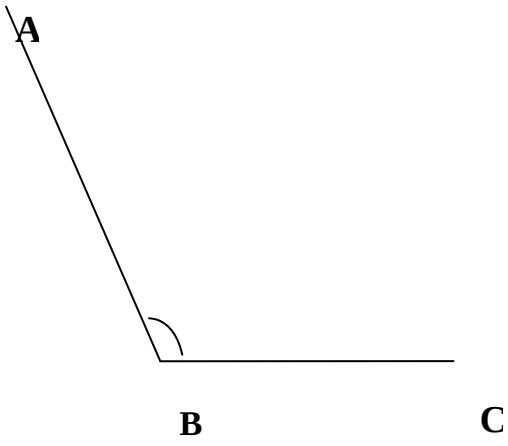
11. Which of the following is called the arm of the angle?

a. AC b. CA c. B d. AB & BC

12. The angle is called ……..

a. Obtuse b. acute c. reflex d. complete angle

13. In the following figure <B is called ……



a. complete angle b. Acute angle c. reflex angle d. obtuse angle

14. One of the following is not an instrument for construction

a. pair of compasses b. Pencil c. ruler d. biro

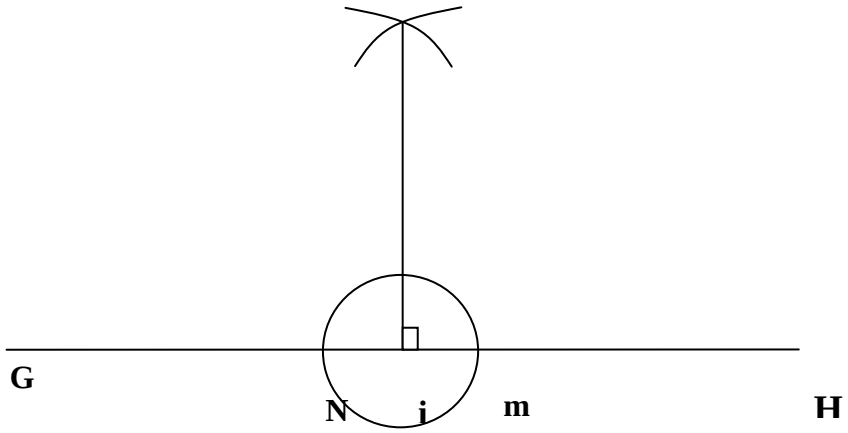
15. To constructs an angle of …… it would be easier if an angle of 90^0 is constructed.

a. 30^0 b. 45^0 c. acute angle d. obtuse angle

16. Construction of an angle of ……. Would be simple if an angle of 60^0 is constructed

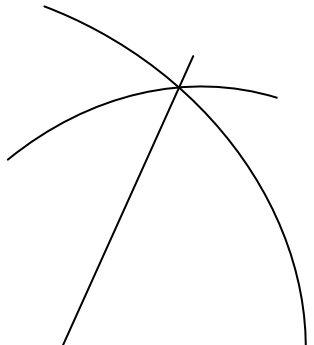
a. 90^0 b. 180^0 c. 360^0 d. 30^0

17. The following figure shows an angle of ……



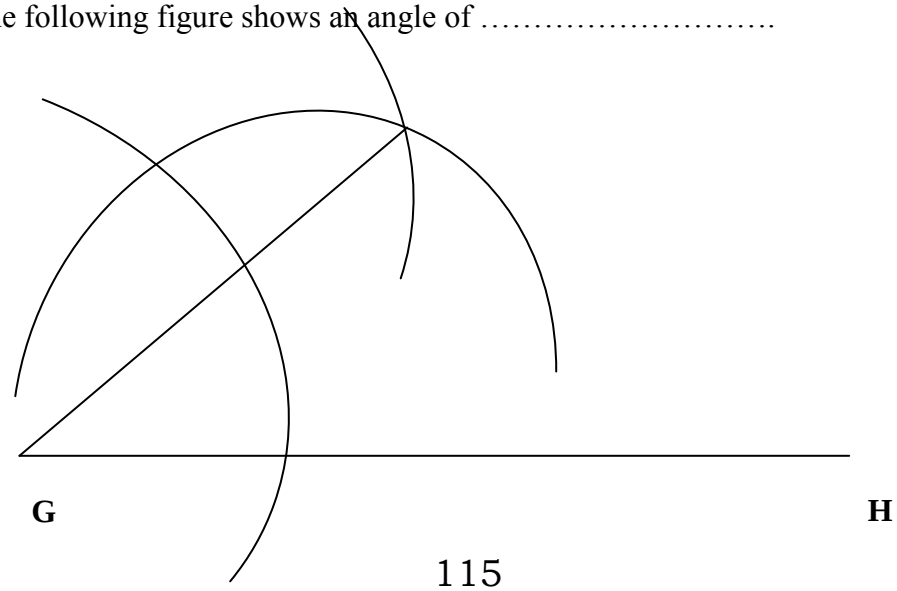
a. 90^0 b. 60^0 c. 45^0 d. 30^0

18. The following figure shows an angle of



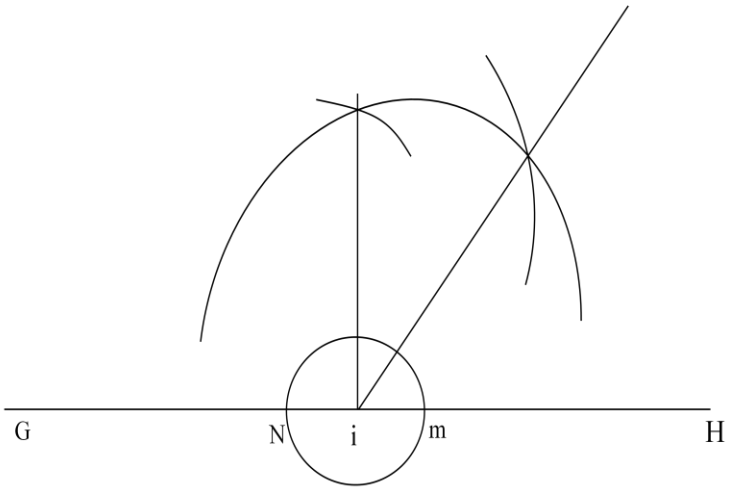
a.30^0 b. 45^0 c. 60^0 d. 90^0

19. The following figure shows an angle of …….



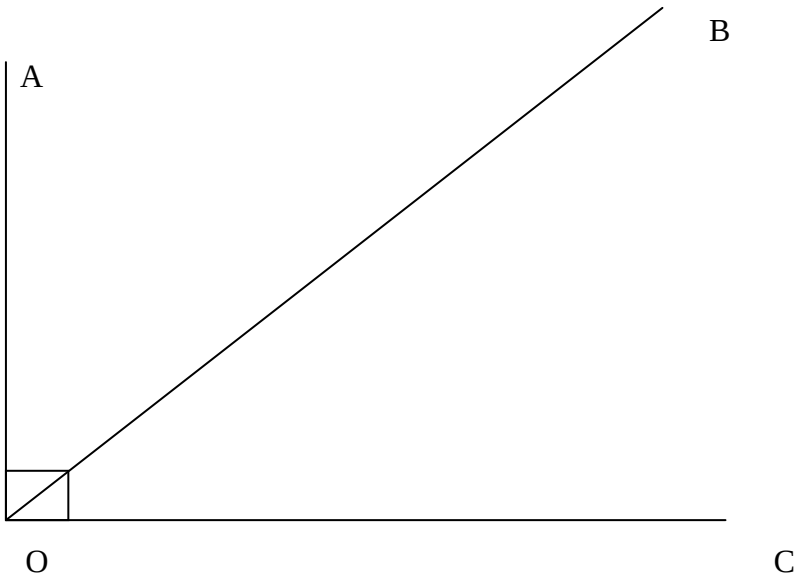
a.30^0 b. 45^0 c. 60^0 d. 90^0

20. The following figure shows an angle of ……..



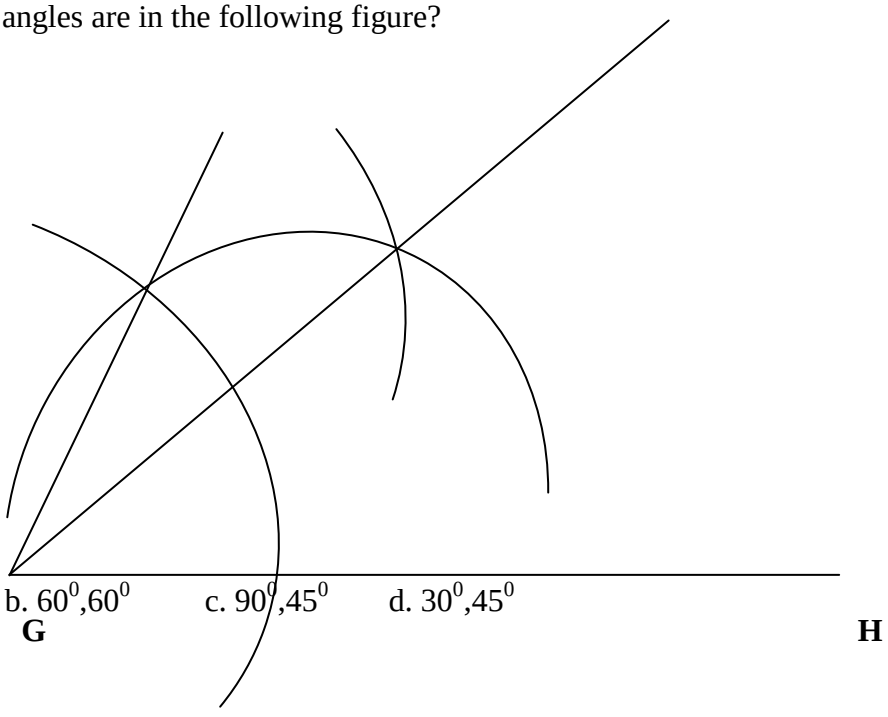
a.30^0 b. 45^0 c. 60^0 d. 90^0

21. In the following figure, one of the following is called right angle



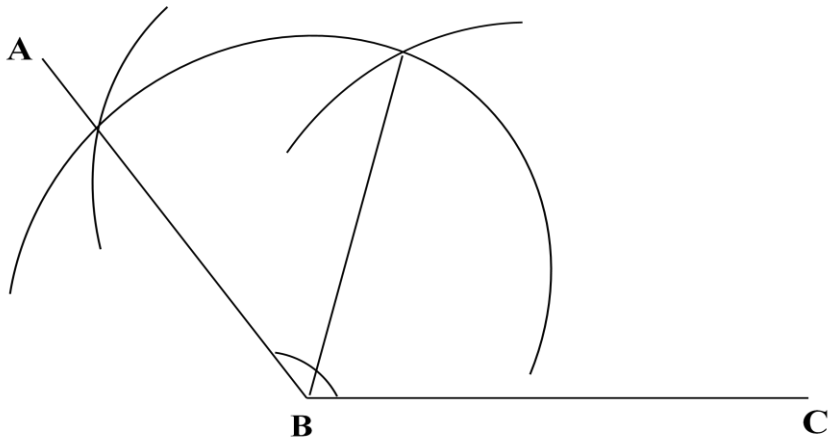
a. OB b. <BOC c. <OB d. AOC

22. Which angles are in the following figure?



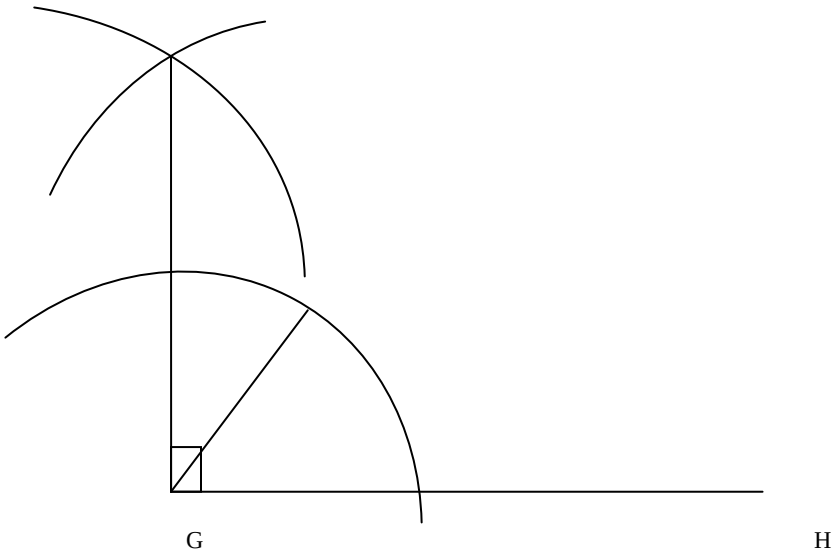
a. 60^0,30^0 b. 60^0,60^0 c. 90^0,45^0 d. 30^0,45^0

23. Which angles are in the following figure?



a.60^0, 60^0 b. 60^0,45^0 c. 120^0,60^0 d. 30^0,120^0

24. Which angles are in the following figure?

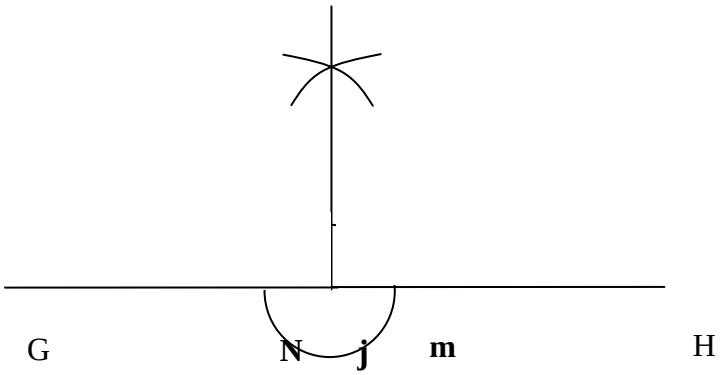


a.90^0, 60^0 b. 90^0,30^0 c. 90^0,45^0 d. 90^0, 120^0

25. The following are several ways of constructing angles accept.

a. using combination of set squares b. using protractor c. using biro d. using a pair of compasses.

26. Which angle is in the following figure?



a.90^0 b. 180^0 c. 45^0 d. 120^0

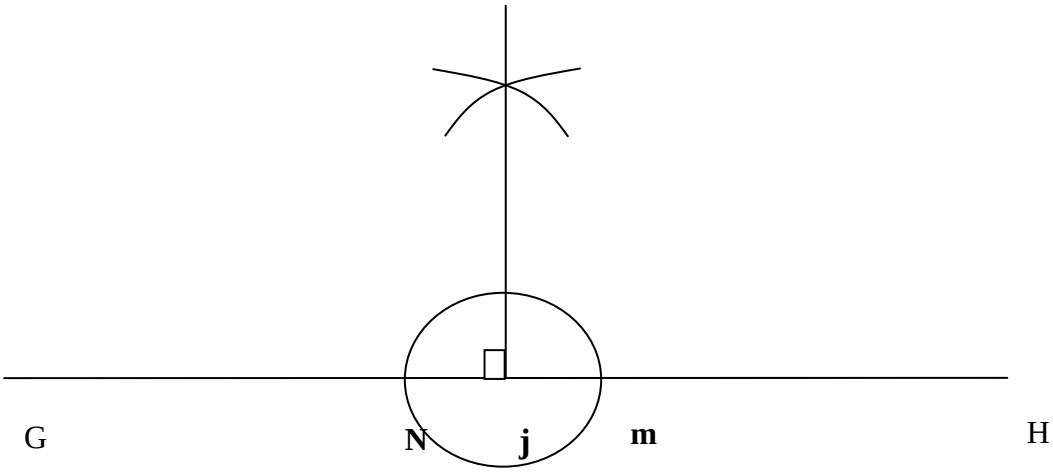
27. We use ……. To measure the number of degree in an angle

a. protractor b. set square c. fresh eraser d. sharp pencil

28. When two straight lines meet, we say that ……. Is formed

a. parallel line b. perpendicular line c. angle d. line

29. Which angles are in the following figure?



a. 360^0, 45^0 b. 360^0,90^0 c. 30^0, 360^0 d. 45^0,90^0

30. Which of the following is not the type of angle?

a. acute b. obtuse c. parallel d. reflex

APENDIX C

Faculty of Education

Department of Science Education

Ahmadu Bello University Zaria

Geometry Construction Performance Test (GCPT)

Post- Post-test Study

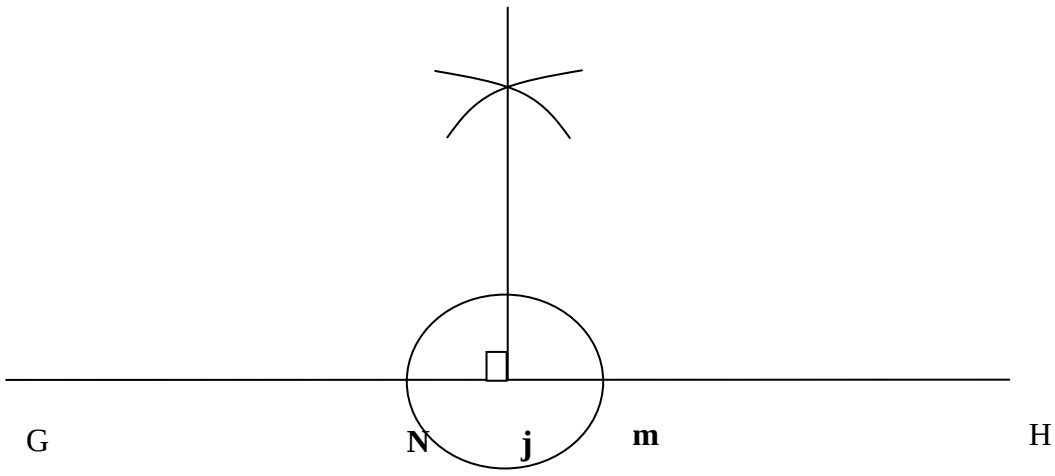
Name:----------

School:----------

Gender: male [ ] female [ ] **Time Allowed**: 1 hr

Instructions: select from the options a-d what you believe to be the correct answer of each question. You are to answer all the questions and all questions carry equal marks

3. Which angles are in the following figure?



a. 360^0, 45^0 b. 360^0,90^0 c. 30^0, 360^0 d. 45^0,90^0

2. To constructs an angle of …… it would be easier if an angle of 90^0 is constructed.

a. 30^0 b. 45^0 c. acute angle d. obtuse angle

3. One of the following is not an instrument for construction

a. pair of compasses b. Pencil c. ruler d. biro

4. Which of the following is not the type of angle?

a. acute b. obtuse c. parallel d. reflex

5. Construction of an angle of ……. Would be simple if an angle of 60^0 is constructed

a. 90^0 b. 180^0 c. 360^0 d. 30^0

6. One of the following is not necessary in construction

a. graph b. pair of compasses c. fresh eraser d. sharp pencil

7. In construction of …….. a straight line must be drawn

a. Graph b. Angle c. drawing d. Compasses

8. In construction of a …….. a set square is need

b. perpendicular line b. Angle c. parallel line d. straight line

9. When an angle is less than $90^{0,}$ is called

b. Acute angle b. Obtuse angle c. right angle d. reflex angle

10. When two straight lines meet, we say that ……. Is formed

a. parallel line b. perpendicular line c. angle d. line

11. When two line met, and at the point of their contact they produced a 90^0 angle it is called ……..

a. Obtuse angle b. right angle c. acute angle d. complete angle

12. When …….. Is constructing, there must to be two points.

a. line b. Angle c. radius d. parallel line

13. When angle is constructed we use ……. To measure whet degree it is.

a. protractor b. set square c. compasses d. ruler

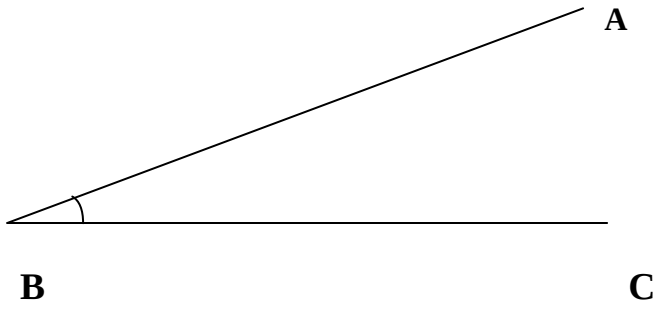
14. …….. Are two lines moving on the same direction without meeting at any points?

a. angle b. Line c. protractor d. parallel line

15. …….. Is name according to its size?

a. line b. Circle c. angle d. parallel line

Use the following figure to answer 16 and 17



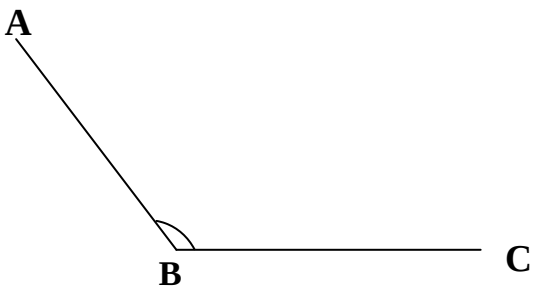
16. Which of the following is called the arm of the angle?

a. AC b. CA c. B d. AB & BC

17. The angle is called ……..

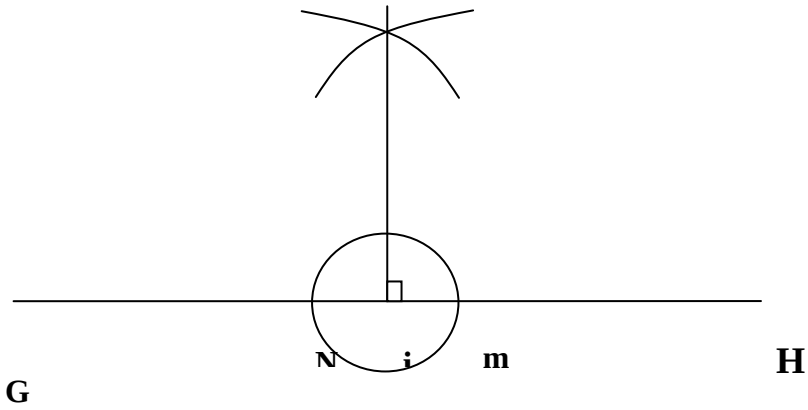
a. Obtuse b. acute c. reflex d. complete angle

18. In the following figure <B is called ……



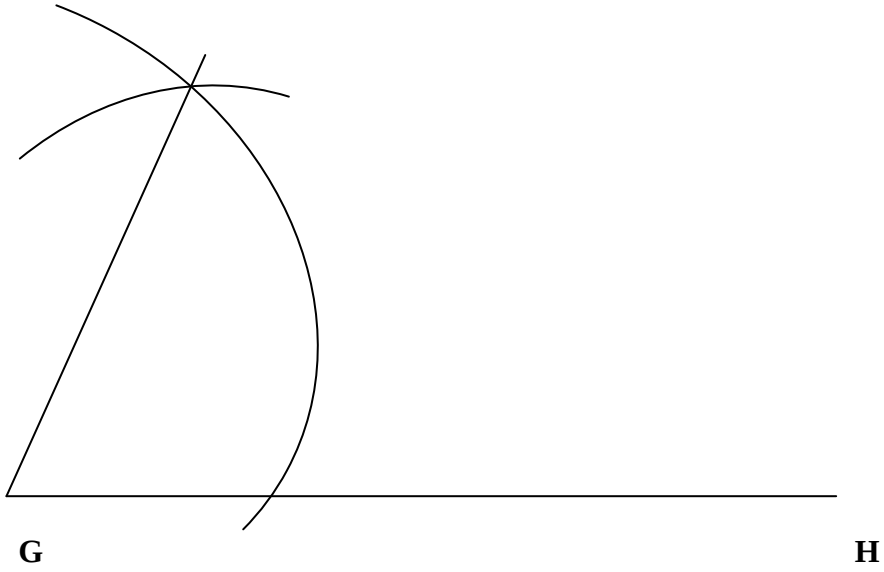
a. complete angle b. Acute angle c. reflex angle d. obtuse angle

19. The following figure shows an angle of ……



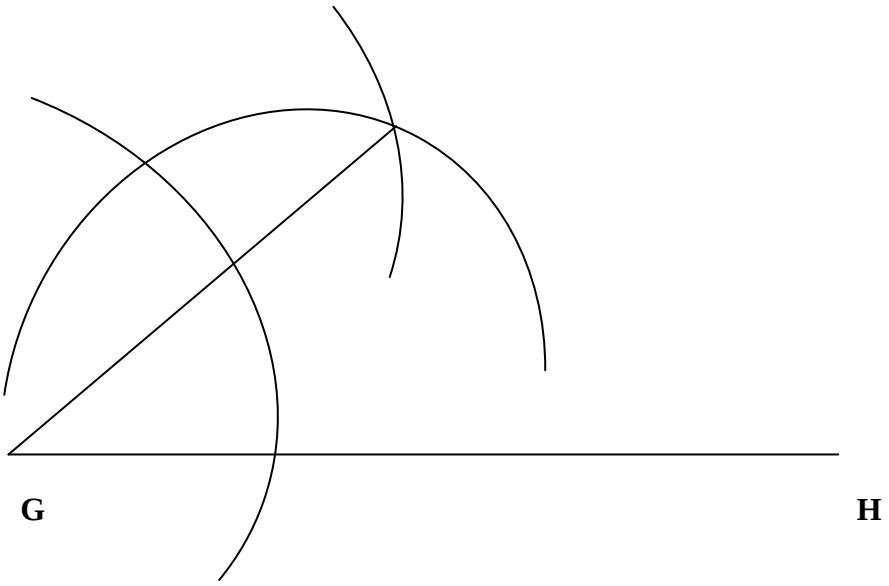
a. 90^0 b. 60^0 c. 45^0 d. 30^0

20. The following figure shows an angle of



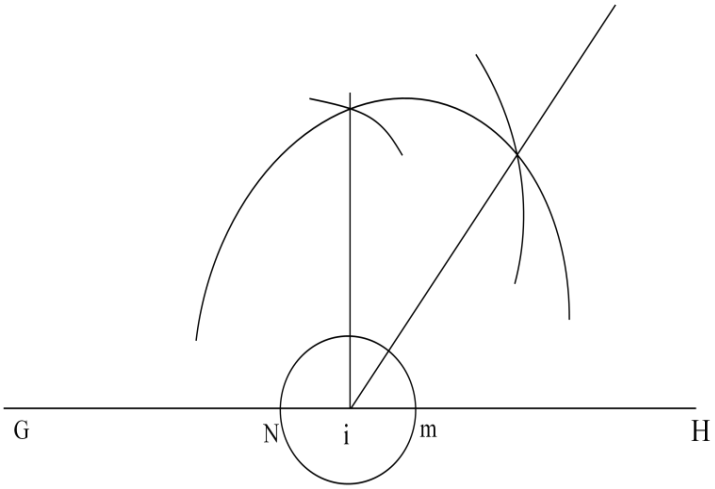
a.30^0 b. 45^0 c. 60^0 d. 90^0

21. The following figure shows an angle of …….



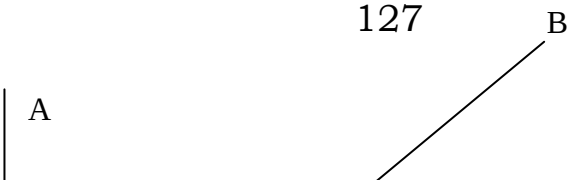
a.30^0 b. 45^0 c. 60^0 d. 90^0

22. The following figure shows an angle of ……..



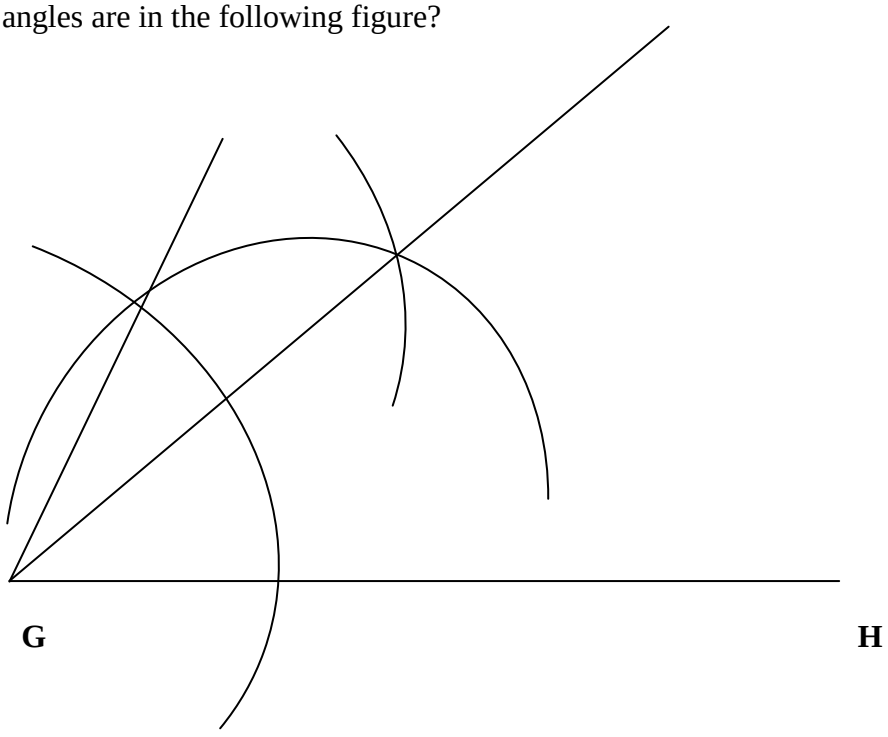
a.30^0 b. 45^0 c. 60^0 d. 90^0

23. In the following figure, one of the following is called right angle



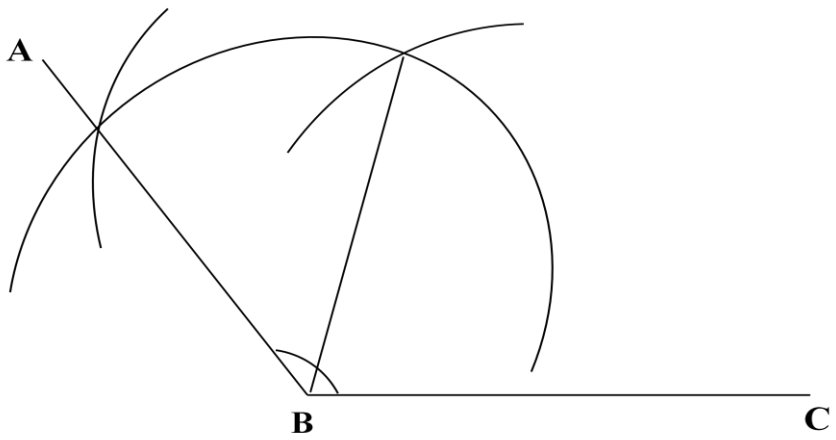
b. OB b. <BOC c. <OB d. AOC

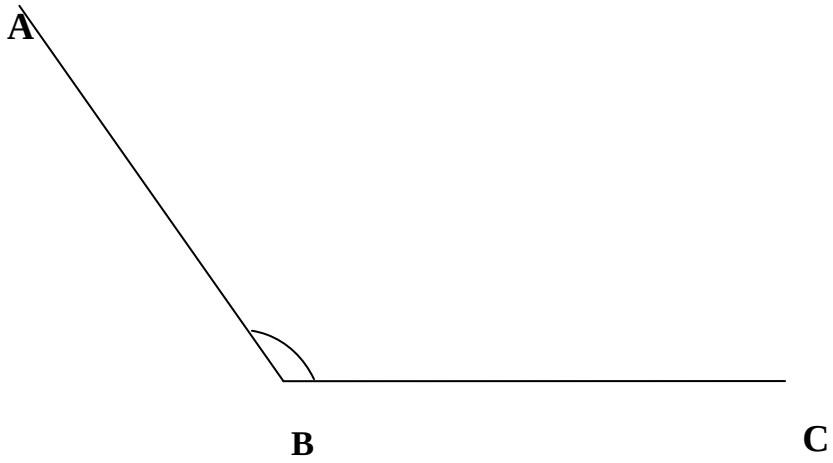
24. Which angles are in the following figure?



a. 60^0,30^0 b. 60^0,60^0 c. 90^0,45^0 d. 30^0,45^0

25. Which angles are in the following figure?


A
B
C

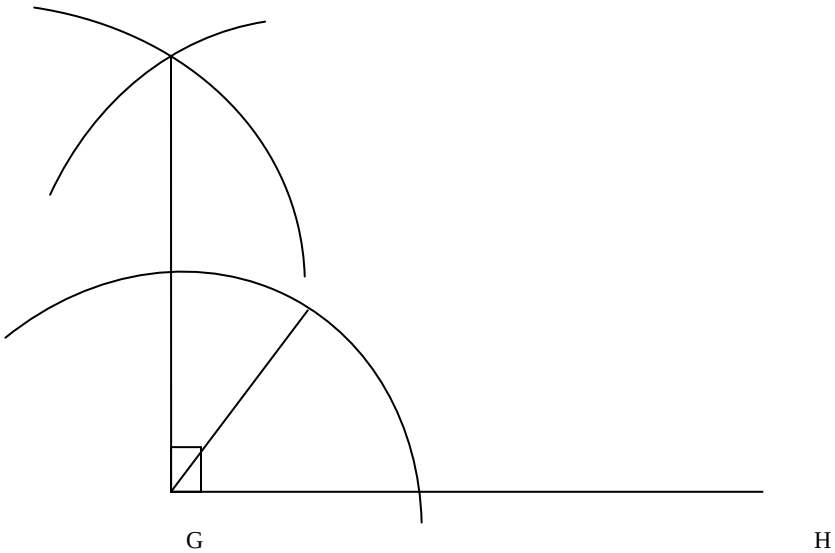


a.60^0, 60^0 b. 60^0,45^0 c. 120^0,60^0 d. 30^0,120^0

26. We use ……. To measure the number of degree of an angle

a. protractor b. set square c. fresh eraser d. sharp pencil

27. Which angles are in the following figure?



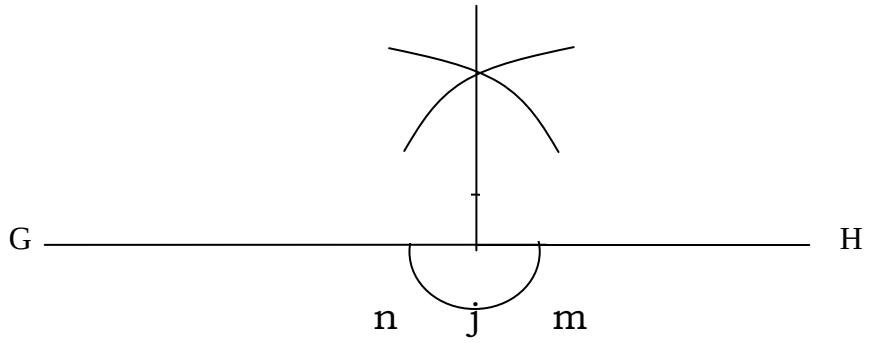
a.90^0, 60^0 b. 90^0,30^0 c. 90^0,45^0 d. 90^0, 120^0

28. The following are several ways of constructing angles accept.

a. using combination of set squares b. using protractor c. using biro d. using

a pair of compasses.

29. Which angle is in the following figure?



a.90^0 b. 180^0 c. 45^0 d. 120^0

30. …….. is the measures of rotation

a. radius b. right angle c. parallel line d. Angle

Apendix D

LESSON PLAN FOR THE EXPERIMENTAL GROUP

Lesson note: One

Method of teaching:	Cooperative learning
Subject:	Mathematics
Topic:	Construction of line
Lesson 1:	
Group:	Experimental
Class:	JSS 3
No. of students in class:	110
Time:	Double period (2 hours)
Instructional material:	Pair of compasses and ruler.
Behavioral objectives:	By the end of the lesson students shall be able to: construct a line
Previous knowledge:	students have unready learned whatne
is?	
Introductions:	Teacher asks the students the following oral question e.g. such as: defined a line construct a line

Activity 1: construction of line. You are provided with the following procedure:

i. draw a straight line AB longer than 7cm

ii. Take a measurement of 5cm using your compass place you compass on point A cut AB.

iii. The following will be the construction of the required line.

- Answers to the above activity will be arrived at through brainstorming, asking group members questions and the use of demonstration to deduce, the outcome

of the even on their own. Within this period subjects are to actively listen to the views of other and discuss their views with group, members to be able to maximize the benefit of cooperative learning.

- Research assistant goes round and remind the subjects to contribute actively to the entire success of their group.
- All completed activities by each subgroup on the answer sheet are to be collected from the group leaders and marked by the research assistant

Evaluation: Teacher evaluates his lesson by asking the following question.

Question: - construct a line

Conclusion: Teacher concludes the lesson by explaining to the students briefly the main points in the lesson that is, the construction of line. The teacher shall inform the students about the next lesson, known as construction, of parallel line.

Assignment: Teacher tells the students to read more about the different techniques of constructing line.

CONSTRUCTION OF PARALLEL LINE

Lesson note:	Two
Method of teaching:	cooperative learning
Subject:	mathematics
Topic:	construction of parallel line
Lesson 2:	
Group:	experimental
Class:	JSS 3
No. of students in class:	110
Time:	double period (2 hours)
Instructional material:	pair of compasses and ruler.
Behavioral objectives:	by the end of the lesson students shall be able to: construct a parallel line
Previous knowledge:	students have unready learn how to construct aline
Introductions:	Teacher asks students the following oral question e.g. such as: i. defined a parallel line ii. Construct a parallel line

Activity 1: construction of parallel line. You are provided with the following procedure:

1. Construct a line through P, so that it is parallel to AB.

2. Place a set square so, that one edge is exactly, alone AB
3. Please a ruler along one of the other edge of the set squared use the left hand edge if you are on the right hand
4. Hold the ruler folly, still the set square along the ruler follow P, and stop when the edge that was on AB riches. P, draw a line along this edges of the set square through P.

a. Answers to the above activity will be arrived at through brainstorming, asking group members questions and the use of demonstration to deduce, the outcome of the even on their own. Within this period subjects are to actively listen to the views of other and discuss their views with group, members to be able to maximize the benefit of cooperative learning.

b. Research assistant goes round and remind the subjects it contribute actively or the entire success of their group.

c. All completed activities by each subgroup on the answer sheet are to be collected from the group leaders and marked by the research assistant

Evaluation:	Teacher asks the following question
Question:	- construct a parallel line
Conclusion	Teacher concludes the lesson by explaining to the students briefly the main points in the lesson that is the construction of parallel line. The teacher shall inform the students about the next lesson, known as construction, of

perpendicular line.

Assignment: Teacher tells the students to read more about the different techniques of constructing parallel line.

CONSTRUCTION OF PERPENDICULAR LINE

Lesson N**ote**: Two

Method of Teaching: cooperative learning

Subject: mathematics

Topic: construction of perpendicular line

Lesson 3:

Group:	experimental
Class:	JSS 3
No. of students in class:	110
Time:	double period (2 hours)
Instructional material:	pair of compasses and ruler.
Behavioral objectives:	by the end of the lesson students shall be able to: construct a perpendicular line
Previous knowledge: construct a.line	students have unready learnt how to
Introductions	Teacher asks students the following oral question e.g. such as: i. defined a perpendicular line ii. construct a perpendicular line

- Each group leader reads out the activity for the group as follows:

Activity	construction of parallel line. You are provided with the following procedure: 1. Place a ruler along the given line 2. Use the two edges of the set square, which contain it right angle. Place one of these edges along the ruler

slide the set square along the ruler until the other edges riches P.

d. Answers to the above activity will be arrived at through brainstorming, asking group members questions and the use of demonstration to deduce, the outcome of the even on their own. Within this period subjects are to actively listen to the views of other and discuss their views with group, members to be able to maximize the benefit of cooperative learning.

e. Research assistant goes round and remind the subjects it contribute actively or the entire success of their group.

f. All completed activities by each subgroup on the answer sheet are to be collected from the group leaders and marked by the research assistant

Evaluation Teacher evaluates his lesson by asking the following question

Question: - construct a perpendicular line

Conclusion Teacher concludes the lesson by explaining to the students briefly the main points in the lesson that is the construction of perpendicular line. The teacher shall inform the students about the next lesson, known as construction, of angle 60^{o}.

Assignment:	Teacher tells the students to read more about the different techniques of constructing perpendicular line.

CONSTRUCTION OF ANGLE 60^0

Lesson note:	four
Method of teaching:	cooperative learning
Subject:	mathematics
Topic:	construction of Angle 60^0
Lesson 4:	
Group:	experimental
Class:	JSS 3
No. of students in class:	110
Time:	double period (2 hours)
Instructional material:	pair of compasses and ruler.

Behavioral objectives: by the end of the lesson students shall be able to: construct an angle of 60^0

Previous knowledge: students have unready

Learnt how to construct a.line

Introductions: Teacher asks students the following oral question e.g. such as:

ii. defined a angle

iii. construct angle 60^0

- Each group leader reads out the activity for the group as follows:

Activity 1 construction of angle 60^0. You are provided with the following procedure:

Procedure

1. Draw a straight line AB longer then 6cm
2. Use you compass with 5cm length and cut an arc C, from the point A to any point between AB
3. Take your compass with the 5cm length and place it on point C and cut another arc D, and take your

compass again and place it on point A and cut another are and on D.

g. Answers to the above activity will be arrived at through brainstorming, asking group members questions and the use of demonstration to deduce, the outcome of the even on their own. Within this period subjects are to actively listen to the views of other and discuss their views with group, members to be able to maximize the benefit of cooperative learning.

h. Research assistant goes round and remind the subjects it contribute actively or the entire success of their group.

i. All completed activities by each subgroup on the answer sheet are to be collected from the group leaders and marked by the research assistant

Evaluation Teacher evaluates his lesson by asking the following question

Question: - construct an angle 60^0

Conclusion: Teacher concludes the lesson by explaining to the students briefly the main points in the lesson that is the construction of angle 60^0. The teacher shall inform the students about the next lesson, known as construction, of angle 30^o.

Assignment: Teacher tells the students to read more about the different techniques of

constructing of angle 30^{o}. .

BISECTION OF ANGLE 30^{0}

Lesson note:	five
Method of teaching:	cooperative learning
Subject:	mathematics
Topic:	Bisection of Angle 30^{0}
Lesson 5:	
Group:	experimental
Class:	JSS 3
No. of students in class:	110
Time:	double period (2 hours)
Instructional material:	pair of compasses and ruler.
Behavioral objectives:	by the end of the lesson students shall be able to: construct an angle 30^{0}
Previous knowledge:	students have unready Learnt how to construct a.line
Introductions:	Teacher asks students the following

oral question e.g. such as: i. defined an angle ii. Construct angle 30^0

- Each group leader reads out the activity for the group as follows:

Activity 1 construction of angle 30^0. You are provided with the following procedure:

Procedure: from angle 60^0 constructed

Use your compass with 5cm length and cut an arc I from the point G to any point between GH.

1. Take your compass with 5cm length and place it on point I and cut another arc K.

Place your compass on point I and cut another arc I, and also place your compass on the point K and make another, are on L point.

2. Use your compass with 5cm length and cut an arc I from the point G to any point between GH.
3. Take your compass with 5cm length and place it on point I and cut another arc K.

4. Place your compass on point I and cut another arc I, and also place your compass on the point K and make another, are on L point.

j. Answers to the above activity will be arrived at through brainstorming, asking group members questions and the use of demonstration to deduce, the outcome of the even on their own. Within this period subjects are to actively listen to the views of other and discuss their views with group, members to be able to maximize the benefit of cooperative learning.

k. Research assistant goes round and remind the subjects it contribute actively or the entire success of their group.

l. All completed activities by each subgroup on the answer sheet are to be collected from the group leaders and marked by the research assistant

Evaluation Teacher evaluates his lesson by asking the following question

Question: -

construct an angle 30^0

Conclusion: Teacher concludes the lesson by explaining to the students briefly the main points in the lesson that is the construction of angle 30^0. The teacher shall inform the students about the next

	lesson, known as construction, of angle 90^o.
Assignment:	Teacher tells the students to read more about the different techniques of constructing of angle 30^o. .

CONSTRUCTION ON ANGLE 90^0

Lesson Note:	six
Method of Teaching:	cooperative learning
Subject:	mathematics
Topic:	construction of Angle 90^0
Lesson 6:	
Group:	experimental
Class:	JSS 3
No. of Students in Class:	110
Time:	double period (2 hours)
Instructional Material:	pair of compasses and ruler.
Behavioral Objectives:	by the end of the lesson students shall be able to: construct an angle 90^0
Previous knowledge:	students have unready Learnt how to construct a.line
Introductions:	Teacher asks students the following oral question e.g. such as:

iv. defined a angle

v. construct angle 90^0

- Each group leader reads out the activity for the group as follows:

Activity 1: construction of angle 90^0. You are provided with the following procedure:

1. Draw a line GH and cut a point I between GH, and use a compass, and make a small circle with two points M and N.
2. Place you compass on the point M with radium 5cm and cut an arc O, and also use the same radium 5cm and place your compass on another point N and cut another arc on the same point O, and then draw a straight line to design I and O

m. Answers to the above activity will be arrived at through brainstorming, asking group members questions and the use of demonstration to deduce, the outcome of the even on their own. Within this period subjects are to actively listen to the views of other and discuss their views with group, members to be able to maximize the benefit of cooperative learning.

n. Research assistant goes round and remind the subjects it contribute actively or the entire success of their group.

o. All completed activities by each subgroup on the answer sheet are to be collected from the group leaders and marked by the research assistant

Evaluation:	Teacher evaluates his lesson by asking the following question
Question:	- construct an angle 90^0
Conclusion:	Teacher concludes the lesson by explaining to the students briefly the main points in the lesson that is the construction of angle 90^0. The teacher shall inform the students about the next lesson, known as construction, of angle 45^o.
Assignment:	Teacher tells the students to read more about the different techniques of constructing of angle 90^o. .

BISECTION OF ANGLE 45^0

Lesson note:	seven
Method of teaching:	cooperative learning
Subject:	mathematics
Topic:	construction of Angle 45^0
Lesson 7:	
Group:	experimental
Class:	JSS 3
No. of students in class:	110
Time:	double period (2 hours)
Instructional material:	pair of compasses and ruler.
Behavioral objectives:	by the end of the lesson students shall be able to: construct an angle 45^0
Previous knowledge:	students have unready Learnt how to construct a.line
Introductions:	Teacher asks students the following oral question e.g. such as: vi. defined a angle vii. construct angle 45^0

- Each group leader reads out the activity for the group as follows:

Activity 1: construction of angle 90^0. You are provided with the following procedure:

1. Draw a line GH and mark a point I
2. Use your compass from the point I and make circle with two points M and N.
3. Place your compass on the point M with radium 7cm to cut an arc O and also place your compass on the point N and cut another arc on the point O.
4. Place your compass on the point H and cut another arc P. place your compass again on the point O and cut another arc on P, with the same radium.

p. Answers to the above activity will be arrived at through brainstorming, asking group members questions and the use of demonstration to deduce, the outcome of the even on their own. Within this period subjects are to actively listen to the views of other and discuss their views with group, members to be able to maximize the benefit of cooperative learning.

q. Research assistant goes round and remind the subjects it contribute actively or the entire success of their group.

r. All completed activities by each subgroup on the answer sheet are to be collected from the group leaders and marked by the research assistant

Evaluation:	Teacher evaluates his lesson by asking the following question
Question:	- construct an angle 45^0
Conclusion:	Teacher concludes the lesson by explaining to the students briefly the main points in the lesson that is the construction of angle 45^0. The teacher shall inform the students about the next lesson, known as construction, of angle 45^o.
Assignment:	Teacher tells the students to read more about the different techniques of constructing of angle 45^o. .

APENDIX E

LESSON PLAN FOR CONTROL GROUP

CONSTRUCTION OF LINE

Names:	lecture method
School:	GDSS Arkilla
Class:	JSS 3
No of roll:	110
Gender:	mixed
Time:	double period
Subject:	Mathematics
Topic:	construction (construction of a line)
Teaching aids:	A pencil, ruler, eraser a pair of line passes

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

- identify instrument used in constructions e.g. pencil, ruler and eraser
- draw a line with given measurement say 5cm, 8.5cm and 8cm

Previous knowledge: Students have an idea on measurement that is how to measure the length of a given figure e.g. rectangle

Introduction: Teacher introduces the lesson by linking the students to their previous knowledge say the length of their table not book and 5cm.

Presentation: teacher presents the lesson as follow:

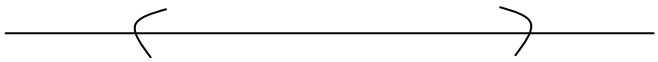
Step I: - defined the word construction and interpret it to the students.

Step II: mention and explain the instrument used in construction such as:

1. sharp pencil
2. straight ruler
3. fresh eraser
4. a pair of compasses

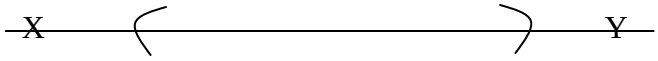
Step III examples:

1. construct a lie AB = 5cm



X Y

2. mark off a point A. with the centre A and a radium equal to 5cm draw an arc to cut xy at b



X Y

A 5cm B

3. AB is the required line

Evaluation: Teacher evaluates the lesson by asking the students to construct a line XY = 7cm in the class

a. mention 3 instrument used I construction

Conclusion: Teacher concludes the lesson by going round and make sure that the above exercise is done correctly y the students and also asked them to construct the following as exercise:

a. a line PQ = 4cm

b. a line AB = 5.5cm

CONSTRUCTION OF PARALLEL LINE

Names: lecture method

School: GDSS Arkilla

Class: JSS 3

No of roll: 110

Gender: mixed

Time: double period

Subject: Mathematics

Topic: construction of parallel lines

Teaching aids: A pencil, ruler, eraser a pair of line

Compasses set

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

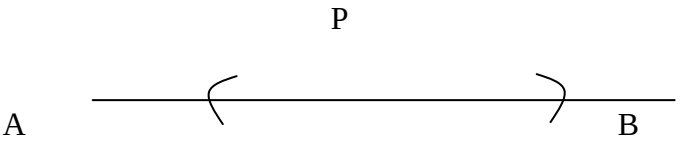
- construct parallel lines

Previous knowledge: students learned how to construct a line say AB = 5cm.

Introduction: Teacher introduces the lesson by linking the students to their previous knowledge e.g. construct a line AB = 5cm.

Presentation: Teacher presents the lesson as follows:

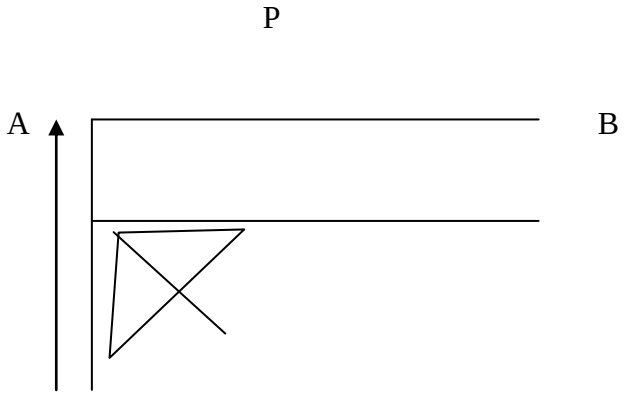
Step I: Example: construct a line through P so that it is parallel to AB



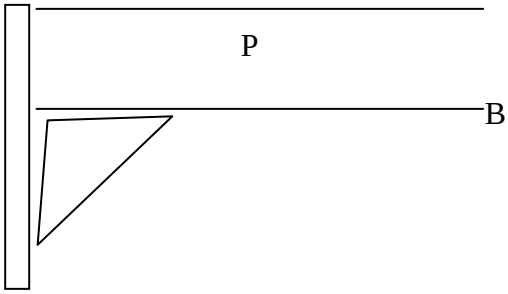
SOLUTION

Procedures

Place a set square so that the edge is exactly along AB as in figure below

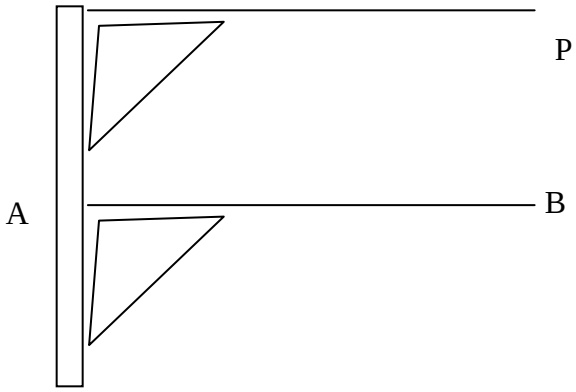


Step II: place a ruler along one of the other edges of the set use the left hard edge if you are right handed)



Step III: Hold the ruler firmly slide the set-square along the ruler towards P. stop when the edge that was on AB

reaches P. Draw a line along this edge of the set square through P.



Step IV: note that in the example it shows corresponding angles the line through P and AB are parallel

Conclusion: Teacher concludes the lesson by going round to make sure that students draw the above example correct and ask their to:

a. construct a line through X so that it is parallel to AB as a exercise.

CONSTRUCTION OF PERPENDICULAR LINE

Names:	lecture method
School:	GDSS Arkilla
Class:	JSS 3
No of roll:	110
Gender:	mixed
Time:	double period
Subject:	Mathematics
Topic:	construction of perpendicular lines
Teaching aids:	A pencil, ruler, set-square
Objectives:	at the end of the lesson students should be able to; - construct a perpendicular line
Previous knowledge:	Students learned how to construct a line and parallel lines. E.g. construct a line though X so that it is parallel to AB.
Introduction:	Teacher introduces the lesson by linking students to their previous knowledge.
Presentation:	Teacher presents the lesson as follow:

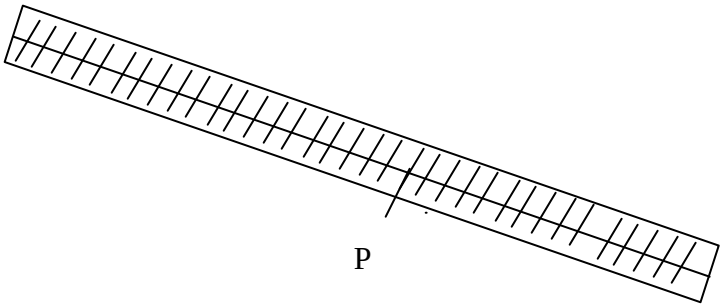
Step I: Example Construct perpendicular lines from a point P on a line L

Solutions

Methods

1. place a ruler along the line drawn given above

L

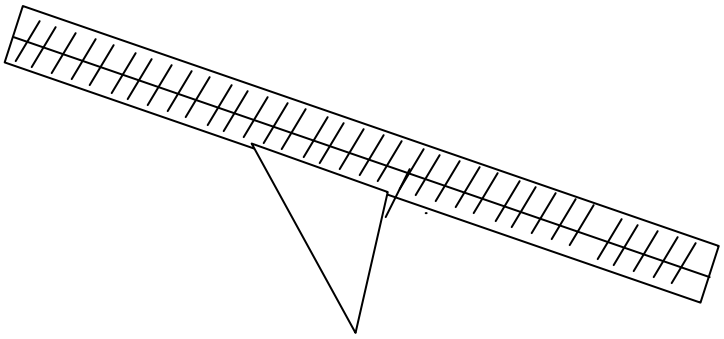


P

Step II.

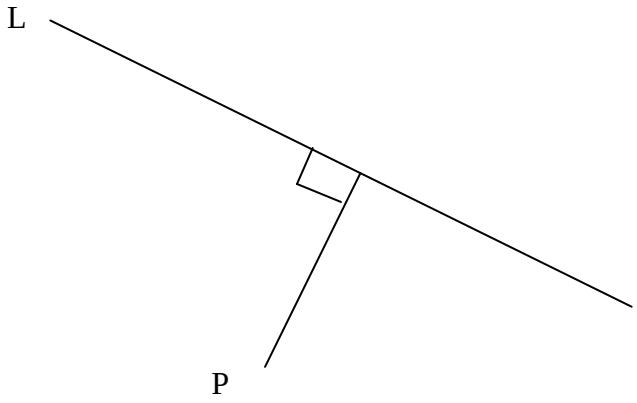
2. Use the two edges of the set square which contain its right angle. Place one of these edges along the ruler slide the set square along the ruler until the other edges riches P

L



P

Step III: Draw a line for P



Evaluation: Teacher evaluates the lesson by asking the

Students to:

b. draw a line which is 5cm

c. construct a perpendicular line from a point X and a line p

Conclusion: Teacher concludes the lesson by asking the following

questions : construct a perpendicular line.

CONSTRUCTION OF ANGLE 60^0

Names:	lecture method
School:	GDSS Arkilla
Class:	JSS 3
No of roll:	110
Gender:	mixed
Time:	double period
Subject:	Mathematics
Topic:	construction of angles 60^0
Teaching aids:	A pencil, ruler, Compasses set, protractor chalk
Objectives:	at the end of the lesson students should be able to: - construct an angle 60^0
Previous knowledge:	students have an idea on how to construct a line measure the, line with a ruler.
Introduction:	teacher introduce the lesson by linking students to their previous knowledge, e.g. construct a perpendiculars line from a point y an a line z.

Presentation: Teacher presents the lesson as follows:

Step I: Example: construct an angles of 60^0 after taking all the material used

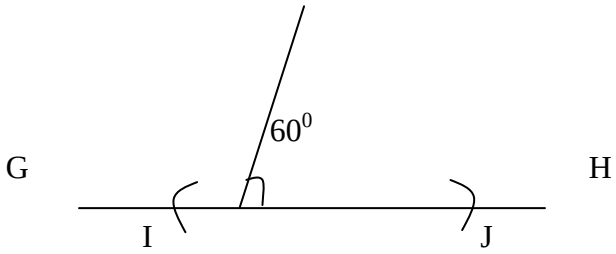
Step II:

Solution

Method: 1. draw a line GH

2, indicate a point 1 anywhere on GH

with centre I and any convenient rachis draw an arc to cut GH at 3



K+Z is the required angles 60^0

Evaluations: used protractor to draw an angle which is 60^0 teachers asked the students

Conclusion: Teacher concludes the lesson by going round to see if

the angle constructed by the students are exactly 60^0

CONSTRUCTION OF ANGLE 30^0

Names: lecture method

School: GDSS Arkilla

Class: JSS 3

No of roll: 110

Gender: mixed

Time: double period

Subject: Mathematics

Topic: Bisection of angle 60^0

Teaching Aid: chalk, ruler, compasses, protractor

Objectives: At the end of the lesson students should be able to: bisection of angle 60^0, construct an angle 60^0

Previous Knowledge: students know how to construct an angle 60^0.

Introduction: Teacher introduces the lesson by linking the students to their previous knowledge.

Presentation: Teacher presents the lesson as follows:

Step I: examples: construct an angle 30^0

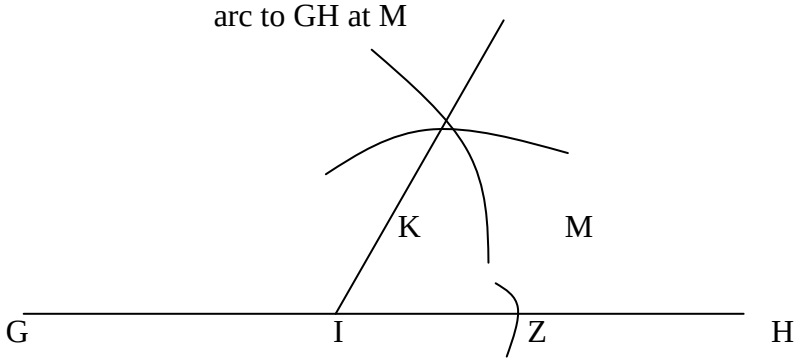
Solution

Before construct an angle of 30^0 are must have construct 60^0 and then bisect it.

Method

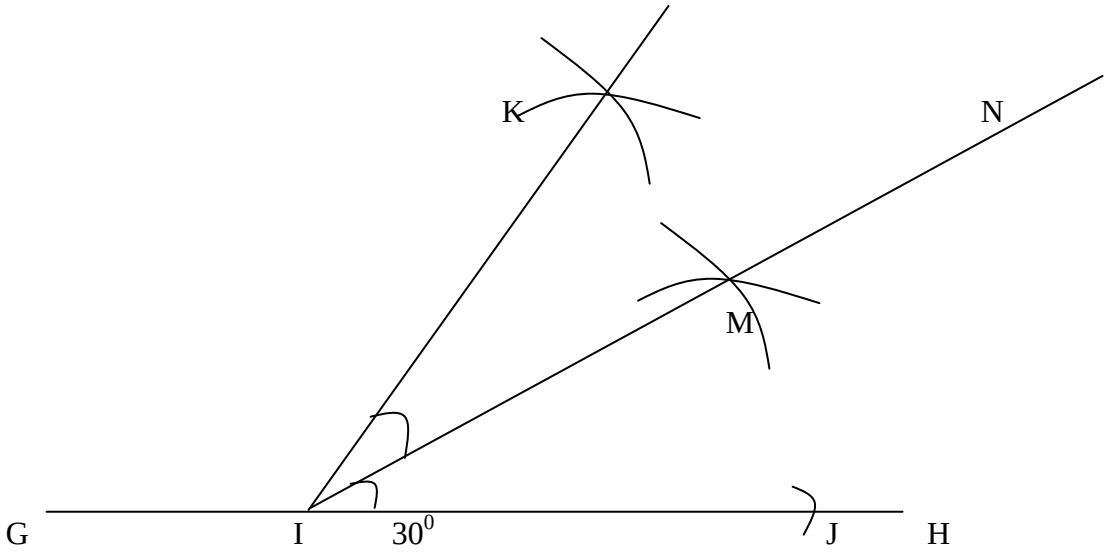
1. draw a line GH
2. inculcate a point 1 anywhere a GH
3. with centre 1 and any convenient radius draw an arc to cut GH at 3 to have
4. with the centre 3 and the same radius draw an arc to cut the previous one at K

5. with centre k and any convenient radius draw an arc to GH at M



6. with centre 3 and the same radius draw an arc to cut the previous one at M and draw the line join M1 to N

7. M, I, H is the required 30^0 angles as



Evaluation: Teacher evaluates the lesson by asking students to use their mathematical instrument to construct the same angle in the note.

Conclusion: Teacher concludes the lesson by asking students to explain how an angle 60^0 can be bisected in order to get 30^0

CONSTRUCTION OF ANGLE 90^0

Names: lecture method

School: GDSS Arkilla

Class: JSS 3

No of roll: 110

Gender: mixed

Time: double period

Subject: Mathematics

Topic: Construction of angle 90^0

Teaching Aid: chalk, ruler, compasses, protractor

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

- construct an angle 90^0

Previous Knowledge: students have an idea on construction of a line and also a perpendicular line.

Introduction: Teacher introduces the lesson by asking the student a question base on their previous knowledge.

Presentation: Teacher presents the lesson as follows:

Step I: examples: construct an angle 90^0

Solution

To construct angle 90^0 is the same as construction of a perpendicular line:

Method

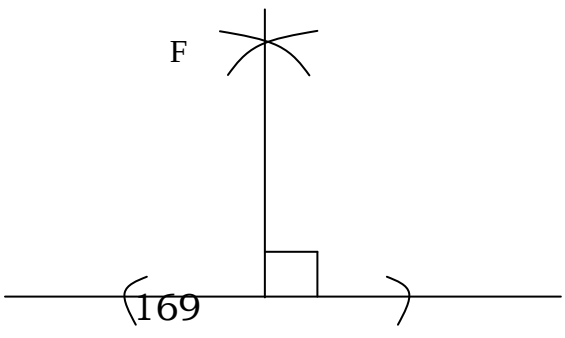
1. draw a line AB
2. mark off any point C or AB

Step III

3. with centre C and any convenient recluse draw an arc to cut AB at D and E
4. With centre D and E and different times and same radius, d raw areas to intersect on one another at a point F.

Step IV

5. join CF not F CB = FC =90^0



A D C E B

Evaluation: Teacher evaluates the lesson to use their mathematical instrument and use the same to construct their own 90^0 angle.

Conclusion: Teacher concludes the lesson by asking the students to mention the procedure to be followed when constructing 90^0 angles also asked their the instrument used or needed before source one will construct an angles which is 90^0

CONSTRUCTION OF ANGLE 45^0

Names: lecture method

School: GDSS Arkilla

Class: JSS 3

No of roll: 110

Gender: mixed

Time: double period

Subject: Mathematics

Topic: Construction of angle 45^0

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

Construct an angle 45^0 and bisect any given angle.

Previous Knowledge: students have an idea on bisection of an angle 60 and construct of 90.

Introduction: the teacher introduce the lesson by looking the students to their previous knowledge

Presentation: Teacher represents the lesson as follows:

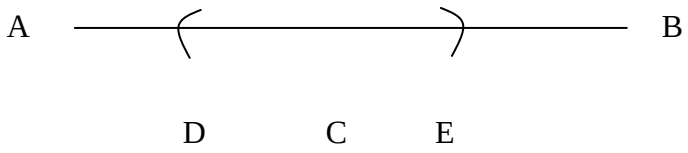
Step I: Example: construct an angle 450

Solution To construct angle 45^0 is the same as bisecting angle 90^0 therefore before constructing angle 45^0 there is need to construct angle of 90^0

Step II.

Method

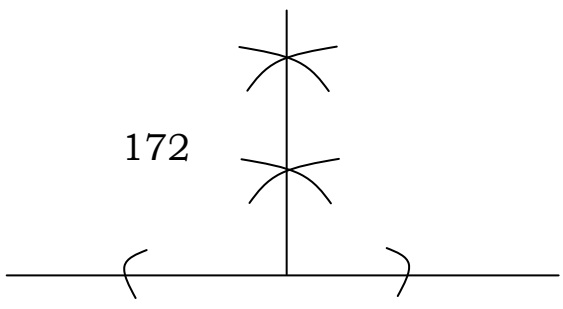
1. draw a line AB
2. mark off any point C on AB
3. with centre c and any convenient radius draw an arc to cut AB at D and E



Step III:

4. with centre D and E at different times and same radius draw arcs to intersect on one another of a point F

5. Join CF : FCB=FCA= 90^0



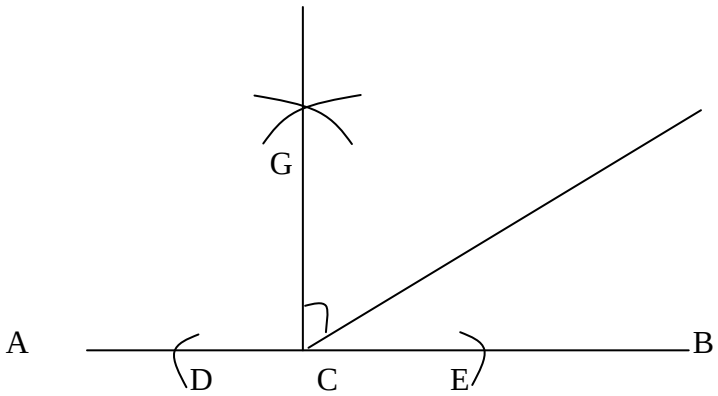
F

G

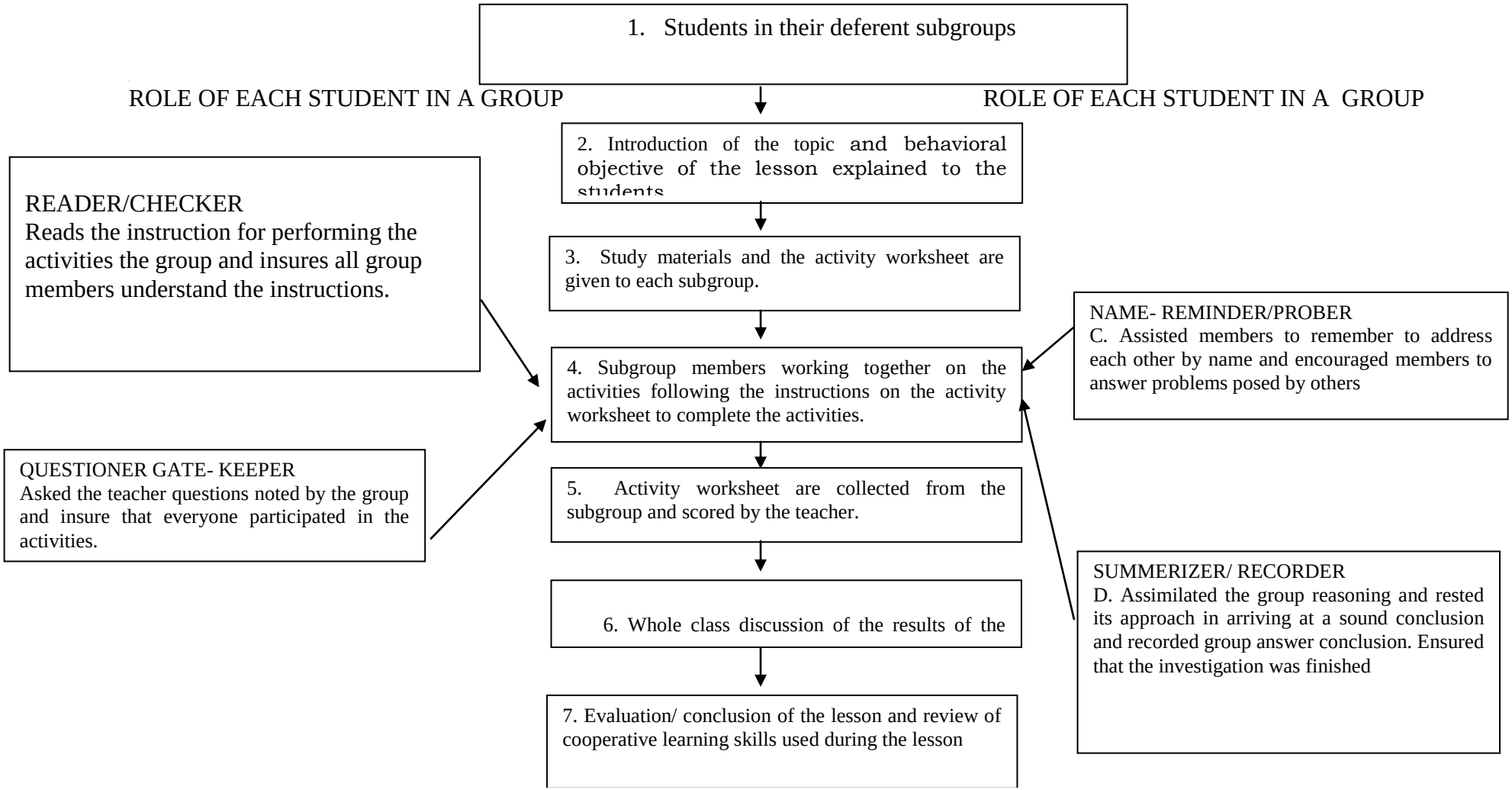
A B

D C E

6. with centre C and any convenient radius draw an arc to cut BC and E and FC at G
7. with centre E and any convenient radius draw an arc to cut BC at H
8. with centre G and the same radius draw an arc to cut the previous one at H
9. join CH and BCH is the required angle 450



Evaluation: Teacher evaluates the lesson by asking the student the following questions
- Method used in constructing angle 45^0



Source: Adopted from Johnson (1975) Model by Olorukooba, (2001).
Fig. 3.4: A Flowchart of cooperative learning Strategy Model used for the study.

NOTE: Explanation on how to use this model would be provided in the lesson plan.

Appendix F

Table 3.4 Distribution of Questions Based on Knowledge, Comprehension and Application

S/N	Topics	Knowledge	Comprehension	Application
1.	Construction of a line	1, 14	-	2,
2.	Construction of parallel line	4, 27	11,	24,
3.	Construction of perpendicular	9,	26	6, 30
4.	Construction of angle 60^0	3, 18	12	22, 23
5.	Bisection of angle 30^0	7, 19	8,	16,
6.	Construction of angle 90^0	17,20	5,13	21, 29
7.	Bisection of angle 45^0	15,25,	10	28