EFFECT OF CONCEPTUAL-DEMONSTRATION STRATEGY ON INTEREST, RETENTION AND PERFORMANCE IN GEOMETRY AMONG JUNIOR SECONDARY SCHOOL STUDENTS OF KADUNA STATE, NIGERIA

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DECLARATION

I, Raphael Babatunde ABIOYE,(M.ED/EDUC/02850/2010-2011, New P15EDSC8098) declare that this dissertation titled "Effect of Conceptual-Demonstration Strategy on Interest, Retention and performance in Geometry Among Junior Secondary SchoolStudents of Kaduna State, Nigeria " was written by the researcher and is my handwork,no part of this Dissertation was previously presented for or another degree at any university.

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CERTIFICATION

This dissertation titled "Effect of Conceptual-demonstration Strategy on Interest, Retention and Performance in Geometry Among Junior Secondary Students of Kaduna State" by Raphael Babatunde, ABIOYE(M.ED/EDUC/02850/2010-2011, New P15EDSC8098)has met the requirements and regulations governing the award of Masters of Education (Mathematics Education) of Ahmadu Bello University,Zaria. Therefore, it is hereby approved for its contribution to knowledge.

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DEDICATION

This study is dedicated to my parents Mr. and Mrs J.O. Abioye, my family members, Richard, Gideon and Henry , my wife (Racheal) and my children Megan, Joseph and Lios. To all those who have contributedimmensely towards the success of this dissertation

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ABBREVIATIONS

NCTM National Council of Teachers of Mathematics

FME Federal Ministry of Education

WAEC West African Examination Council

NECO National Examination Council

NBTE National Board for Technical Education

STAN Science Teacher Association of Nigeria

JSS Junior Secondary School

GPT Geometry Performance Test

GIS Geometry Interest Scale

GRT Geometry Retention Test

CDS Conceptual Demonstration Strategy

MAN Mathematical Association of Nigeria

OPERATIONAL DEFINATION OF TERMS

Retention: The act or power remembering things or a memory of what is retained in the mind.

Performance: That which is performed or accomplished; a thing done or carried through; an achievement.

Demonstration: Is a teaching strategy which involves experimentation.

Strategy: The science plan, method technique of action intended to accomplish a specific goal using a teaching technique.

Conceptual-demonstration strategy: Instructional strategies are therefore ways, tools, methods, channels, techniques and medium employed by the teacher in teaching the students.

ABSTRACT

This study investigated the effect of conceptual-demonstration strategy on interest, retention and performance in geometry among Junior Secondary Students. The study adopted quasi-experimental design involving pretest, posttest and postposttest using one experimental and one control groups. A pretest was administered before the treatment to establish the equivalence of the experimental and control groups. Four junior secondary schools with a population of 212 students were randomly selected. The sample was divided into two groups Experimental and Control Groups namely;GSS Pambegua, GGSS Kawo, GSS Bomo and GGC Kwoi with 109 male and 103 female students as experimental and control respectively. The effectiveness of conceptual-demonstration strategy with experimental classes was compared with the effectiveness of the conventional method of teaching geometry in the control classes. Geometry Performance Test(GPT), Geometry Retention Test (GRT) and Geometry Interest Scale (GIS) data were analysed to determine the effectiveness of the two instructional strategies and the three research questions and hypotheses were tested using Means, Medians, Standard Deviation, T-Test Analysis and Mann-Whitney reliability coefficient of $p \leq 0.05$. The results showed that students taught using conceptual-demonstration teaching strategy performed significantly higher in geometry test than their counterparts exposed to conventional method of teaching. The researcher recommends among others for the improvisation of conceptual-demonstration teaching strategy within the context of mathematics teaching in junior secondary schools and the mathematics teachers should continue to use and adopt conceptual-demonstration teaching strategy more into strain of their classroom practice.

CHAPTER ONE

THE PROBLEM

1.1 Introduction

Mathematics is described as the queen of science. It is not only the language of science, but the essential nutrient for thought, logic, reasoning and progress Azuka (2013). Mathematics is the body of knowledge centered on such concepts as quantity, structure, space and change and also the academic discipline that studies them. Benjamin (2004) called it “the science that draws necessary conclusions. Teaching mathematics is much like building a house (Gluck, 2000). If the foundation is weak, many difficulties will appear later. Students’ understanding of the basic mathematical concepts help them move to the next logically connected concepts. Progress made in mathematics will imply a positive relation in science and technology. For this and many other reasons researchers and educationists have continued to explore avenues in which to improve the teaching and learning of mathematics at all levels.

Traditional methods used in most mathematics classes do not allow students enough time to fully reach the required understanding. According to Hartshorne & Boren (2000) one way to strengthen students’ understanding of mathematics is the use of manipulative materials. Recent studies show the importance of the use of conceptual-demonstration models at all grade levels (Thomas and Chinnappan,2007). The National Council of Teachers of Mathematics (NCTM, 2013) also encouraged the use of concrete models at all levels. The NCTM’s curriculum and evaluation standards (2002) for junior secondary and senior secondary schools emphasize the use of conceptual-demonstration strategy in representing mathematics and processes. “Learning can be more effective with the use of conceptual-demonstration materials designed to reflect underlying m[illegible] ideas. It was underlined that engaging students in examining, measuring, comparing and contrasting a wide variety of shapes develops essential learning skill (NCTM, 2002). kanaya, Light and Culp (2005) developed the strongest arguments in favor of the conceptual models. Piaget (1973) studied the stages of cognitive development of children from birth to maturity.

According to Piaget (1973), understanding comes from actions performed by an individual in response to his or her environment. These actions change over time from very physical actions to partially internalized actions that can be performed with symbols. According to Piaget's theory, this is a continuous process of accommodation to and assimilation of the individual environment. The cognitive development starts with the use of physical actions to form schemas, followed by the use of symbols. Piaget emphasized that learning involves both physical actions and symbols that represent previously performed actions. Therefore, learning environments should include both conceptual-demonstration strategy and symbolic models of the ideas to be learned. However, these models should be consistent with the development of schemas at the various development levels. A child's learning at the beginning of his or her cognitive development should be made meaningful with conceptual models, while at more advanced levels may be replaced by symbolic models. Children up to the age of 12 can use symbols only after they have experienced the ideas to be learned through the manipulation of conceptual models. Hence, at these ages, conceptual experiences should facilitate the learning of most of mathematical ideas.

Kanaya (2005) study supports Piaget's findings, that described three ways of knowing: enactive, iconic and symbolic. He said that a growing human being acts towards his or her environment through direct actions, imagery and language. A child starts to play with objects, by touching, smelling and tasting, he/she experiences the characteristics of the objects. Later, the child develops mental images and remembers the objects. Even later, he/she connects names with the objects. According to Bruner (2006), after children learn to distinguish objects by colour, size and shape, they begin mastering the concept of numbers. Later in school, when children learn new mathematics concepts, they need to go in the same sequence from solid objects to pictorial and then to abstract symbols.

In Nigeria priority is accorded to the teaching and learning of mathematics in school curriculum as stipulated in the National Policy on Education (FRN 2014). The National Policy on Education (FRN 2013) emphasizes the need to equip students with knowledge that will enable them effective life in the modern age of science and technology. In spite of the importance of mathematics in the country's scientific and technological development, students perform poorly or in some cases fail the subject especially in external examination conducted by West African Examination Council (WAEC), National Examination (NECO), National Board for Technical Education Examination (NBTE), Interim Joint Matriculation Examination and IJMB.

Despite various efforts in Nigeria, mathematics has not secured its rightful position in the mind of students because of the problems associated with its instruction and students attitude. The resultant effect of this problem is that performance of students has become poorer as the test items moved from those requirement ability to recall, to those involving understanding and problem solving (Nigeria Education and Research Development Council work shop 2014).

Researchers and finds by people have attributed poor performance in mathematics in Nigeria to many factors, such as lack of qualified mathematics teachers, lack of teaching materials and lack of incentives to the available qualified teachers to mention but few. Taking into consideration for example, Science Teachers Association of Nigeria (STAN 2000) in their annual conference highlight that prominent among the causes of students poor performance in mathematics includes the following: (i) acute shortage of qualified professional mathematics teachers (ii) exhibition of poor knowledge of mathematics teachers (iii) overcrowded mathematics classroom (iv) adherence to old teaching method in spite to exposure to more viable alternative (v) students negative attitude toward mathematics and (vi) undue emphasis on the syllabus coverage at the expense of meaningful learning of mathematics concepts to mention just a few. The situation is not quite different in Kaduna State Nigeria with regard to the teaching and learning of mathematics as a subject. The researcher being a teacher and also an assistant examiner in the marking of WAEC/NECO for the past six (6) has observed the deplorable condition of teaching, learning and students performance in both internal, junior (JSEC) and external examination (SSCE) .

This situation led to low enrollment in the tertiary institutions. These catalogues of problems do not create conductive environment and the right channel for mathematics education to thrive in the state and in the nation at large. This calls for an urgent need to constantly seek ways of improving the teaching and learning of the subject at all levels of education.

It is to be expected that once it is ascertained that the use of conceptual-demonstration strategy at all levels will improve geometry learning at secondary school levels. Teachers and students will be encouraged to use as one possible means of fighting failure and frustration in teaching and learning geometry in mathematics. It is hoped that this strategy of teaching would encourage the participation of students, increase their interest, self-confidence and enhance greater interest in learning geometry.

1.2 Statement of the Problem

The persistent poor performance of students in public schools both in internal and external examination in Nigeria today is a serious and challenging issue to the education sector; government, stakeholders, students, parents and well-meaning Nigerian. From the researchers` ten years teaching experience it was observed that, the overall pattern of intellectual transaction between teachers/students could be described as being teacher dominated and extremely theoretical. Many teachers do not consider the use of instructional method as one among the problems causing students failure/frustration in the study of mathematics. Teachers continue to use one particular method (lecture method) year after year with no much innovation, even if the result at the end is discouraging. Students these days have great difficulty in understanding, comprehending and assimilating contents of mathematics which they are exposed to. They neither understood the basic principles, logic, fundamental principles, nor do they understand processes that give rise to mathematical facts. Hence, they resort to learning by rote memorization, which resulted in consistent gross mass failure and forming negative attitudes. This can be seen from NECO/BECE examination results of Kaduna state from 2009 to 2014 in Table 1.1.

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Table 1.1 Summary of NECO/BECE results in mathematics from 2007 to 2014

Year	%P	%F
2009	24.3	75.7
2010	35.9	64.1
2011	32.4	67.6
2012	18.4	81.6
2013	24.5	75.5
2014	39.7	60.3

Source: Kaduna State Ministry of Education. Headquarters, Kaduna (2015).

This problem is a source to worry the researcher and many stakeholders. The researcher investigated whether the use of conceptual-demonstration strategy in geometry approach would help to alleviate some of these problems. Would the use of Geometry Performance Test Questionnaire (GPTQ) approach prove better in improving students understanding of geometry and hence improve their performance better than the conventional? It is in view of this, the researcher notice that at present there is research gap in establishing the effectiveness of the relationship between the conventional method and conceptual-demonstration strategy (CDS) in mathematics at Junior Secondary School (JSS) level.

In the light of the above reasons, the major concern of this study investigated the effectiveness of using CDS in search for greater performance, retention and developing positive attitude in mathematics among junior secondary school students in Kaduna State.

1.3 Objectives of the Study:

The main objectives of this study was to find the effects of Conceptual-demonstration strategy on interest, retention and performance in geometry among junior secondary school students of Kaduna State, Nigeria. Specific objectives are as follows:

1.Examine the effect of conceptual-demonstration strategy on interest towards geometry among JSS students.

2.Investigate the effect of conceptual-demonstration strategy on retention ability of JSS students in geometry.

3.Determine the effect of conceptual-demonstration strategy on academic performance in Geometry among Junior Secondary Students.

1.4. Research Questions

This research work was guided by the following research questions:

1. What is the effect of conceptual-demonstration strategy on interest among JSS students' in geometry?
2. What is the effect of conceptual-demonstration strategy on retention ability among JSS students
3. What is the effect of conceptual-demonstration strategy on performance in geometry among JSS students.

1.5 Hypotheses

The following hypotheses were formulated and tested at 5% level of significance:

H_{01} There is no significant difference in the interest level of JSS students taught geometry with CDS and those taught to lecture method.

H_{02} There is no significant difference in the retention ability of students that were taught using CDS and conventional group toward learning of geometry.

H_{03} There is no significant difference in the performance of JSS students that were taught with CDS and their counterpart that were taught with the conventional teaching method.

1.6. Significance of the Study

There is need in mathematics teaching to develop conceptual understanding in students rather than encourage memorization, which favors procedures and activities. According to Mana (2005), the conceptual framework that students develop as they learn science makes remembering a consequence of understanding. When students understand a concept quantitatively, they can easily understand and remember it and therefore, be able to apply the knowledge to solve problem. Mathematical shapes are of importance in the sense that, they help man to understand his capabilities and his environment, therefore there is need to make investigation into way by which students could attain meaningful learning of good mathematical shapes. The conceptual-demonstration strategy (CDS) technique used in this study intended to bring about such meaningful learning and thereby, improve student`s performance and retention level follows:

1. The result of this research will provided insight into the factors responsible for poor academic performance of students in geometry, which when objectively carried out could be used by teachers in providing ground for class control, inclusiveness, classroom management procedures, students` engagement and motivation and content coverage that are overly complain by both the teachers and students.
2. The study showed how to overcome the difficulties in teaching some concept of geometry that are identified to be difficult.
3. The result of the study also guide text books publishers to reframe their text books on activity based and more of work sheet that promote thinking and deemphasize rote learning.

4. The finding of this study benefits students because their varying differences are considered, also their interest appears to enhance their motivation and learning in the classroom.

5. The finding of this study helped professional bodies and association such as Mathematical Association of Nigeria (MAN) and Science Teachers Association of Nigeria (STAN) to training the prospective members on the effective use of conceptual-demonstration strategy in teaching geometry.

6. The result of this study will add to existing mathematics education literature for the researchers to review and perhaps open a gateway for further research.

7. The result will help the school administrators to encourage teachers to use innovative strategies and methods of teaching that recognizes students` diversities in learning abilities.

1.7 Scope/Delimitation of the Study

This study covered all junior students I-III of secondary schools in Kaduna State. The analyses and interpretation of the result was based on students' National Examination Council (NECO), performance in examinations for the period 2009 – 2014. Due to geographical spread of the schools and the large number of students that offer the subject in the State, four divisions were used (Kafanchan, Anchau, Kaduna and Zaria) to represent the State. The Geometry Interest Scale (GIS) which is a multiple choice objective test was used to test the level of interest of the students toward geometry concepts and the Geometry Performance Test Questionnaire (GPTQ) which covered Plane Shapes in Geometry was used to elicit information from teachers and students .

CHAPTER TWO

REVIEW OF RELATED LITERTURE

2.1 Introduction

This chapter reviewed literature for the study the effects of conceptual-demonstration strategy on interest, retention and performance of junior secondary school students in geometry of Kaduna State, Nigeria. The aim of the study was to determine the effect of conceptual demonstration strategy on the academic performance and interest of student in geometry. This is because geometry has been a sub-topic in mathematics where students have performed poorly and sometimes avoid completely in terminal and standardized examinations. The discussion was done under the following sub-headings:

2.2 Theoretical Framework

2.3 Conceptual Strategy

2.4 Demonstration Method

2.5 Conceptual-demonstration strategy in Mathematics.

2.6 Bridging the gap between Conceptual-Demonstration Strategy and Abstract Thinking

2.7 Interest toward Geometry.

2.8 Over view of Related Studies.

2.9 Implication of the reviewed literatures to the Present Study.

2.2 Theoretical Framework:

Many teachers and educators appreciate the value of conceptual-demonstration in teaching and learning mathematics. However, for some teachers the purpose of using concrete model is not clear, and tends not to realize that students need structure for effective use of conceptual model materials (Lawless and Pellegrino, 2007). According to Ani, Kulm and Wu, (2004) teaching using model materials generally begins with activities, which aim to explore the properties of the materials and their actions. The target procedu an algorithm or problem solving sequence.

There are different types of models and variety of ways to use them. Sometimes teachers do not know which teaching approaches are appropriate and which are inappropriate for a particular teaching situation. Szendrei (2001) has noted that if teachers do not know the proper use of the materials, such materials might do more harm than good. In this cas ral analogy theory can provide a set of guiding principles for the use of naterials in a particular situation. Ani,

(2004) stated that the aim of a procedural analogy theory is to guide instruction and look for both theoretical and practical guidelines, which will bring changes to students' cognitive structures.

There are two kinds of knowledge: declarative and procedural knowledge. According to Anderson (2002) students make a declarative encoding of verbal instructions given by the teacher and they cannot put this knowledge into practice until they transform this declarative encoding to procedural encoding. Declarative encoding takes place on hearing the teacher's description of a new concept or relationship in school learning. This declarative knowledge can only be transferred to procedural knowledge through teacher instruction, demonstration and example. The aims of the teacher is to help students to form declarative knowledge and then transfer to procedural knowledge. The use of conceptual-demonstration strategy help students to perceive declarative and procedural knowledge easily by providing a bridge between symbol systems about them. Conceptual model can help students move from the declarative knowledge to procedural knowledge if they are given by guided instruction in how to use the model materials. In this way, students can transform declarative knowledge into procedural knowledge, which they can use to develop, apply and remember algorithms (symbolic systems).

Cooper and Dunne, (2000) describe declarative knowledge and procedural knowledge. Declarative knowledge is descriptive and includes facts, events and generalizations. Procedural knowledge is prescriptive and includes strategies, tactics and plans. Since declarative knowledge is made up of generalizations, students may be able to repeat the knowledge to the teacher, but cannot put the knowledge into practice or use it in operations (Fuys, Geddes and Tischler, 2004). According to Cooper and Dunne, (2000) students need procedures in order to transform this declarative knowledge correctly into useful operational knowledge. The initial declarative knowledge is very important. It can be inefficient if it is coded incorrectly (Hill, Rowan and Ball, 2005). To avoid misrepresentation and misconception, teachers should ask students to repeat what was said, to write it down and to read it out.

The teaching sequence in using conceptual model involves many instances of declarative and procedural knowledge. As students' progress from one step to another new declarative knowledge has to be formed and then presented through action on model materials. Procedural analogy theory is concerned with the movement from the declarative to the procedural knowledge and conceptual model materials allow the proceduralization process begins. Teachers should explain the procedure using the model shapes instead of using abstract ideas. This process helps teachers to see what the students are thinking when they are manipulating their thoughts. In other words, materials provide a visible analogy of the students' working memory. It also allows teachers some access to the students' cognitive processes and gives a chance for the teacher to intervene and increase learning efficiency. As a result, the purpose of the theory is to apply analogies so that students are able to move from conceptual model representation of a process to a symbolic representation of that process (Dunne 2000). In this process, concrete materials will be very helpful because it will be easier for the teacher to describe actions on physical objects than to describe operations on symbols and for students to proceduralize such a description correctly. With this the interest, retention ability of the students can increase the performance of students in mathematics at JSS level and also in Senior classes at large.

2.3 Conceptual Strategy

Conceptual strategy is an art of conveying concept. It is designed to present an idea (Cambridge Advanced Learners` dictionary 3rd Ed, 2009). Conceptual strategy is also known as category learning in which a human or machine learner is trained to classify objects/shapes by being shown a set of example objects along with their class labels. The learner will simplify what has been observed in an example (demonstration). This simplified version of what has been learned will be applied to future examples. Conceptual strategy range in simplicity and complexity because learning takes places over many areas (Ratcliff & Roger, 2006)**.**

Conceptual strategy assessment typically on a learners` ability to consider the nature of instances encountered based upon defining attribute belonging to the concept category ( Bruner, Goodnow & Austin. 1956). The objectives of science (mathematics) at all levels are conceptual understanding (Gabel, 2003). Conceptual knowledge refers to a persons` representation of the major concept in a system. It is also known as the kind of knowledge that may be transferred between situations. This is different from routine knowledge which is knowledge that is applicable only to certain situation (Webster M., 2006).

Conceptual instruction (strategy) leads to increased conceptual understanding (Alibali, 2000). Concept formation or concept learning is referred to as the development of the ability to respond to common features or categories of objects or events. Concept are mental categories of objects, events or ideas that have a common set of features (Howard & Martin, 2002). Concept learning encompasses learning how to discriminate and categorize things (with critical attributes). It involves recall of instances, integration of new examples and sub-categorization. Concept formation is not related to simple recall, it must be constructed.

Research by Bethany (2006) from Verndabiit University has found that students benefit more from being taught the concepts behind math problems rather than the exact procedure to solve the problems. The finding offer teachers new insights in how best to shape Math instruction to have the greatest impact on students learning (Bethany R. J., 2009). Teaching students the basic concepts behind problems is more useful than teaching students procedures for solving the problems, these students gave better explanation and learn more (Webster M., 2006). With conceptual strategy, teachers explain the basic concepts of problems underlying structure. That type of instruction enables students to solve problems without having being taught specific procedures and also to understand more about how problems work. Conceptual in the subject to be taught (Gobinath,2001). Conceptual strategy according to Ibrahim, Erdal and Mustapha (2009) is the process of acquiring a better understanding in which concepts are exposed to the impacts of new data. It seeks to use the new knowledge to improve the concepts that our thought, while conceptual problem is a problem of which solution requires understanding of the concepts. Science educators and teachers have often assumed that success in solving quantitative problems should indicate mastery of science concepts (Nakhleh, 2003), which shows that concept learning is very vital in learning practical sciences .

2.4 Demonstration Method

Demonstration method is a teaching strategy which involves experimentation (Igboegwu, 2012). The basic method of instruction for teaching skill-type matter is the demonstration –performance method of instruction in which Obeka (2010) opines that this method is recommended for teaching skill because it covers all the necessary steps in an effective learning order. According to him, the demonstration steps gives trainees the opportunity to see and hear the details related to the skill being taught. Those details include the necessary background knowledge, the steps or procedures, nomenclature and the safety precaution.

Demonstration may be defined as display of an event or process. It involves the teacher or the student showing activities in front of a class and explaining it as he/she proceeds (Uche & Umoren, 2000). Though demonstration activities are often defined to embrace laboratory experiments, however , there is a distinction between the two practices. The mode of communication prevalent in demonstration strategy is a two way communication in which the teacher communicates with the students and the students also communicate with the teacher. In this method, the teacher encourages minimal participation from students. Demonstration is essentially a teacher activity aimed at showing how a skill, procedure or a process work or is done. The purpose is to ask students to acquire the required skills to procure related knowledge. In the discipline of science, demonstration has a long history of usage and it basically entails showing how certain scientific equipment operates or a certain operation in mathematics serves to explain a given concept. In a class room, demonstration may be subjected to uses including to pose a problem that requires a solution or to illustrate a problem in order to ensure a quick arrival at the solution. Similarly, a demonstration may be applied to precede or to follow a discussion, or it may be used to illustrate the application of a principle. As a rule, demonstration is jointly used with other skills such as explaining, discussing and performing. It can be considered as a valuable instructional method if it adequately or significantly serves to improve students` learning. If demonstration is to exercise its effects on the degree of students` learning, the mathematics teacher must do a number of things including specifying the objectives to be attained as a result of the demonstration, preparing for and trying the demonstration in advance in order to be confidently sure that it works, carrying out the demonstration at a point or surface that is clearly visible to the entire class.

The teacher can employ demonstration in the following ways according to Uche and Umoren (2000):

- As a set induction (at the beginning of the lesson) to initiate critical thinking for further studies and to stimulate interest
- As stimulus variation (along the development of the lesson)
- As a lesson closure (that is; at the end of the lesson) to summarize the vital concepts to arouse further critical and analytical thinking
- To introduce experimental method and techniques
- To solve problem

2.5. Conceptual-Demonstration Strategy in Mathematics

In mathematics classes, different types of tools have been used to improve student achievement and develop students' positive attitude towards mathematics. These tools have been classified and defined in different ways. Some researchers defined them as materials (e.g. Sowell), others named them as models.

According to Sowell (2002), there are three kinds of materials: concrete, pictorial, and abstract. Concrete materials can be moved around or manipulated by students. Materials that are basically visual and include pictures, diagrams and charts are defined as pictorial. Numerals and words are called abstract materials.

Baki, (2004) put concrete, pictorial and symbolic models in the category of representational models. Blocks, sticks, chips, Cuisenaire rods and Diene blocks are examples of concrete models. Pictures of the very same items represented on worksheets, textbook pages, papers or cards are examples of pictorial models. Numerals on worksheets, textbook pages, papers, cards, chalkboards or bulletin boards are examples of symbolic models.

Similarly, Guven and Karatas, (2003) stated that three types of conceptual-demonstration could represent mathematical ideas: concrete, symbolic and pictorial. A conceptual-demonstration model represents a mathematical idea through the three dimensional objects. A symbolic model represents a mathematical idea of commonly accepted numerals and signs that show mathematical operation or relationships. The third type, the pictorial models, attributes both concrete and symbolic models.

In the present study, the experimental group was instructed through the use of different kinds of tools or concrete models. They consist of tools constructed for educational purposes (geo-boards, cubes, solid figures etc) and real life objects (sugar, water, rice, coloured paper and geotrigmetric set). The term "concrete models" is consistent with the terminology of Guven and Karatas (2003) and Baki (2003). Other studies provide different names such as manipulatives (Garofalo, Drier, Timmerman and Shockey, 2000) or concrete materials.

2.5.1 Effects of Conceptual-demonstration Strategy in Mathematics Classroom

Many educators and researchers emphasized the importance of using conceptual-demonstration in mathematics classes (Baumert et al 2010). The concrete models have been receiving increased attention of scholars since 1960s, after the publication of theoretical justifications of the use of manipulatives by Edwards and Jones (2006). However, there are mixed opinions regarding the effectiveness of conceptual-demonstration on students' achievement and attitudes towards subjects. The results of the early studies on models representation in teaching mathematics from 1980s and 1990s were inconclusive (Baki, 2003). Almost half of the studies (7 out of 15) showed no significant differences between manipulative and non-manipulative treatments, four favored the manipulative groups, three showed mixed results and one favored the non-manipulative group. A majority of more recent research supports the importance of using conceptual-demonstration in developing mathematical concepts (Hannafin, Burruss and Litte, 2001). Burruss in his study of the activity based mathematics learning in JSS classes determined that mathematics achievement increased when manipulatives were used. A research review conducted by Burruss (2001) suggests that manipulatives enhance mathematics achievement across a variety of topics, grade levels and achievement and ability levels. Educators have different attitudes towards the use of conceptual-demonstration in mathematics classrooms for children of different ages. For example, Kanaya Light and Culp (2005) claims that while beginning learners usually benefit from the use of concrete materials, older learners not always do. On the contrary, Tularam (2013) reported benefits for all learners. While middle and upper primary students observed experienced considerable difficulty making sense of base ten blocks, Guven and Karatas (2003) who investigated the use of base ten blocks in teaching addition and subtraction algorithms reported that their students had amazing success. In a different study, base ten blocks had little effect on upper primary students' understanding or use of their already memorized whole number addition and subtraction algorithms (Butt, 2008). On the contrary, Wearne and Niebert (2006) reported consistent success in students' understanding of decimal fractions and decimal numeration when conceptual-demonstration materials were used. Thomas (2007) suggested that mixed and contradictory results might result from the studies that do not investigate instructional methods and student engagement. It is obvious that mere use of conceptual model materials is not enough to guarantee success. Only through the examination of total instructional environment can one understand the effective use of models materials, especially of teachers' images of what they try to teach and of students' images of the activities in which they are asked to engage.

The aspects of teacher preparation for the use of conceptual-demonstration, including teaching approaches and lesson contents were investigated in detail by Thomas and Chinnappan (2007). They emphasized the link between the action on the base ten blocks and written symbols, and the use of much verbalization about the blocks, in everyday English and in base ten terms. This research provides strong support for the educational value of solid materials, and for the need to use them in particular ways to meet specific objectives.

The detailed description of how the conceptual-demonstration are used in the classroom is important for making them work successfully. Boaler and Staples (2008) criticized the studies that do not provide a clear feedback on the use of solid materials. The scholars outlined the points that need clarification, such as the details of the instruction, the specificity of what was actually compared between the control group and the experimental group, the treatment, which the groups did, and its difference with the control group, and the meaning of concreteness.

The use of conceptual-demonstration strategy yield the best results when applied as a long term project. Sowell (2002) conducted a meta-analysis of 60 studies which ranged from kindergarten children to university students and used a wide range of manipulative and mathematical topics. Sowell came to a conclusion that the long term use of manipulative was more effective than the short term use. He stated that the short term treatment with manipulative caused no difference in the post test scores of the manipulative and non-manipulative groups. Besides this, when manipulative are used over an extended period of time teacher's training critically influences their effectiveness. Sowell noted that groups taught by teachers trained in the long term use of manipulative have higher scores (Sowell, 2002).

In Turkey, Yildiz (2004) has recently studied perceptions, beliefs and expectations of the pre-service teachers regarding the use of conceptual models in mathematics classes as well as the influence of the field experience on the use of manipulative. She reported that after taking the method course the pre-service teachers developed positive attitudes towards manipulative in mathematics classes.

Although educational research indicates that manipulative can be very effective, not many teachers are using them. Borgen and Manu, (2002) studied the recognition, availability and use of eleven (11) manipulatives among JSS teachers. The results showed that the less experienced teachers tend to use manipulative more often than the more experienced ones, probably because experienced teachers lack the training that more recent graduates have. Directed in-service training in application of manipulative however, increases their use among all teachers. To assure the best results, the teacher training should not only teach the content and introduce various manipulative but also develop good classroom organization skills (Szendrei, 2000).

Jakuncy and Kerr (2002) held that conceptual-demonstration materials are especially helpful in the situations where the structure of the material and the structure of the concept correspond to each other. She extended her argument to suggest that the effectiveness of conceptual-demonstration materials is a function of the concrete processing load required in their use. When the materials and analogies are unfamiliar or inappropriate and the students lack declarative and procedural knowledge, the processing load for the students increases and the effectiveness decreases. In other words, a teacher who attempts to assist students in their learning may unwillingly hinder the learning by providing perceptually compelling but misleading cues. Therefore, the use of concrete materials should be combined with careful instruction. The teacher has to make sure that conceptual-demonstration aids as tools for teaching and learning do not create a barrier between learners and their construction of mathematical knowledge.

Guven and Karatus (2003) pointed out that children could learn better if their understanding environment includes experiences with models that are suited to the children's level of cognitive development. As children progress through the elementary school, the conceptual-demonstration should be replaced with the symbolic models in order to facilitate the comprehension of mathematical ideas. At the concrete-operational stage of cognitive development (up to the age of twelve), learners can learn with symbols only if the symbols represent the actions that the learners had experienced before. Guven and Karatas reported that because children enter the elementary school with a few conceptual-demonstration experiences, they need a concrete representation to facilitate their learning of mathematical ideas. At the upper school levels, where the experiential background of the learners is much richer, the symbolic representation is more adequate.

In the middle school, teachers tend to apply conceptual-demonstration approaches to teaching mathematics less often than in the lower grades. However, according to Piaget's (1973) classification of ages and learning stages, the average student is still at the concrete to semi-concrete learning stage in the JSS and just begins to understand abstract concepts in the SSS classes. Thus, the mismatch between the teaching methods and the learning stages which frequently occurs in the middle school, creates a discouraging factor in the study of mathematics (Boling, 2000).

In the middle school, the content of mathematics becomes more abstract and remote from the everyday experience of the students. Solving word problems demands from the senior secondary students a higher level of thinking than is generally required by other subjects. This circumstance discourages students from studying mathematics. In addition, because of the middle students are still at the concrete learning stage, they lose their interest in mathematics or have troubles learning it (Boling, 2001).

What is taught is not as important as how it is presented. Teachers need to use conceptual-demonstration to introduce and reinforce concepts to be learned. Since most middle school students have not yet moved from the concrete and semi-concrete stages to the abstract stage of learning, they do not consider manipulative "childish" if the materials are used with appropriate activities. Indeed, the students seem to be more interested in using manipulative rather than in following the traditionally dominant paper-and-pencil activities. When teaching a new mathematics topic, teachers need to consider adding a concrete activity and a pictorial representation to the symbolic mathematical expression of the topic. This approach allows students who are not at the symbolic level yet move along with the lesson and eventually understand the topic. It also promotes better retention of the topic by all students (Guven and Karatas, 2003).

The use of conceptual-demonstration strategy in the mathematics classroom increases the responsibilities of the teachers. Teachers should have good classroom organization skills. They should carefully select the manipulatives, which are the best for the learning objective, and organize concrete models for easy use and distribution to the class. However, more is needed to start the mathematics learning process. The teacher should also give children precise instructions on what to do with the manipulative. Wiest (2000) stated that without proper instruction children would play with the materials rather than use them for learning. Teachers should also be aware of how children interpret the manipulative materials. Assuming that students understand materials in the same way as teacher does may jeopardize the communication between the teacher and the students in the situations when students' understanding is different. There is a danger of misusing conceptual-demonstration by teachers. This usually happens when the teacher has a prescribed activity in mind and rejects students' findings that do not correspond to the convention. In such situations, students are made to believe that "to understand" means to memorize a prescribed activity (Thompson 2004; Wiest 2000). Therefore, the misuse often happens when students are forced to memorize.

Teachers should learn the proper use of conceptual-demonstration and reserve enough classroom time to teach students how to use the models. Conceptual-demonstration should be selected carefully to be meaningful and acceptable to the children. Fielder (1989) outlined some selection criteria. The materials should:

- Serve the purpose, for which they were intended
- Be multipurpose if possible
- Allow for proper storage and easy access by teachers and students
- Prompt the proper mental image of the mathematical concept
- Be attractive and motivating
- Be safe to use
- Offer a variety of embodiments for a concept
- Be durable
- Be age appropriate in size

Model real problem solving situation . Children should be free to choose from alternative types of models so that they can find one which is helpful to them at their developmental level. The advantages of the use of conceptual-demonstration can be summarized as follows: Conceptual-demonstration strategy:

- Facilitate the development of initial concepts, procedures and other aspects of mathematics.

- Encourage the use of correct language and symbolism.
- Provides means to learn thinking strategies.
- Helps students develop some skills in spatial relations (2 or 3-dimensional geometry), Euclidean geometry, probability and measurement which are not equally developed through the out of class experience.
- Helps students make connections between mathematical topics

Elswick (2005) argued that in a long term run manipulative help students develop a sense of confidence in their ability to think and communicate mathematically. The introduction of manipulative into the curriculum helps teachers teach mathematics in a meaningful way and increases teachers' confidence and skills in teaching mathematics (Guven and Karatas, 2010). Conceptual-demonstration should be used with a care (Myers and Halpin, 2002). The advantages and disadvantages of conceptual-demonstration should be examined carefully. The following points should be taken into consideration before starting to use the conceptual-demonstration:

- Teachers should plan the use models according to the needs of the society and the educational philosophies of the school (Karatas 2010)
- Teacher training should be given for the use of models. The role of teacher training at any level should be not only to teach the content and introduce the different types of conceptual-demonstration but to develop good classroom organization skills as well (Guven 2010).
- Students should have enough experiences with the conceptual-demonstration before they start to learn a mathematical concept. The experiences with conceptual-demonstration are not enough. Students need to connect this experience with abstract mathematical forms of the concept (Leitze and Kitt, 2000).

- Teachers should tell the importance of the use of conceptual-demonstration in learning of abstract mathematical concepts (Cain-Casson, 2003).

  Meaningful learning of mathematical ideas is likely to happen when concrete and symbolic models are used properly. When the needs of middle school students are understood and methods of teaching mathematics are adjusted to fit these needs, both students and teachers enjoy mathematics classes more and the students' achievement often improves. Students are also able to better apply what they have learned to new situations and easily master the highly abstract content of advanced mathematics.

2.5.2 Conceptual-demonstration Strategy and Students Retention

Retention is the ability to retain and consequently remember things experience or learned by an individual at a later time (Bichi 2001). Retention can also be described as a form of reaction to what has been presented in the past. In other words it is a result of orientation or attitude, which marked an original perception.

Writing on retention Sogbesan (2004) said, retention is an unconscious activity, it is probably that as a result of experience and learning our brains actually undergo structural changes of sub-microscopic size; so that certain of the nerve cells are more likely to be excited again given the right stimuli`s. The sows clearly that retention seems to be dependent upon psychological changes, long as these remain uncompromised we retain the power to remember each specific thing we have learnt. If this structural change in the rain does not persist indefinitely we slowly forget most material that we have learnt. Retention can thus be measured by finding out how much the subject can remember of what he/she has learnt, or how much havoc has been done-or what she/he and other people have been deeply involved. Thus retention and what is retained also depends on the individual frame of reference. The problem now is how we maximize the level of retention and future recall of what is learned, since there are variations in the process of learning. As we can see progress in learning varies greatly among individuals as well as among kinds of learning. Just as the learners own characteristics influence his learning so do they affect his retention of what she/he has learned? The most important of these characteristics are his capacity, has determination to remember and his attitude towards the material. Retention increases if the learned materials are used. Thus, to maximize the level of retention for future recall we ought to have an insight in to factor contributing retention.

2.5.3 Factors Influencing Retention

Several factors are known to influence retention. Bliar et`al (2005) report in Bichi (2001), that anything that aid learning should improve retention. While things that leads to confusion or interference among learned material decreases the speed and efficiency of learning.

Retaining the effect of learning could be possible if the learning is coded in to memory. Appropriate coding of incoming information provides the index that may be consulted so that retention takes place without an elaborate search in the memory lane, (Oyedokun, 2002). Understanding and retention are product of meaningful learning when teaching is effective and meaningful to students. The nature of the materials to be coded contributes to the level of retention. Materials are related to the quality of retention in forms of their meaningfulness, familiarity, concreteness and image evoking characteristic (Adeniyi 2000).

Generally common, familiar, meaningful and structured materials are easily retained than unrecognizable haphazard data. Successful school learning requires that information and then retained over quite long interval. Typically mathematics concepts learned one day most be recalled again on the next day when it is used again with perhaps new rules added to it. There should be less problems in retaining organize meaningful materials as this can be analyzed without difficulty. It is important to note that abstract ideas are difficult to retain because they are difficult to represent in memory and therefore difficult to retain because they are difficult to represent in memory and therefore difficult to generate for retrieval. In practical term, the teacher must try to recall is facilitated-what variable affect retention while our immediate response to such question is that, our memory for a piece of information decreases with time. It is important to consider the condition that prevail when recall is attempt, the type of material learned and what actually happened during the interval between learning and recall. Characteristics that differentiate as stated above play significant role in the functioning of retention. Items like interest existing knowledge, intelligence, curiosity and anxiety state affect the amount of interest the individual can put into understanding the materials. Yet, the more a person know about the meaning of an item store in his memory the more items can be retrieved.

The following are some of the condition under which learned materials/information can be retained.

The materials must be actually learned to begin with, since only what has been learned can be retained.

1. The teacher can help recalled by providing cues to enable the student to retrieve information from memory.
2. The learning should be meaningful and the materials structured so that it is self-cueing.

3. The teacher must ensure that there is adequate revision, if the retention period is long and can aid memory by planning the learning programme so that there is frequent incidental recall.

Children who are poor at retaining information will need more frequent revision than others and so individual differences in retention ability should be identified and catered for, (Philipp, 2008). A number of empirical research have been done on retention and structural strategy in recent years. Humphreys, Johnson and Johnson (2000) compare cooperative, completion and individualistic strategies in science classes and find that students who were taught by cooperative method learned and retained significantly more information than students taught by the other two methods. Perraton (2000) found similar result in a study involving high school general mathematics classes taught by laboratory (solid shapes) and traditional(conventional) methods. Lagoke (1999) in Oyedokun (2002), test the retention ability of two groups of students (experimental and control) each from different school in her study. The experimental group was taught using the analogical linkages strategy for teaching Biological concepts while the control group was taught using the conventional teaching methods. The result of analysis showed that the students in the experimental group performed significantly better and retain more of the biological concepts taught to them than their counterparts in the control group.

In another study Ezanwa (2000) compare the effectiveness of the concept mapping and the guided discovery teaching strategic on student`s retention of some chemistry concepts. To test the retention ability of students taught using two teaching strategies the mean scores and standard deviation of the concept mapping and guided discovery group were used to calculate t-test. The result of the t-test analysis revealed a significant difference in performance between the pre-test post-test of the guided discovery group. There was a significance difference between the concept mapping and guided discovery groups in post-test score. It follows that the concept mapping method enable students to have a better understanding of concepts taught and retain more knowledge of the chemistry concept than the guided discovery methods. In the present study an attempt is being made to compare the effectiveness of the laboratory teaching strategy and traditional teaching method as relating to students achievement, retention and attitude on two different groups of student (Experimental and control).

2.6 Bridging the gap between Conceptual-demonstration Strategy and Abstract Thinking

Many students have difficulty understanding mathematics because they cannot make a connection between the physical world and the world of thoughts, in other words between concrete and abstract (Yousef, 2002).

The stage between conceptual-demonstration and abstract attracts increased attention of the scholars and is interpreted in a number of ways. Baki (2004) defines the learning stage between the concept model and the abstract levels as the semi-concrete stage. Heddens (1984) adds one more level, the semi-abstract level, to this scheme. The semi-concrete level is a representation of a real situation, that is, the pictures of the real objects are used instead of the actual items. The semi-abstract level includes a symbolic representation of concrete items. The symbols or pictures represent the objects but do not always look like them. Tallies are used to represent the objects. According to Ma (2001), the gap between concrete and abstract functioning should be considered as a continuum.

Similarly, Sowell (2002) divides the intermediate stage into concrete-abstract and pictorial-abstract. At the concrete-abstract level, the students begin to notice the relationships. At the pictorial-abstract level, pictures or diagrams are used in conjunction with the written symbols. At the end of this continuum, the learning experience is completely abstract. Eventually the students are expected to formulate the relationships and use them to solve related problems. Piaget (1963), in his theory stated that learners cannot understand an abstract representation of new knowledge until they internalize this knowledge. He defined the two process of interaction between the reality and the mind as accommodation and assimilation. Some children can assimilate new knowledge very rapidly, while others need considerably more time to accommodate, or reorganize, their mental structures to incorporate new knowledge (Baumert, Kunter and Blum, 2010). Likewise, Kunter (2008) underlined that children should have enough conceptual-demonstration experiences before they are asked to work with abstract matters. Children usually learn to operate at the abstract level over a period of time, after acquiring different experiences at other levels. At the concrete-abstract level, students should be encouraged to record what they are doing as a group and as individuals (Baumert, 2010).

Scholars such as Garofalo, Drier,Timmerman and Shockey (2000) and Straesser (2001) provided various suggestions about bridging the gap between conceptual model and abstract. All of them emphasized the crucial role that teachers play in this process. Heddens (2002) claimed that children begin to develop their own thought techniques and use them in their own thinking through a systematic questioning from the teacher. Teachers should ask questions to the students and evaluate the quality and level of questions posed by the students. The questions of the teachers should guide the children's thinking through the studied mathematical concepts.

Questions can show new directions of thought, encourage children to continue their current line of thought and provide clues that will stimulate thinking when the progress has been temporarily blocked. Heddens reported that the use of conceptual-demonstration materials enhances children's thought-processing skills, for example logical thinking, and facilitates the transition from concrete to abstract (Heddens, 2002).

With conceptual-demonstration strategy, the students can internalize mathematical concepts and develop them at the abstract or symbolic level. Otherwise, students will see mathematics as rules to be memorized rather than as a unique and helpful way to look at the world. If the students are asked to explain their procedures, they should be expected to use their own words and show the understanding based on their work. If students memorize the procedures without understanding, they will quickly get confused or forget. Thomas and Chinnappan (2007) stated that real understanding will be expressed in the students' own words and will last longer. According to Heddens (2002), verbalization is also important in developing thought-processing skills of students. Students should be given opportunities to verbalize their thought processes to clarify their own thinking.

As mention above they also suggest the use of manipulative as a means of bridging the gap between the concrete and abstract levels, although doing so requires careful approach. If the bridge has not been structured through a careful choice of manipulative, children may not be able to solve the problem at the abstract level even though they can solve the same problem at the concrete level.

Sowell (2002) stated that comprehension of new mathematical concepts should begin with concrete learning experience. Students need to manipulate the objects by themselves. Teachers' demonstration alone does not provide the concrete learning experience. In another research, Sowell (2002) reemphasized the idea of using manipulative and underlined the importance of their long term application. He noted that children should have enough conceptual-demonstration experiences before they are asked to work abstractly. He also suggested that the teacher's training for effectiveness.

Mainali (2008) noted that mathematical concepts are best taught by activities, which involve the transition from concrete to abstract. At the first stage of concept development, children should take part in experiences using concrete materials. Later, these remembered concrete experiences would provide the basis for understanding and performing abstract paper-pencil activities. The scholars pointed out that when children engage in experiences with manipulative materials, they should use semi-concrete or pictorial representations of the same materials. In this way, children can transfer their knowledge derived from manipulating concrete objects to the pictures of these objects. The next step in moving children from concrete to abstract involves activities that use semi-abstract diagrams. Concrete experiences—actual or recalled—should constitute the first step in the development and symbolization of the new abstract concepts. If students receive the initial idea of the concepts by manipulating conceptual model objects, they can later develop their own internal mental images of the concept. When mathematical symbols are introduced, students can accept them as a code to represent ideas that they had already understood.

Bohan (2000) held that since most children cannot proceed directly from the conceptual model to abstract symbolism of mathematics, using pictures of the objects (semi-concrete models) when children are engaged in actual manipulations could guide children along the road to abstract symbolism. Diagrams or illustrations (semi-abstract models) of concrete materials continue this process. Once a concept has been introduced with conceptual model materials, pictures and diagrams, the learner is ready to comprehensively use numerals and symbols (abstract models).

he intellectual development is the transformation of the overt actions into mental operations. Physical objects that exemplify given concepts, patterns or operations would help students carry out actions. Pictorial or semi-symbolic representations and then, imaged objects and operations should be given after physical objects. Subsequently, the abstract concepts emerge in a form that can be not only used meaningfully, but can also be reinterpreted in terms of the previous levels of representation instead of existing solely at the symbolic level (Guven, 2007).

In the middle school mathematics classes, students are often expected to think at the abstract (symbolic) level without experiencing the concrete level first. The content of the middle school mathematics becomes more abstract and remote from the students' everyday experience. While instructors often use conceptual model materials in teaching lower-grade mathematics, they tend to disregard them in the middle school. Boling (2001) suggested that teachers should consider incorporating concrete activities and pictorial representations, in addition to symbolic mathematical expressions into the middle school instruction. This recommendation can satisfy a twofold purpose, to help the students who are not advanced enough for the symbolic level to move along with the lesson, and to assure that all students gain a deeper understanding of the topic.

2.7 Interest towards Geometry

Girls and boys in middle school tend to have different interest towards mathematics. Studies have shown that more boys than girls have positive interest at the middle school and high school levels (Guven 2007). Aiken (2001) established a positive correlation between mathematics achievement and interest towards mathematics. Furthermore, Perl (2003) emphasized that for both males and females, ability and achievement in mathematics results in positive interest to mathematics. The perceived usefulness of mathematics for educational and career goals, and the positive influence of key reference groups, such as parents, teachers, counselors and peers were found to be particularly important in forming positive attitudes to mathematics.

Most of the studies focus on the relationship between the students' mathematics achievement and students' attitude in mathematics. Aksu (2005) focused on the effect of gender on students' interest towards mathematics. Although their subjects were from different grade levels (secondary school and university), they have reported that there is no significant mean difference between interest scores of girls and boys.

At the same time, we found in Nigeria dedicated to possible effects of students' interest towards geometry on their geometry achievement. Bulut (2002) developed an attitude scale to measure students' attitudes towards geometry. The present study applies Bulut's geometry interest scale.

It is widely believed that a teacher's attitude towards mathematics affects students' interest. A study conducted by Guven and Karatas, (2003) established that prospective teachers for the lower grade levels (JSS to SSS) have less favorable attitudes towards mathematics than prospective high school mathematics teachers. Since students tend to form lasting interest towards mathematics during their middle school years (Lavy and Shriki, 2010), it is essential that their teachers have a positive attitude towards mathematics. When conceptual-demonstration materials are used in mathematics lessons, both teachers and students report that they enjoy mathematics learning more (Baki, 2009). This is only one of the many ways that teachers can create a positive attitude in the math class. Because mathematics achievement is closely connected to the attitude, improving achievement necessarily improves the attitude (Aiken, 2001).

2.8 Implication of the Reviewed Literature to the Present Study

The study show a direction through which one could positively help students irrespective of their attitude or abilities to attain better understanding of mathematics concepts. The review also points out that the development of positive attitudes and interest to mathematics rest squarely on the teacher`s methods, strategies and behavior. It implies also that if mathematics teachers want to develop an understanding of the concepts and principles of mathematics in the classroom then more is required than simply providing theoretical facts and connections which will not be discovered by students through traditional or conventional teaching methods, lectures or written examples. The study also show that mathematics teachers would have to reconsider the purpose of teaching/learning so that pupils are not left behind in a state of confusion at the end of mathematics lesson.

In other words, what are evident from all these discussions are the presence of a large array of condition, events, influence and personalities that come to play when teaching, learning and testing is going on in the classroom. It is not possible to eliminate all these variables but at least effort can be made to reduce their influence during interaction. A good instructional strategy is good control measure. So long there are needs to carry out more researches on students performance and attitudes towards mathematics learning at both junior and senior secondary school levels like the present one.

In the light of the advantages of learning mathematics under conceptual-demonstration teaching/learning strategy and the realization of modern mathematics teaching and learning more effective applicable to students. It becomes very important for teachers and curriculum developers to be initiative more in the development and implementation process of mathematics curriculum.

CHAPTER THREE

RESEARCH METHODOLOGY

3.01 Introduction

This chapter presents a detailed description of the procedure adopted for the investigation. The methods and steps followed in carrying out this study are presented under the following sub-headings:

3.02 Research Design

3.03 Population of the Study

3.04 Sampling and Sampling Techniques

3.05 Instrumentation

3,06 Validation of the Instruments

3.07 Pilot Testing

3.08 Reliability of the Instruments

3.09 Procedure for Data Collection

3.10 Procedure for Data Analysis

3.02 Research Design

The study adopted Quasi-experimental research design (pre-test and post-test) control group design. The design was adopted because it was not possible to have complete randomization of the students. In fact classes were randomly assigned to experimental group (EG) and control group (CG) by balloting. Both the experimental group and the control group were given the same pre-test before the experiment and pre-test after the treatment, the grouping were chosen using purposeful sampling. This is because the schools offer the same curriculum and syllabi in the state junior secondary schools. Pre-test was used here to serve as the base line and to established equivalent relation. Different treatments were given to the two groups, conceptual-demonstration materials teaching strategy to the experimental group and the conventional method to the control group. After the treatment post test and retention test as well Geometry Performance Test (GPT) and Geometry interest scale (GIS) were used to collect data for analysis during the present study.

3.03 Population of the Study

The population of this stud ll junior secondary schools in Kaduna State. There are presently 234 sec ols with a population of 39,388 junior secondary students spread into 12 inspectorate divisions for ease of administration in the state. These inspectorate divisions are not based on Local Government basis. Summary of schools is provided in Table 3.1

Table 3.1: Population of the Study

N/S	Zones	Senior secondary only	Senior and Junior	No of Students
1	Anchau	5	16	21
2	Birnin Gwari	2	6	8
3	Giwa	7	7	14
4	Godogodo	6	13	19
5	Kachia	9	15	24
6	kafanchan	15	9	24
7	Kaduna	11	5	16
8	Lere	8	10	18
9	Rigachikun	4	13	17
10	Sabon Tasha	14	12	26
11	Zaria	10	10	20
12	Zonkwa	6	21	27
	Total	97	137	243

Source: Kaduna state Ministry of Education Statistics.(2015)

The target population for the study specifically involves all junior secondary schools JSS (III) students with some of their teachers. There are twelve (12) Educational Zones in the state with a total of 137 senior and junior secondary schools. Four (4) zones of Kaduna state namely; Anchau, Kaduna, Kafanchan, Zaria were used in this research because of their geographical location is about 60 kilometers away from each other to minimize interference.

3.04 Sample and Sampling Techniques

Random sampling technique of 'drawing the hat' was used in selecting the sample for this study. The sampling technique enable us to produce a smaller sample size to represent the population (Sambo, 2008). The sample was randomly selected by using Stratified Random Sampling technique in each of the experimental and control groups. One junior secondary school from each of the four divisions namely Anchau, Kaduna, Kafanchan and Zaria participated in this research so that all students in junior secondary schools in the four zones were covered. In the four zones, two schools were used as experimental and the other two used as control group from the selected schools, a random sample of students was then selected. Thus a total of two hundred and twelve students (212) were used for the study. Each category was assigned a class of 50 students each for three weeks, equal male and female students were been selected. Below is the table of the sample size for this research work:

Table 3.2 Sample Size for the Study

School	Status	Male	Female	Total
School A	Experimental	57	-	57
School B	Experimental	-	52	52
School C	Control	59	-	59
School D	Control	-	44	44
Total		116	96	212

3.05 Instrumentation

The study adopted three research instruments for collection of primary data; these are Geometry Performance Test (GPT),Geometry Interest Scale (GIS) and Geometry Retention Test. The GPT and GIS were used to collect the data required, individuals express his or her opinion about an issue or event.

3.05.1 Geometry Performance Test Questionnaire (GPT)

Geometry Performance Test (GPT); was a multiple choice objective tests (see Appendix A). The 30 objective test items were adopted with modification from National Examination Council Junior Secondary School Mathematics Examination of 2009-2014 (objective papers). This was conducted after lesson presentation so as to measure the immediate performance of the students. The items of this instrument covered JSSI-III Geometry Mathematics curriculum (2014).

3.05.2 Geometry Interest Scale (GIS)

Geometry Interest Scale was adopted from Oyedokun (2002). It was adopted to suit the present study and thus for data collection. The interest scale has total number of thirty (30) questions to test for a change in attitude after teaching geometry in mathematics. The interest scale was administered to both experimental and the control groups and the purpose of this instrument is to determine whether students have favorable or unfavorable attitude towards manipulative materials teaching strategy as well as the traditional method. They are required to respond by making a choice out of the five options provided (Strongly Agree, Agree, Undecided, Disagree, Strongly Disagree).

3.06 Validation of Instruments

The GPT and GIS items were subjected to face and content validation by three experts who are well experienced in test construction. They comprised two senior lecturers in mathematics science, mathematics education section and a secondary school mathematics teacher with minimum of first degree and minimum of 15 years teaching experience. The validators were requested to among other things:

- Check the suitability of the test.
- Check if the language used in constructing instrument is suitable for secondary school students and teachers.
- Remove any item(s) that were not necessary or appropriate and add any item(s) which are necessary, but had not been included.
- Check if the factors identified are actually being targeted at each of the research instruments. Their useful and constructive suggestions led to re-framing and eliminations of some questions, which were found to be either sub-standard or ambiguous. Responses collected were analyses using appropriate statistical tools like: mean, standard deviation, T-test and Mann-Whitney.

3.07 Pilot Testing

The GPT, GIS and GRT were subjected to trial testing as a preliminary assessment of the tools used. This was done using a sample of 50 JSSIII students of Barewa College Zaria. The school was part of the research population and therefore shares the following characteristics with the population location, academic standard, staffing and administrative competencies. However, Barewa College was not selected as part of the research sample to avoid experimental contamination of Barewa College as a subject. Both GPT and GIS were administered to only the (JSS III) class immediately after their regular mathematics class. The major objective of the pilot study was to estimate the internal consistency and reliability coefficient of the instruments. Internal consistency reliability defines the consistency of the results obtained in a test, ensuring that the various items measuring the different constructs deliver consistent scores (Shuttleworth, 2009).

3.08 Reliability of the Instruments

The reliability of Geometry Performance Test Questionnaire (GPT) was ascertained using the test-retest method. For GPTQ, its reliability was found to be 0.74 when subjected to Pearson Product Moment Correlation (PPMC). For the GIS the split-half reliability method was used. It produce a Guttman Coefficient of 0.79 . Hence, the instruments are reliable.

3.09 Procedure for Data Collection

The researcher after designing the instruments and subsequent validation collected a letter of introduction from the department of education, A.B.U Zaria; titled "Students' Field Research" to facilitate data collection from the various schools and organization visited. The researcher personally visited the various locations to administer the instruments. With the assistance of the school teachers, the researcher supervised the administration of the instruments (GPT and GIS) on the respondents for each of the schools visited and retrieves them within two days to allow proper responses to them. Geometry Performance Test (GPT) was conducted personally and the researcher supervised the conduct of the test in order to clarify any ambiguity for the students. The Responses collected were analyzed using appropriate statistical tool. Data from examination body NECO was obtained by visiting their Kaduna headquarters and contacting the registry.

3.10 Procedure for Data Analysis

As mentioned earlier, the purpose of the study was to examine the effects of conceptual-demonstration strategy on interest, retention and performance in geometry among students of junior secondary schools. Data were gathered through geometry interest scales and geometry performance test questionnaire. The three variables interest, retention and performance of geometry were analyzed, presented and discussed in relation to the students' achievement. The three variables mentioned earlier were treated as independent variables and performance of GPT treated as a dependent variable.

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND DISCUSSION

4.1 Introduction

The purpose of the study was to investigating the effects of conceptual-demonstration strategy on the interest, retention and performance in geometry among JSS three students in Kaduna state. The result of data analysis and hypotheses tested for the study is containing in this chapter The chapter is presented under the following subheadings:-

4.2 Data Presentation

4.3 Analysis and Results

4.4 Summary of Major Finding

4.5 Discussion.

4.2 Data Presentation

In order to establish the existence or otherwise of homogeneity among all the students engaged in the study, descriptive analysis was used and the results are presented in tables corresponding to each research question. To test for any significant difference, inferential statistics was used to test the hypotheses. Four pairs of data were obtained in the course of this investigation participating to students in the two group [EG] and [CG], namely;

1. Performance scores pretest

2. Performance scores posttest

3. Performance scores retention test.

4. Rating scores of students` attitude towards geometry and conceptual-demonstration strategy. The equivalence of the two groups was determined from the pretest scores of the two groups in the Tables 4.0

4.2.1 Answers to Research

This section presented the answers to the research question asked in section 1.4.

Research Question 1

What is the effect of CDS on interest towards Geometry concepts among JSS students and those exposed to the conventional method.

Table 4.01 Summary of Descriptive statistic between experimental and control on Interest

Group	N	Mean Rank	Sum of Ranks
Experimental Group	109	137.68	15007.50
Control Group	103	73.5	7570.50

Table 4.01 presents the mean ranks and sum of ranks of the experimental and control groups respectively. The experimental group had a higher mean rank of 137.68 compared to that of the control group who had a mean ranks of 73.5. Also, the experimental group had sum of ranks of 15007.50 while the control group had 7570.50 as its sum of ranks. This shows that there is a difference in the mean rank and sum of ranks of the two groups in favour of the experimental group.

Research Question 2

What is the effect of CDS on retention ability of Geometry concepts among JSS students and those using conventional method?

Table 4.02 Summary of Descriptive statistics between experimental and control groups in retention

Group	N	Mean	Std. Deviation
Experimental Group	109	66.37	10.86
Control Group	103	41.18	10.82

There is difference in the retention level of students taught geometry with conceptual-demonstration strategy and those taught with conventional method of teaching. The mean score of experimental group was 66.37 and control groups was 41.18 respectively, and their standard deviations are 10.86 for experimental and 10.82 for control respectively.

Research Question 3

What is the effect of conceptual-demonstration strategy on JSS geometry students performance and their counterparts exposed to lecture method?

Table 4.03 Summary of Descriptive statistics between Performance between Control and Experimental Group

Group	N	Mean	Std. Deviation
Experimental Group	109	60.12	11.41
Control Group	103	41.31	9.87

Table 4.03 presents the mean scores and standard deviation scores of the experimental and control groups respectively. The experimental group had a higher mean score of 60.12 compared to that of the control group who had a mean score of 41.31. Also, the experimental group had a standard deviation score of 11.41 while the control group had 9.87 as its standard deviation. This implies that there is a difference in the mean and standard deviation scores of the two groups in favour of the experimental group.

4.2.2 Hypotheses Tests

This section presents the testing of the null hypotheses stated in section 1.5 at $P \leq 0.05$ level of significance. The result is presented as follows:

Null Hypothesis 1

The hypothesis states that, there is no significant difference in the interest level of students that were taught with CDS and their counterpart that were taught with the conventional method. To test this hypothesis, the scores of the students follow up (post test re-test) was compared. The mean scores of students were tested using Mann-Whitney Test. The results are presented in table 4.04

Table 4.04 Summary of Mann-Whitney Test for Interest between the experimental and control group

Group	N	Mean Rank	Sum of Ranks	U.value	P-value
Experimental Group	109	137.68	15007.50		
				2214.50	0.001*
Control Group	103	73.50	7570.50		

*Significant at $p \leq 0.05$

From the above Table 4.04 shows that there was significant difference in the interest ability experimental groups as supported by U.value= 2214.50 and p-value = 0.001 < α = 0.05 level of significance. The result indicated that there was significant difference in the mean scores of the two group`s interest ability which means that conceptual-demonstration strategy approach is friendly. Therefore the H_{01} hypothesis was rejected.

Null hypothesis 2

The hypothesis states that, there is no significant difference in the retention ability of students taught using CDS and conventional group toward learning. The results are presented in Table 4.05

Table 4.05: Summary of t-test for Retention between Experimental and Control Groups

Group	N	Mean	SD	df	t. value	P-value	Remark
Experimental Group	109	66.37	10.86				
				210	16.907	0.001	Reject H_{02}
Control Group	103	41.18	10.82				

Significance at p≤ 0.05

Table 4.05 revealed that a t-value of 16.907 at 210 degree of freedom gave a P-value of 0.001. This value is significant at P ≤ 0.05. Therefore, the null hypothesis two is hereby rejected. Hence, it was concluded that a significant difference exists between the two groups retention level.

Null Hypothesis 3:

The hypothesis states that, there is no significant difference in the performance of students taught geometry with CDS and those taught using the conventional method.

To test this hypothesis, the mean scores obtained from the Geometry Performance Test (Table 4.03) of the experimental and control groups were subjected to the t-test statistics at P≤ 0.05 as shown in Table 4.06

Table 4.06. Summary of t-test for performance between Experimental and Control groups.

Variable	N	Mean	SD	df	t,value	P-value	Remark
Exp. Group	109	60.12	11.41				
				210	12.799	0.001*	Significant
Control Group	103	41.31	9.88				

* Significant of P≤0.05

From Table 4.06, the t-value of 12.799 which has a P-value of 0.001 at 210 degrees of freedom, was less than P-value of 0.05 level of significance. P = 0.001 is significant. Hence, the null hypothesis three (**H_{o3}**) was rejected. This meant that there was a significant difference between geometry performance of the experimental and control groups in favour of the experimental group..

4.3 Summary of the Major Findings

The following finding were obtained during the course of study.

1. There was a significant difference between the mean performance scores of students taught geometry using the conceptual-demonstration strategy CDS and those taught using the lecture method. Teachers should employ the CDS in the teaching of geometry in junior secondary schools' classroom to enhance students' performance and interest at it since the strategy is student-centered based.
2. There was a significant difference between the retention level of students taught geometry using the conceptual-demonstration strategy and those taught by the lecture method. Students should be encouraged by their teachers to participate in the CDS because it is a result oriented strategy that has the potential of improving their retention and performance in mathematics.

4.4 Discussion of finding

The data collected for this research were based on academic performance of students in Geometry performance Test (GPT),responses obtained from the students attitude to Geometry Interest Scale (GIS) and also responses from the Geometry Retention Test (GRT). These were analyzed according to the demand of the research questions, hypothesis formulation and the research design. The discussion of the results are as follows:

The result indicates that the experimental group exposed to CDS performed significantly better than their counterparts in the control group who were taught using conventional method. The higher performance in favour of the experimental group suggests that use of Conceptual-demonstration has greater effects over the conventional method of teaching. The finding of this study is in conformity with other studies conducted on effect of conceptual-demonstration in teaching geometry. In other words, results from such studies have shown that the use of conceptual-demonstration in teaching improve the performance of students Oyedunbe 2005, that found that using conceptual-demonstration is more superior over the conventional method in enhancing students high academic performance. They all emphasized that the academic performance obtained from the use of conceptual-demonstration might have been due to the students active participation and discussion freely with one another writing the group members. The process stimulates high cognitive skills. The result obtained from comparing the male and female students indicates that there was no significant different in the post test mean score of male and female students when exposed to conceptual-demonstration strategy in teaching mathematics. This implies that the use of geometric model is gender friendly meaning that both male and female benefit almost equally from the use of conceptual-demonstration strategy. This result was in agreement with the finding of Oyedunde 2005 that gender and ability of student failed to have any significant effect viz the use of CDS. Similar finding had also been reported by Andis 2005 who reported that male are not better than female in geometry in term of educational achievement after he had carried out study on sex differences and student`s performance at secondary school level. On the contrary Aigborman 2002 reported that males archived significantly better than females in science, technical and mathematics subjects. This might have been attributed to the method of instructional material used in teaching the subject. The major important of this finding is that conceptual-demonstration is gender friendly. The result from the analysis of the interest questionnaire revealed a significant different in the retention of geometry students in experimental group before and after exposure to conceptual-demonstration strategy. This result shows that students demonstrated positive attitudinal change after exposure to their conceptual-demonstration. This favorable attitude demonstrated by the student toward geometric models might have been attributed to the advantages derived from the CDS. This finding is an agreement with those reported by Johnson 2003 that use of CDS promote attitude toward the instructional materials in their finding, they emphasize that the favorable attitude shown by the students could be attributed to the educational benefit the student drive from strategies. When students are successful, they view the subject with a very positive attitude because their esteem is enhanced. From the finding of this study, the use of CDS in geometry was observed to generate a more positive attitudinal change and enhance student performance in the subject. Consequently, this strategy hold a viable promise for improving teaching and learning and processes in mathematic generally and geometry in particular at junior schools levels.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This study was carried out to find the effect of conceptual-demonstration strategy on interest, retention and performance in geometry among junior secondary school students indented to discuss the following sub-head:

5.2 Summary

5.3 Conclusion

5.4 Contribution to Knowledge

5.5 Recommendations

5.6 Limitation of the Study

5.7 Suggestion for Further Studies

5.2 Summary

Chapter one proved bases for the research focusing on the effects of conceptual-demonstration strategy on interest, retention and performance of geometry among junior secondary students. Four null hypotheses and research questions were formulated and investigated and the significance of the study targeted at students, teachers parents community members and so many others. The scope of the study was JSS I-III students in Kaduna state.

Chapter two contained a review of related studies on the conceptual-demonstration theories of teaching and learning geometry which included: Framework; Theoretical Framework; Conceptual-demonstration strategy of Mathematics; Conceptual-demonstration Strategy Approach of Mathematics Teaching; Effect of Conceptual-demonstration strategy in Mathematics; Attitude of Students towards Geometry; Retention Ability of Gender in Geometry; Over view of Related Studies; and Implication of the Literature to the Present Study.

Chapter three contained the research methodology used in the study. A Quasi-Experimental study that used a pre-test post- test group design was adopted. A purposive sampling technique, a population of 39,388 students and a sample size of 212 students were used for this study. Instruments; three instruments were used namely, Geometry Performance Test Questionnaire (GPTQ), Geometry interest scale (GIS) and Geometry Retention Test (GRT) ; Validity; Treatment Administration; The data collected from the research ir ere analyzed using descriptive statistics (means, medians and standard dev iswer research questions and inferential statistics (t-test and Spearman Brown formula) was used for hypotheses testing. The finding from the three research questions and three hypotheses led to the following major finding:

Chapter four constituted the following items: Data Presentation; each of the four research questions and null hypotheses were stated and answered via a statistical table beneath it using the described statistical tools required. In answering the research questions, the data collected were analyses using descriptive statistics of Means Medians and Standard Deviation to answer research question at $P \leq 0.05$. analysis of Results; the results of the analyses were tabulated and explain according to the probability statement of $P \leq 0.05$ level of significant and finding were itemized. Discussion was carried out step by step according to the four hypotheses formulated.

The final chapter of this research report was dedicated to the following vital subheadings: Summary; Conclusion; recommendation; Limitation of the study; and Suggestion for further studies. The study concluded that there were statistically significant differences in the scores of experimental and control groups in academic performance, interest, retention and between male and female experimental groups. The finding further showed the conceptual-demonstration strategy was gender friendly on academic performance and retention ability but it was gender friendly on attitude. Based on the finding some recommendations were made to students, teachers, administrators, community members and many others. Teacher should engage students in an active process of learning in mathematics class involving students in really doing mathematics-experimenting first with physical objects in the environment and having concrete experience before learning abstract mathematical concepts. Minds on; focusing on the core and critical thinking processes needed for students to create and re-create mathematical concepts in their own minds. Allowing students to explore, discuss and meaningfully understand concretes and relationship in contexts that involves real-world problems and projects that are relevant and interesting to the learner.

5.3 Conclusion

Based on the findings of this study the following research conclusions were drawn:

1. Students taught with CDS had proved a more effective approach in teaching geometry.
2. Also using CDS enhancing the retention level of JSS students in mathematics.
3. Students attitude were positively affected by the use of conceptual-demonstration.

Generally, use of CDS has the potential of enhancing mathematics students interest, retention and performance in geometry. Therefore using CDS for improvement of mathematics at JSS level is a good and welcome idea.

5.4 Contribution to Knowledge

The researcher contributions to knowledge are as follows:

1. The researcher was able to establish that the use of CDS in mathematics teaching in schools improves the interest, retention and performance students in junior secondary schools.
2. The study establishes that, proper use of CDS with good content knowledge and the right pedagogical approaches will make students developed love and interest for the subject, and help in disabusing the students on math phobia.
3. The CDS can help create a foundational base for developing strong mathematical skill needed for the future among students irrespective of gender especially in geometry which enables students to develop the skills of visualization, critical thinking, intuition, perspective, problem-solving, conjecturing, deductive reasoning, logical argument and proofs. These skills are very useful in higher mathematics. Also, the findings of the study added new knowledge to the existing literature on CDS and the improvement of students' interest and performance in geometry.
4. The research work serves as a blue print to other research studies, as these finding therefore provides a good reference point for researchers, curriculum planner and policy makers.

5.5 Recommendations

1. Based on the finding above the following recommendations have been made: Since this study indicted enhanced student's academic performance when Conceptual-demonstration were used, the use of such teaching aids should be encouraged in schools in teaching the subject and other related science subjects at JSS level.
2. Other resources Centre such as National Mathematics Centre, (NMC) National Teachers' Institute (NTI), Science Teacher Association of Nigeria (STAN), Nigeria

Education Research Development Council (NERDC) and NGO that carry out seminars, workshops and conference should encourage the use of Conceptual Models in their mathematics curriculum at JSS level. The Federal and State Ministry of Education should at all levels sponsor mathematics teachers for research training on the using of conceptual-demonstration needed to improve the performance of students in the subject.

5.6 Limitation of the Study

1. The time allocation for each lesson in Junior Secondary School is 30 or 40 minutes and this is not enough for enrichment and teaching and learning mathematics. This is a limitation beyond the researcher`s control.
2. Getting male and female students, work together in a team can be a bit tasking especially where there is inferiority complex among the female students.
3. This study was limited to four Educational Zones in Kaduna state due to the geographical spread and the financial demanding of the study not all students in the selected sampled of the four Educational Zones were used and four schools from each of the sampled Educational Zones were used for the study. Some students lack the basic teaching of the practical mathematics (solid geometry and trigonometry).

5.7 Suggestions for Further Studies

Since teaching in mathematics education from the past till date has neglected the use of CDS, the comment research shows the need to revive instructional aids. The fact that the experimental subjects did better in the geometry post-test deserve further studies. This research intended to promote and encourage further finding in the related studies:

1. A similar study may also be conducted in senior secondary schools and tertiary institution and find their effects.

2. Effects of conceptual-demonstration strategy and the conventional method learning on content, textbook and instructional materials in geometry in junior and senior secondary schools.

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APPENDIX A

Geometry Performance Test (GPT)

Dear Respondent

I am a postgraduate student of Ahmadu Bello University Zaria (ABU, Zaria) conducting a research on the effects of conceptual-demonstration strategy on the performances in geometry among junior secondary students in Kaduna state. The attached is a Mathematics Content Assessment instrument designed to elicit information from you in order to achieve the objective of the research. Please respond to the items according to the instruction below.

Thank you

Raphael Babatunde Abioye

M.Ed/Educ./02850/2010-2011

Mathematics Education Section

Department of science Education

Faculty of Education,

Ahmadu Bello University,

Zaria.

Instruction

1. Answer all questions. If your answer is option A, then you just circle it.

2. Time allowed: 45 minutes

3. Gender: Male [ ] Female [ ]

(please tick as appropriate)

1. Find the volume of a cone whose height is 15cm and the base diameter 14cm

(a) $2310cm^3$ (b)$1320cm^3$ (c)$770cm^3$ (d) $660cm^3$ (e)$220cm^3$

2. A cylindrical can of volume $198cm^3$, has a height of 7cm. Find the radius of the cylinder

(a)2829cm (b) 18.00cm (c) 9.00cm (d) 5.20cm (e)3.00cm

3. Find the area of a parallelogram whose base and height are 46cm and 12cm respectively.

(a) $29cm^2$ (b) $58cm^2$ (c)$116cm^2$ (d)$276cm^2$ (e) $552cm^2$

4. The perimeter of a football field is 102cm. Find the length of the field if its breadth is 24cm. (a) 12cm (b) 27cm (c) 48cm (d) 51cm (e) 6cm

5. Calculate the area of a rhombus whose diagonals are 6cm and 8cm

(a) $48cm^2$ (b) $36cm^2$ (c)$28cm^2$ (d) $24cm^2$ (e) $14cm^2$

6. The volume of a cylinder is given by the formula V= llr^2 h. find the height of the cylinder if its volume and radius are 154cm and 3.5cm respectively.

(a) 1694cm (b) 357cm (c) 44cm (d) 4cm (e) 0.40cm

7. A square field has a perimeter of 48m. Find the area of the field.

(a) $144cm^2$ (b) $96cm^2$ (c) $48cm^2$ (d) $24cm^2$ (e)$12cm^2$

8. The following are quadrilaterals EXCEPT

(a)circle (b) parallelogram (c) rectangle (d) square (e) trapezium

9. What is the perimeter of a regular decagon of sides 3.25cm each?

(a) 3.25cm (b) 26.5cm (c) 28.5cm (d) 32.5cm (e) 40cm

10. What is the value of each exterior angles of a regular octagon

(a) 45^0 (b) 150^0 (c) 100^0 (d) 90^0 (e) 45^0

11. Find the length of the diagonal of a rectangle whose length and breadth are 4cm and 3cm respectively . (a) 6cm (b) 5cm (c) 4cm (d) 3cm (e) 2cm

12. A cylindrical container of height 70cm has a base diameter of 24cm. find its volume.

(a) 2,640cm^3 (b) 10,560cm^3 (c) 31,680cm^3 (d) 31,860cm^3 (e) 126,720cm^3

13.The volume of a cuboid is 1920cm^3 . If the area of its base is 24cm , find its height.

(a) 8cm (b) 12cm (c) 24cm (d) 64cm (e) 80cm

14. The length of a basket ball pitch can be divided into 12parts, each 25cm long. How many parts, each 20cm long can be obtained from the pitch?

(a) 12 (b) 13 (c) 14 (d) 15 (e) 16

15. Find the area of a semi-circle of diameter 28cm.

(a) 924cm^2 (b) 308cm^2 (c) 616cm^2 (d) 1232cm^2 (e) 2464cm^2

16. Find the circumference of a circle whose diameter is 28cm.

(a) 44cm (b) 88cm (c) 176cm (d) 308cm (e) 616cm

17. What is the volume of a cuboid tank whose edges measure 5.2cm each?

(a) 5.2cm^3 (b) 27.0cm^3 (c) 77.2cm^3 (d) 100.1cm^3 (e) 140.6cm^3

18. How many cubic sugar of edge 2cm can be flitted into a cuboid container of dimension 4cm by 6cm by 10cm?

(a) 30 (b) 22 (c) 20 (d) 12 (e) 8

19. Calculate the volume of a cylinder of height 14cm and radius 3cm.

(a) 396cm^3 (b) 264cm^3 (c) 198cm^3 (d) 172cm^3 (e) 132cm^3

20. The height of an equilateral triangle is 15cm and its perimeter is 36cm. Find the area of the triangle?

(a) 60cm^2 (b) 72cm^2 (c) 90cm^2 (d) 270cm^2 (e) 540cm^2

21. A cone with base radius 7cm has a volume of 308cm^3 . find the vertical height of the cone. (a) 3cm (b) 6cm (c) 7cm (d) 10cm (e) 44cm

22. Two similar cardboards have area of 24cm^2 and 150cm^2 . If the length of the bigger on is 10cm, what is the length of the smaller one?

(a) 4cm (b) 6cm (c) 8cm (d) 10cm (e) 16cm

23. Find the number of rectangular tiles each of 8cm by 6cm that need to be fitted into rectangular floor of 3.6m by 2.4m

(a) 900 (b) 1000 (c) 1200 (d) 1800 (e) 2000

24. Find the circumference of a circle of radius 21cm.

(a) 21cm (b) 66cm (c) 76cm (d) 132cm (e) 1386cm

25. The perimeter of a parallelogram is 54cm. Find the length if its breadth is 12cm. (a) 12cm (b) 15cm (c) 27cm (d) 39cm (e) 42cm

26. Find the curved surface area of a cone of radius 5cm and slant height 35cm. (a) $110cm^2$ (b) $175cm^2$ (c) $275cm^2$ (d) $550cm^2$ (e) $915cm^2$

27. If there are 18 triangles in a polygon how many sides has the polygon?

(a) 10 (b) 12 (c) 14 (d) 16 (e) 20

28. Find the sum of angles of a hexagon

(a) 360^0 (b) 720^0 (c) 900^0 (d) 1080^0 (e) 1440^0

29. Find the area of a trapezium which has a height 20cm and its parallel sides are 7cm and 8cm long.

(a) $140cm^2$ (b)$150cm^2$ (c) $160cm^2$ (d) $560cm^2$ (e) $1120cm^2$

30. Calculate each exterior angle of a regular decagon

(a) 10^0 (b) 18^0 (c) 36^0 (d) 180^0 (e)360^0

APPENDIX B

ANSWERS TO THE GEOMETRY PERFORMANCE TEST

1. C	21 B
2. E	22 A
3. E	23 D
4. B	24 D
5. A	25 B
6. D	26 D
7. A	27 D
8. A	28 B
9. D	29 B
10. E	30 C
11. B	

12. C

13. E

14. D

15. B

16. B

17. E

18. A

19. A

20. C

APPENDIX C

GEOMETRY INTEREST SCALE (GIS)

Section A

1. Name of School...

2. School Ownership Type: Private……………..

Public……………….

3. Age: Between 12 and 14 Above 14

4. SEX: Male: Female:

5. Do you offer Mathematics? Yes No

Section B

Instruction: Please express your feelings concerning the statements below. For each item, place a tick (√) under the column that best describes how you feel about each statement. Work quickly, but be sure to think about each item.

SA: **S**trongly **A**gree A: **A**gree UND: **Und**ecided D: Disagree SD: **S**trongly Disagree

	STATEMENT	SA	A	UD	D	SD
6	Studying Mathematics has benefited my other subjects					
7	I work hard in Mathematics but cannot get good marks in examination					
8	I find most topics in Mathematics easy to understand especially geometry					
9	I find most areas in geometry strange and abstract.					
10	Geometry relate with real life.					
	The approach the teacher uses in teaching geometry					

has:					
11 Helped me to be more active in class activities.					
12 Helped me to see the logical concepts not as difficult as I though were to understand.					
13 Helped me understand the ways my teacher present Mathematics in class.					
14 Helped me to contribute and participate during Mathematics class.					
15 Helped my experience in general mathematics and a lot In geometry.					
16 Helped me to understand general mathematics better.					
17 Allows the sharing of ideas which has helped me to appreciate the significant of mathematics to my existence.					
18 Helped me to study mathematics alone after class.					
19 Helped to change my view of the mathematics concepts taught.					
20 Helped me more likely to study Mathematics at University					

APPENDIX D

LESSON PLAN IN PLANE GEOMETRY FOR EXPERIMENTAL GROUP I

Subject: Mathematics

TOPIC: Geometry

Sub-topic: Properties of Planes

Class: JSS III

Average Age: 13+

Duration: 40 Minutes

Methodology: Demonstration Method

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

(1) draw shapes figures

(2) identify properties of plane figures

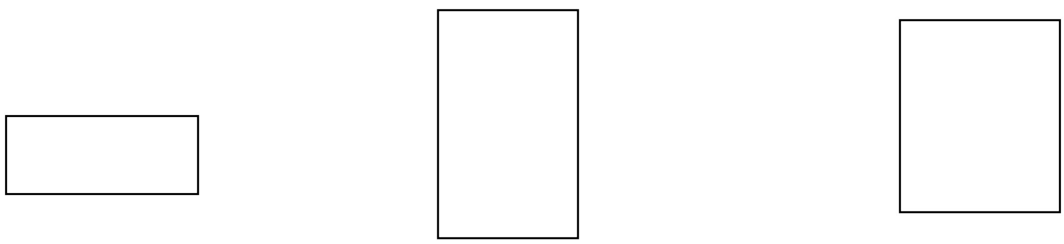
Teaching/Leaning materials: Chalk board, packets of sugar, cut of plane figures, colour chalk, card board paper and mathematical set.

Grouping: There will be five group and each group will contain a presenter, a recorder, and a facilitator, a time keeper and an encourager who will always motive and encourage team member on the stated target these will encourage cooperative learning and group work.

Background Information: Just as we have several common 3-dimensional figures, so also we have different kinds of plane figures. These are Rectangles, Squares, Circles and Triangles.

Procedure:

Activity I: Place the match box you used when treating 3-dimensional shapes on a sheet of paper. Draw round the shape of the face touching the paper. Repeat the process for the other two different faces.



Each of the shape above is a rectangle.

Activity II

Ask the students to bring their triangular pyramids. You should places your own on a sheet of paper. Trace round the space of the touching the paper. Now direct your students to do the same with their own triangular pyramids to obtain the triangle as shown in the figure below

Figure above are triangles

Activity III

Design some practical activities which will enable the students to discover the properties of a rectangle on their own. Using the groups in the class and provide each group with a ruler and protractor. Supply the students with diagrams of rectangle of various dimensions, ask each group to measure and record the measurements of both the sides and the angles of the rectangle supplied to them.

Activity IV

Go round to ask the students what they have found. Summarize their result as follows:

(1) the opposite sides are equal

(2) all the angles are right angles

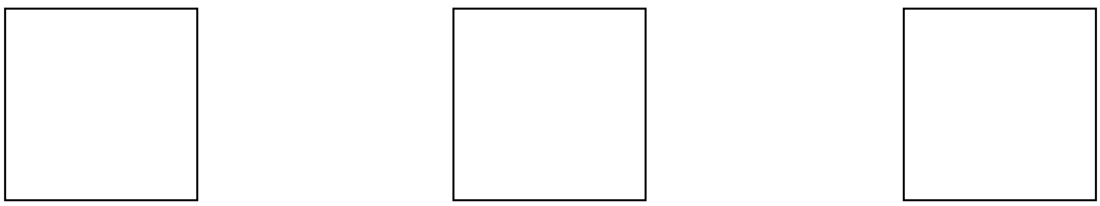
(3) the diagonals bisects one another

(4) the opposite angles are equal.

Note: Present the properties diagrammatically for better understanding.

Activity V: Drawing of a Square

Place a cube which is large enough to trace on sheet of paper. Trace the shape of the face touching the paper. Repeat the process for other sides…



Remind the students that they are to draw all the 6 faces of a cube in their note books.

Activity VI

Provide the students with cubes and ask them to trace the faces on their sheets of papers. After this, draw various squares on the chalkboard so that the students can see. Lead the students through with various types of practical activity to enable them discover the properties themselves. You can design the method like the one you did when you were finding the properties of a rectangle.

Activity VIII

Tabulate your results as follows:

1. The opposite sides are equal
2. The opposite angles are equal
3. All the sides are equal
4. All the angles are right angles
5. The diagonal bisect one another at right angle
6. The diagonal bisect the opposite angles
7. A square has four (4) axes of symmetry.

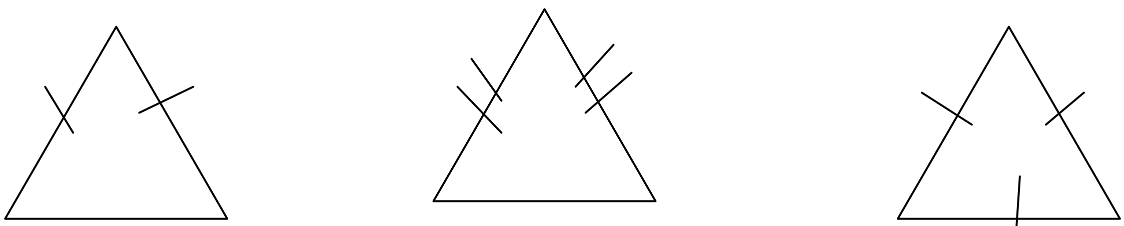
Activity IX

Triangle means three angles. A triangle has three side and three angles. In fact, it is: the simplest plane geometric shape. There are many kinds of triangles. Draw each of these groups of triangles on cardboard using a pair of compasses and cut the out.

Group I: Those with two sides equal

Group II: Those with 3 sides equal

Group III: Those with the 3 sides equal



Carry out the following on all the three types of triangles and discover lines in symmetry if any. Guide students to discover that:

(a) An isosceles triangle has

(i) one line of symmetry and (ii) base angle are equal.

(b) An equilateral triangle has

(I) all the angles equal to 60^0 (ii) three lines of symmetry

Group/individual practice:

1 How many isosceles triangles are contained in a square when the diagonals are draw? Name them.

2. Draw a rectangle ABCD sides 6cm and 9cm. Label it such that AB=9cm and AD=6cm. measure AC.

3. write down the properties of (i) a rectangle (ii) a square

Conclusion

The teacher concludes by assisting students while they are working.

(i) By checking and marking while they are working

(ii) By summarizing the important steps in properties of plane

APPENDIX E

LESSON PLAN IN GEOMETRY EXPERIMENTAL GROUP II

Subject: Mathematics

Topic: Geometry

Sub-Topic: Area and Volumes of Cuboid

Class: JSS III

Age: 13+

Duration: 40 Minutes

Rational: To enable the students draw and find areas and volumes

Methodology: Demonstration Method

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

(i) determine the areas and volumes of irregular and regular plane shapes (ii) derive the formulae for the areas and volumes of cuboids and right triangular prisms.

Teaching/learning materials: Black board, Unit cubes, hollow cubes and cuboids, locally made unit cubes, Drawing materials, Mathematical set, colour chalk, card board paper.

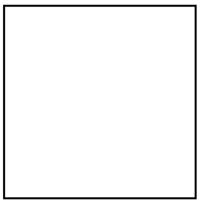
Background Information: The area of a given plane shape is the amount of space covered by the shape. This word area is so important that every country of the world respects and protects its own area of jurisdiction.

One standard unit of measuring area is $1cm^2$.

Just as area is a measure of the surface of a shape so is the volume a measure of the amount of space occupied by a 3-dimensional shape. In fact, the distinction between the two concepts is that , area deals with a plane shape which has length and breadth only but no height, whereas, volume deals with 3-dimensional shape which possess length, breadth and height.

Activity 1:

Lead the students through some practical activities in the classroom. Provide them with cut-out of squares you have prepared. Make sure they keep quite a lot with you for your own illustration. Point to the students that what each one of the is holding is called one square which like this



Activity 2: Area of Square

Provide the students with various sizes of cut- outs of square and ask them to carry out the experiment as they did before. Let them find out that the area of a square is the length x length.

Example: fine the area of square field whose length is 5cm.

Area of square= L x L

:. Area = 5 x 5 = $25cm^2$

Activity 3: Area of Triangle

The teacher demonstrates to the students that any diagonal of a rectangle divides it into two equal right-angle triangles. Present what you explain on the chalkboard for the students to see.

Area of a triangle = ½ base x height

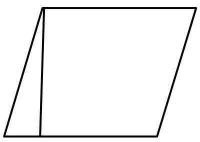
EXAMPLE: The teacher calculates the area of a triangle of height=4cm and base=5cm

Solution: Area = ½ (base x height)

Since h = 4cm and b = 5cm

Area = ½ x 4 x 5 = $10cm^2$

Activity 4: Area of Parallelogram



Area = base x height

Example : Calculate the area of the parallelogram below

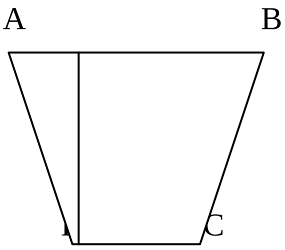
9cm

SOLUTION: The height of the parallelogram is 6cm and the base is 9cm

:. The area = 9 x 6 = $54cm^2$

Activity 4: Area of Trapezium

Draw the figure show below on the chalkboard. Show the students where the sides of a trapezium are, that is AB and DC are parallel.



Area of a Trapezium = ½(sum of parallel sides) x perpendicular distance.

Example: Calculate the area of the trapezium ABCD whose parallel sides are 4cm and 6cm respectively and whose perpendicular height is 3cm.

Solution:

Area of a Trapezium = ½ (a + b) x h

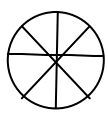
= ½ (4+6) x 3

=½ x 10 x 3 22/7

= 5 x 3 = $15cm^2$

Activity 5 : Area of a Circle

This concept can best be demonstrated through practical activity with the students. Get the students close to you in the classroom. Draw a circle of radius 6cm as shown on a piece of paper. Cut out the circle and divide it into as many equal sizes as possible.



Mention to the students that each part is called a sector.

Area of a circle = pr^2

Example: Find the area of a circle whose radius is 3½cm

Solution: Area of a circle = pr^2

Where p = 22⁄7 r = 3½

:. Area = 22⁄7 x 7⁄2 x 7⁄2

= $38.5cm^2$

Activity 6: Unit of Volume

Give every student in the class a unit cube to hold. Explain to the that what they are holding is the standard unit for measuring volumes. Draw it on the chalkboard for them to see even though they are holding it. The measurement of large volume a unit cube of edge 1 metre is used.

Volume of the cube is $1cm^3$. to convert this to cm^3 proceed as follows:

1m = 100cm

$1m^3$ = $(1 x1 x 1)m^3$

= $(100 x 100 x 100)cm^3$

= $1000000cm^3$

Example : Find the volume of a cube of sugar of length 4cm

Solution: Volume of cube = f^3 because all the sides are equal = 4 x 4 x 4

=$64cm^3$

Activity 7: Volume of Cuboid

Guide the students to carry out another activity for finding the volume of a cuboid. Since they did that of a cube this one will not be a problem.

Volume V of a cuboid = $(L x B x H)cm^3$

Example: Calculate the volume of a rectangle tank which measures 40cm x 20cm x 15cm

Solution: Volume of the tank = l x b x h

= 40 x 20 x 15

= $12000cm^3$

Example: A box 3m long by 2m wide contains $30m^3$ of air . Calculate the height of the box.

Solution: volume l x b x h

But volume = $30m^3$

$$:. 30m^3 = 3 \times 2 \times$$

$$6h = 30$$

$$h = 5m.$$

Class work/ Assignment:

i. The diameter of a tank is 28cm. what is the circumference of the base tank.

ii. Calculate the volume of a cylinder of height 14cm and radius 3cm.

iii. The height of an equilateral triangle is 15cm and its perimeter is 36cm. Find the area of the triangle?

iv. A cone with base radius 7cm has a volume of $308cm^3$. find the vertical height of the cone.

v. Two similar cardboards have area of $24cm^2$ and $150cm^2$. If the length of the bigger on is 10cm, what is the length of the smaller one?

APPENDIX F

LESSON PLAN IN GEOMETRY CONTROL GROUP I

Subject: Mathematics

Topic: Geometr*y*

Sub-topic: *Properties of Plane*

Class: *JSS III*

Age: *13+*

Duration: *40minutes*

Methodology: *Lecture Method*

Objective: *By the end of class, students should be able to:*

(i) draw shapes of plane figures

(ii) identify properties of plane figures

Previous Knowledge: *Free sketching of different line/curves*

Apparatus: *Chalkboard, construction materials, colour chalk and duster.*

Introduction: *The teacher introduce to the lesson by asking questions that are related to the students` previous knowledge.*

Presentation: The teacher present his lesson using free hand and ruler to draw and explain how to draw plane shapes.

Step II: *The teacher further explain to the students through the various properties of a rectangle, square and triangle.*

Step III: The teacher ask the students question on properties of the various plane.

Conclusion: The teacher concluded the lesson by summarizing the important step of properties of plane.

Evaluation: Students answer questions to help them remember the steps to develop the skills.

APPENDIX G

LESSON PLAN IN GEOMETRY CONTROL GROUP II

Subject: Mathematics

Topic: GEOMETRY

Sub- topics: Areas and Volumes of Cuboid

Class: JSS III

Age: 13+

Duration: 40 minutes

Methodology: Lecture Method

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

(i) determine the area of irregular and regular plane shapes.

(ii) determine the volume of some common 3-dimensinal shapes and right triangular prisms.

Previous Knowledge: Properties of plane shapes

Apparatus: Chalkboard, construction materials, colour chalk and duster.

Presentation: The lesson is presented through the following steps:

Step I: the teacher draw a square and a rectangle on the board and find the area of the planes. Area = Length x Breadth

Step II: The teacher use free hand to draw a triangle, types of triangles with reference to area of a triangle. Area =½(base x height)

Step III: The teacher first draw a parallelogram on the chalkboard and shows the students the base and the height of the figure.

Area of parallelogram = Breadth x Height

Step IV: A circle is drawn on the chalkboard and the teacher shows the students the diameter and the radius of the circle. Area of a circle = pr^2

Step V: *The teacher draw a cuboid; with measurement 40cm x 20cm x 15cm and ask the students to solve using the formula. Volume = L x B x H*

Step VI: *The teacher gets feedback from the students using questions from areas and volumes of plane and cuboids*

Conclusion: *The teacher concludes the lesson by summarizing the important steps in finding the area and volumes of planes and cuboids.*

Evaluation: *Students to answer the following question as class work/assignment.*

Assignment:

1. Calculate the area of a circular field with radius 14m

2. Write down two differences between a square and a rectangle.

3. Name one property common to all solid.

4.How many isosceles triangle are contained in a square when the diagonals are drawn? Name them.

APPENDIX H

Raw data of post test achiever scores for experimental group

38	64	52	49	58	63	69	70	73	51
48	59	61	71	39	49	62	61	64	53
55	59	70	72	82	81	59	48	60	61
44	53	57	55	57	39	38	89	81	53
74	54	58	68	66	63	62	72	79	71
48	57	53	63	62	59	72	70	71	59
81	39	48	55	63	48	48	57	69	63
66	60	52	61	88	66	73	49	73	69
59	67	61	53	59	61	73	80	58	60
56	70	62	58	44	60	38	39	60	72

APPENDIX I

Raw data of post test achiever scores for control group

47	59	43	31	52	35	29	45	32	45
39	57	39	36	25	28	31	48	34	40
23	57	42	39	46	53	37	46	53	49
28	37	53	21	30	35	47	51	41	38
36	43	48	39	47	34	42	49	37	39
53	42	49	48	42	39	51	30	32	41
22	27	18	58	47	59	33	37	52	51
31	49	54	59	46	33	27	39	46	40
24	39	53	47	29	48	51	48	29	28
32	52	33	49	42	64	56	39	42	38
36	48	38	46	39	36	29	49	40	37

APPENDIX J

Raw data of post test experimental group females

51	47	56	72	61	49	52	71	63	50
62	38	29	77	28	57	72	45	67	82
71	59	71	85	49	66	49	81	74	61
49	81	29	30	47	88	41	73	21	33
47	50	31	29	47	77				

Control group female

30	42	43	58	54	41	57	70	23	32
40	32	21	18	31	42	19	19	28	43
34	39	33	46	46	32	23	20	18	17
28	39	52	44	44	70	61	42	23	26
26	18	19	33	45	27	26			

APPENDIX K

Raw data of retention test experimental group female

57	51	43	70	38	44	71	52	58	31
22	38	51	49	49	71	69	66	69	51
47	39	47	55	47	58	33	44	49	27
61	29	39	39	43	63	69	45	49	47
29	31	50	45	49					

Control group female

31	31	29	41	32	18	27	18	27	52
61	40	30	17	38	47	52	49	49	43
34	20	30	44	30	20	19	26	61	52
18	17	42	33	33	47	37	34	20	25
19	30	17	43	19	33				

APPENDIX L

Raw data of retention test experimental group male

65	75	63	78	87	49	62	55	71	68
84	52	73	61	81	48	63	49	68	78
59	80	93	48	73	83	57	60	83	73
66	42	47	51	78	64	57	68	91	82
71	69	80	83	72	65	49	59	57	62
61	56	58	72	70	65	59	63	61	59
54	65	63	58	70	72	66	55	49	67
67	71	73	57	67	69	71	55	66	70
56	80	78	67	76	78	72	53	72	50
71	82	73	78	67	56	69	63		

Control group male

33	39	43	51	37	47	47	52	39	38
27	52	47	21	30	41	45	53	29	65
32	33	48	44	51	29	72	27	49	29
57	61	40	42	31	37	39	46	50	56
59	36	49	51	21	29	29	37	41	

APPENDIX M

Raw data of retention test score for control group

53	31	41	39	43	29	43	48	50
43	62	52	49	53	29	37	44	34
52	44	44	59	43	31	43	41	41
46	51	51	46	47	50	35	23	31
38	43	43	46	21	32	51	24	41
43	52	53	29	28	52	51	42	48
57	45	65	32	31	51	59	28	19
49	21	39	41	32	52	41	32	18
43	19	29	19	28	46	38	47	29
54	38	49	47	38	48	49		

APPENDIX N

Raw data comparing of attitude of the experimental group before the experimental

49	66	66	56	46	61	46	34	47	61
39	48	37	38	28	53	38	61	41	47
52	44	39	51	48	57	52	59	47	45
65	52	29	48	29	53	63	61	40	25
38	44	53	31	21	66	58	40	39	49
56	59	63	69	58	61	39	37	48	70
68	42	25	21	69	72	59	43	58	49
43	48	68	48	23	45	44	49	58	48
58	46	59	48	60	49	68	52	59	51
58	49	63	47	58	59				

APPENDIX O

Raw data of comparing of attitude of the experimental group after the experimental

59	70	27	63	78	69	62	68	58	49
76	59	59	75	59	69	49	71	78	65
82	88	68	59	51	69	66	70	72	68
75	65	52	49	79	74	80	63	43	58
45	53	79	63	67	39	46	63	58	59
71	67	68	23	51	66	68	58	30	59
72	94	75	65	75	57	73	74	84	64
83	69	64	81	55	72	73	68	90	85
71	61	77	58	69	53	70	62	48	57
59	53	62	74	68	56	40			