**CHAPTER ONE**

**INTRODUCTION**

This chapter focused on the background of the study, statement of the problem, purpose of the study, research questions, research hypotheses, significance of the study, delimitation of the study, limitation of the study and definition of the basic terms.

**1.1 Background of the Study**

Mathematics is an indispensable tool in human development, since it aids the study of science, humanity and technology. Its usefulness in human activities cannot be underestimated because it is the precursor of scientific discoveries and inventions (Salman, 2014). Amino (2013) as cited remarked that the prime place of mathematics in the present scientific and technological world cannot be over-emphasized. Agwagah (2014) noted that without mathematics, no nation could survive scientifically, technologically, politically and economically. Mathematics is a language that uses carefully defined terms and concise symbolic representations which add precision to communication (Obodo, 2012).

According to Kolawole and Oluwatayo (2011), Mathematics is defined as a human inventions borne out of human resolve to solve human problems. Borasi (2015) asserted that mathematics is a science that draws necessary conclusions. The summary of the overview stated points on mathematics is that mathematics provides special skills required by an individual to solve his or her day-to-day problems, communicate effectively, reason appropriately and make necessary connections. Researchers from other countries other than Nigeria also viewed mathematics as being important. For instance, Funkywizards (2013) expressed the importance of mathematics in terms of its advancement in science and our understanding of the working of the universe. This researcher also describe a mathematics in terms of its personal advancement of individual, both mentally and workplace. This implies that every individual requires mathematical skills for personal progress and in job assistance. In support of the above, the British National Curriculum (2012) asserted that mathematics equips students with uniquely powerful tools to understand and change the world. These tools they remark that include logical reasoning, problem-solving skills and the ability to think in abstract ways. Hence, mathematics is importance in everyday life in many forms of employment, science and technology, medicine and economy, the environment, development and in public decision-making. This implies that an individual needs the study and understanding of mathematics to function well as a person or in work place.

The British Career Guide (2015) and Amioo cited in Agwagah (2017) viewed the importance of mathematics in terms of its pervasive nature. They opined that mathematics is very importance in getting a variety of good jobs. The British Career Guide pointed out that employers are increasing looking for graduates with skills in reasoning and problem-solving which are the skills developed through the study of mathematics. Mathematics is also considered in terms of its inter-relatedness and inter-connectivity and its utility, the themes of mathematics includes number and numeration, algebraic processes, geometry, statistics and calculus. Among these themes, geometry is one of the themes that cut across different levels of our educational system from primary to tertiary level and also across different disciplines (Ashbacher *et al.,* 2012).

Geometry therefore should be given proper attention in terms of teaching at the foundation classes. Inspite of the importance and usefulness of geometry as a theme of mathematics and mathematics in general and emphases placed on the teaching and learning, a major problem still exists. Students’ mass failure is recorded in school certificate mathematics examinations. Many students try to avoid enrolling in mathematics courses if not that they are strictly required to do so (Agawagah 2012). Lesh cited in Agwagah (2012) affirmed that an increasing number of students seem unable to succeed in mathematics probably because the teaching approach used in teaching most of the themes are not interesting. In agreement to the above statement, Amoo documented in Agwagah (2012) noted that the traditional place of mathematics education seems to be in changer. In other words, the prime position accorded mathematics education in the society is at risk because of students’ persistent poor performance. Amoo (2012) remarked that the psychological fear in mathematics by many students leads to the perennial poor performance of students in the subject. Sokunbi (2014) equally observed that poor performance in West African Examination Council (WAEC) and National Examination Council (NECO) certificate result in mathematics may be due to improper teaching approaches by the instructors. However, poor achievement in mathematics is not perculiar in Nigeria alone, other countries suffer the same threat. In Ghana, Mensah (2016) expressed regrets about poor academic performance of candidates especially in English Language and mathematics and advised teachers to work hard and students to read more to improve on their standards. This deplorable state of mathematics achievement is attributed to a number of factors such as students inability to have mathematics reading comprehension in word, problem-solving, teachers not using practical methods like the use of models, the use of appropriate calculating devices in carrying out computational problems in mathematics (Agwagah, 2012, Ogoamaka cited in Harbor-Peters, 2015).

Poor primary school foundation in the teaching of mathematics classes in the school system, the use of unqualified mathematics in school system, lack of students interest towards mathematics leads to lack of achievement and retention (Ifeanacho 2012, Adedayo 2014, Amoo 2014 and Batiku 2014). Other reasons why students lack interest and retention and perform poorly in the mathematics are attributed to inadequate provision and the use of instructional materials, attempts to cover so many mathematics topics within a period of time, school location and sex (Amoo, 2012; Adedayo, 2014; Harbor-Peters, 2012, Efunbajo, 2017; Erinosho, 2013; Ifelumni, 2015; Harbor-Peters, 2014). Although, the above assertions were some of the reasons attributed to students’ poor achievement in mathematics, a good number of researchers laid the blame on the use of inappropriate teaching approaches which might lead to lack of interest and retention of mathematical concepts. Such researchers includes Harbour Peters (2012); Kurumeh (2014); Agwagah (2015); Iji and Habor-Peter (2012) and Ogbonna (2014, 2016). These researchers believed that in-effective teaching approaches were being adopted in the teaching of mathematics which lead to students lack of interest and subsequent poor achievement and retention. Hence, these researchers also proposed various approaches other than expository approach in the teaching of mathematics. Current studies such as Agomuoh (2017) and Ogbonna (2016) on how students learn science and mathematics in support of the above proposal reveal new ideas and instructional approaches for teaching different themes of science and mathematics. These studies indicate that one of the way of seeking solutions to the problems of teaching science and mathematics is by comparing methods so as to identify the ones that are suitable for solving different mathematical concepts. Based on this point of overview, the researcher decides to investigate if the teaching of geometry can adopt guided-discovery using science process skills, rather than the expository approach.

There are fifteen (15) science process identified by the American for the advancement of science and mathematics AAS Finley in (Vikoo, 2013). these include observation, classification, communication, comparison, measurement, use of numbers, inference, prediction, recognition and use of spatial relation, interpretation, control of variables, design of experiment and use of models. Any scientific and mathematics processes may adopt any of these skills depending on the type of investigation. Guided-discovery is one of the practical way of teaching models that requires learning by seeing, touching and doing. It encompasses set of science process skills such as observation, classification/recognition, measurement, use of models, communications (Ifeanacho 2012).

Guided-Discovery approach is an approach designed to facilitate learning through inquiry, using the appropriate science process skills. This approach was created by Chapman (2011) as a way flexibly implements inquiry-based learning in mathematics for teachers who seek for a way to support learners who are psychologically good in mathematics at school. Chapman feels that learners difficulty arise from the fact that they have not acquired the previous learning which they encountered in classroom during the cause of instruction. Chapman therefore creates the necessary problem-solving procedures (process skills) with regular reinforcement of prior learning. Guided-discovery instructional approach is characterized by convergent thinking the instructor devices series of statement or questions that guide the learners step by logical step, making a series of discoveries that lead to a single predetermined goal (Akuma, 2013).

According to Okoye (2012) and Nwagbo (2012), during the early 70’s the rational fare science teaching shifted as discoveries approach was adopted worldwide, this was because, students tended to memories facts and concepts. Okoye and Nwagbo (2012) maintained that there was a great burst of interest as the guided-discovery was adopted in Nigeria curriculum. Guided-discovery approach is an activity oriented and involves practical demonstration, discussion and experimentation during such instruction; the students employ the processes of science skills like observation, classification, investigation and critical interpretation of findings. In this approach, there is a clear definition of what the students will be expected to learn and assistance given to them where-ever they express need for it. The teacher needs to define what level of inquiry or standard of students performance to be attained in pursuing the objectives. The teacher needs to employ the science process skills relevant to the concept under discussion to teach all the students as a group. The teacher is to evaluate the students after teaching the units and match class performance with the inquiry level already (Diagnostic progress test for each unit). The teacher is to re-teach the content units, if the inquiry level for the class was not attained after the diagnostic test. After this point, the teacher should be ready to give more explanation and develop in the students a high level of motivation. This re-teaching process is used to enable those who could not attain inquiry level at the point of the diagnostic progress test; to do so, in order to encourage them complete all the content units. At the end of the teaching, comes the final assessment test (Akima, 2013).

Guided-discovery tries to help the entire student develop the appropriate skills that could enhance a proper understanding of the concept being taught. There are many benefit of adopted guided-discovery approach to the teaching of mathematics concepts by the teachers.

Some of the benefits are:

* Ability to incorporate a balance between direct instruction and inquiry based learning.
* Leads to higher level of cognitive thinking and learning
* Encourages development of higher order skills such as critical thinking, problem-solving and collaboration.
* Increase ability to think critically and solve problems
* Students may work at their own peace and demonstrate their learning in difference ways.
* Ability to incorporate many students’ interest, retention and achievement accommodation for specific goals (Obodo, 2013). Guided-discovery approach could be used to teach all the concepts of geometry because its promotes learning through problem-solving reasoning which leads to deeper mathematical understanding resulted interest, retention and achievement among the students (Obodo, 2013).

Bostock (2016) describe guided-discovery approach of teaching as a constructivist instructional design that contains principles from discovery learning with the principles of cognitive design in which learners are involved in scientific activities that lead them to discover new knowledge. Guided-discovery approach is an instructional approach that guides and motivates learners to explore information and concepts of order to construct new ideas, identify and new relationship and create new models of thinking and behaviour. It was also stated that the steps involved in guided-discovery learning include:

* Exploration: in this step, the teacher present divergent (series) of questions and assess the student by provided them with an environment for discovery.
* Invention: At this step, the teacher guide the students to fine the meaning and structure of ideas of the lesson.
* Discovery: In this step, the learner apply what was learnt at the stages of exploration and inventions to the new situations.

Scheider (2015) referred to guided-discovery as an instructional approach where students’ discovery knowledge through the guidance of the facilitator, developing their own understanding as they interact with the tools, equipment while the role of the instructor is to provide suitable learning environment and a guide.

Mossten (2014) indicated that guided-discovery is an instructional approach that encourages acquisition of practical skills, makes learning more memorable and promotes independence among learners. The approach of guided-discovery is meant to create an in depth realization of academic through personalizing learning. It is an approach of teaching and learning triggers curiosity which evaluates as a powerful motivator, engages the learners and capture their attention better than other teaching approach; the teacher becomes a facilitator who relies on the students work and success, to drive students’ learning activities. Facilitators are a guide to the “side” rather than the “sage” on the stage that typifies the conventional teaching approach. The conventional teaching approaches are used by teachers to ensure that students master concepts taught through strict learning procedures. Such conventional learning approaches include expository approach, demonstration approach, discussion approach and other approaches. In these types of approach, Kurumeh (2016) opined that learning takes place through vote memorization of concepts, rules and formulae. Kurumeh further affirmed that the conventional approach is an approach that centred on the teacher rather than the students. The teacher according to Kurumen, is more interested in seeking the correct answer to validate students learning.

Borasi (2015) exposed conventional mathematics teaching approach to be a method whereby everybody is the same for the teacher. The teacher shows the students several examples of how to solve a certain type of problem and then have them practice this method in class and in homework.

The National Research Council Battista (2012) dubbed this kind of learning produced by such instruction as “mindless mimicry mathematics” that means instead of students to understand what they are doing, they parrot and practice what they have seen and heard. Expository approach is an approach of teaching in which the students learn through memorization and recitation techniques which help the students to develop their thinking and make decision. It focuses on rote learning whereby the students sit down to listen to the teacher without or partial participation in the learning process. The students are told what they need to know causing the students to stay focused on a particular concept.

It involves presenting clear and concise information in a purposeful manner that allows the students to easily make linkage connections from one concept to the next concept (Slosson, 2017). Expository teaching approach involves the transmission of information in a single direction from one source to the students. This approach cannot activate the students’ interest and retention during the teaching learning process because there are no activities and this make learning becoming monotonous and students feel bored during the learning process (Millar and Stoeckel, 2017).

Expository learning is a teaching approach in which the teacher stands in front of the students lecturing and their students only take notes. The students are being told what they need to know as such, the teacher is termed information given, the teacher explains what to be explained after which the teacher gives the learners test that is the learner are assessed or evaluation (Riza and Servika, 2017).

Expository approach is a teaching approach in which the teacher has direct control ever what is taught and the learners are presented with the information they are to learn that is the teaching process is controlled by the teacher in that his or her information is needed by the learners to develop their knowledge about the concept being taught. This approach emphasized on the manner and way of exposing the topic or subject or content to the learners. First, the subject matter is logically sequenced and organized by the teacher for clearer understanding and easy grasping (Nwaforia, 2014).

Mangal (2019) stated that there are four (4) kinds of expository approach which include lecturing, drill work, review and concept mapping: Lecturing is a planned scheme devised and employed y the teacher to present a unit of described (desired) content material through verbal communication of ideas aimed at attaining cognitive and affective domains of the learner’s behaviour. Drill work is employed to help fix-in the minds of the students, the material they had already learnt. Review is an expository devise used to make the learning permanent through revision. Concept making entails using visual organizers that can enrich students understanding of a new concept. It organizes and represents new knowledge of the concepts or subject. Geometry is a recognized and identified concept in Nigerian Mathematics Curriculum. It is concepts that deals with shapes, angles and their properties the Mathematics Teachers National Council (2013) stressed that the major objectives of geometry instruction is to help children (learners) develop under-standing of geometric shapes, angles structures. Thus, the fundamental skills such as reasoning providing problem-solving, communication, making connection, creative and innovative thinking and inquiry can be enhanced and fostered geometry. The concept of geometry is basically classified into two broad area which are:

* Two dimensional shapes otherwise called plane shapes
* Three dimensional shapes otherwise called solid shapes

The plane shapes are called two dimensional shapes because they exhibit only two aspect which are the length and breadth while the solid shapes has length, width and breadth.

According to the Nigerian mathematics curriculum, geometry is arranged as:

* Construction
* Proof of some basic theorems
* Trigonometric ratio
* Mensuration such that perimeter, area, volumes, angles and their properties can be find.

Geometry is an important concept of mathematics that should requires practical source of instruction that leads to real life such as measurement and construction to styles of living. It is a concept if properly taught by the mathematics teachers especially the area of three dimensional shapes construction will be of great skillful acquisition for students who are psychologically good in nature thereby lead to self-independency by fetching of their own money after their secondary education and enhances interest, retention and achievement.

Interest as one of the variable in this study is a feeling somebody has when he or she wants to know or learn more about something. Interest in mathematics could be achieved when students are made to see the importance of what they are about to learn. It involves linking the new concept to be learnt to the learners’ previous experiences. Natalie (2014) defined interest as a tool used as a motivating force through learning should take place. In support of the definition, Tozard in Natalie (2014) noted that interest need special consideration in child education and remarked that the teacher cannot teach her student the same way since child (learner) interest differ.

Renninger (2013) noted that interest has a strong influence on individuals’ cognitive and affective functioning. According to Renninger, interest has been conceptual both as an individual predisposition and as a psychological state. This psychological state is characterized by focused attention, increase cognitive and affective functioning and persistent effort. The relationship between interest and learning is focused on three (3) types of interest which are:

* Individual interest
* Situational interest
* Topic interest

Individual interest is considerate to be an individual pre-disposition to attend to certain stimuli, event and objects. Situation interest is elicited by certain aspect of the environment. These include content features such as human activity or life themes and structure features such as the ways in which tasks are organised and presented. Topic interest is the level of interest triggered when a specific topic is presented. It seems to have both individual and situational interest (Ainly, Hidi and Berndorff, 2017).

Rheinberg (2018) and Schiefele (2018) remarked that, the way the three types of interest and through what processes they influence learning has not been clearly established, however, they said that new ways of accessing the processes that link interest and learning are required. Alexander as documented in Ainley *et al.,* (2017) suggested that in addition to more Standard qualitative and quantitative methodologies, the complexity of academic development in specific domains requires the creation of alternative techniques that can documented and described the nature of interest and the influence of interest on students learning. Weinten (2015) point of view stated that interest could be achieved when students are made to see the importance of what they are about to learnt.

Interest is developed when new concepts are linked to the learners previous experiences. Klimesch (2016) stated that interest has a strong role on individuals’ retentive memory functioning such that the way interest reacted and through what means the individual person received that learning domains. Spear (2016) stated that the use of models is a very useful approach for captivating students’ interest during and at the end of any learning presentation .Lieberman (2014) state that interest is an important element of getting the students’ attention to the teaching and learning processes. As such, the teachers should endavour to provide means of getting their learners mind setting.

Aliaderson (2013) remarked that mind setting is the major motive that help interest to occur among the students’ readiness to the lesson. Hence, students’ readiness to lesson through individual mindset leads to retention. Retention is the ability of an individual to remember fundamental concept. It is the way remembering take place effectively when experience are passed across the learner through an appropriate instructional approach which is capable of arousing students’ interest (Purdy and Luepruti, 2014).

Thrateriah (2016) defined retention as the ability to store fact and remember things easily. This implies that if there is no proper storage structure developed in the learners, information recalling may be marred and consequently to poor achievement. This structure is what Ausubel in Ogbonna (2017) referred to as cognitive structure which was defined as every information pertaining to one’ life experiences. Ausubel also noted that when students learn new things and relate the new ideas to what is already stored and get them organized into more complete cognitive structure, then they are engaged in more meaningful reception learning that leads to retention. This is why, the teacher must be able to make learning meaningful to the students by presenting the materials or information to be learnt in various forms.

Ogbonna (2017) remarked that students should be given an opportunities to use the information that would often enhance fast learning to enable its storage in the memory. Ogbonna opined that when this is done, the information can be easily recalled because learning is permanent as far as that idea is concerned and the students used it in various forms. Teaching and learning processes is not a difficult task when students are able to retained/retrieved that concept they have learnt that is when retention is among the factors that affect teaching and learning approaches. Retaining or retrieving what has been taught over a long period of time requires the information to be processed in such a way that the ideas is move from short-term memory to long-term memory and then fix the new ideas with what had already been to known (Bennett and Rebello 2015).

* **Previous knowledge:** This deals with what an individual had already known earlier and this often help to arouse the learners to be alert and also direct the learners to the areas that will require attention.
* **Re-presentation of Information:** This is revoking ideas from verbal to pictorial so as to recapitalize information and create multi-faceted memories that can easily be accessed.
* **Interpretive Work:** This takes place when the learners are actively engage on their thoughts in order to process information.
* **Practices at retrieval:** This occurs when generating information in different application with minimal ales using Socratic questioning to recall information promote remember**ing.** This deals with the process of trying to remember answers to questions. This enable students recalling the information when needed but selective forgetting can happen if the students were not asked to recall especially newly learned information.

Ebbinghaus (2018) defined retention as the way of storing the learnt information in the memory whether short memory or long memory such that it can be readily be used when needed but differs in the sense that for information to be viewed as retained students must be able to recalled it when appropriate in response to prompts, such as those usually found in schools and not merely in response to experimental cues. Lieberman (2014) state that the retention of the previous learned information connects to the memory of the present response to the new processed information. At the end, suggested memory and retention are inter-related in nature such that any information retained are processed and stored in the memory, therefore, an individual cannot retained information without the processes of the memory. Chunking is a useful strategy for retention of learned information. Chunking is a process of grouping together individual items of similarity and attaching a new name rather than the name of each item, associating group of items with things held in memory stores to make information more memorable and retention could be highly achieved. Another way in which information can be effectives is through VAI memory principal: Visualization, Association and Imagination. This principles combine different methods improving memory and retention in order to create one comprehensive method of engaging in successful learning. When learning new information, deeper processing of the real learning material result in more effective encoding and retrieval also matching retrieval cues. When learning new information to information that has already been encoded in the brain helps improve memory and retention (Pearie, 2014). In teaching and learning processes, interest motivated or leads to retention and this takes place within an individual perspective such that gender is considered (Paris, 2012). Gender is one of the factor that is always ague a disturbed on and how it influences the environments of group of people. Gender is a sociological and physiological characteristic that distinguish a man or a woman. It is a factor that differentiates a male from a female (WHO, 2017). Gender is also described as the differences existing between a man and a woman based on strength, mental ability and behavioural characteristics (Debath, 2016). Hyman (2017) defined gender as a state of being a male or female demoting the culturally and socially constructed differences between men and women. Gender issues as a factor or variable to this study is not get skewed to any direction. There are different findings on gender matters, some in favour of males, others in favour of females and sometimes no gender differences are found. For instance, Damarin (2015)remarked that Mathematics, Science and Technology are traditionally taught and reflected a masculine approach to the world that tends to marginalize women.

Okonkwo in Ikeazota (2015) found no significant difference on the interest and retention between male and female students in quadratic equation. This agrees with Aiyedun (2013) who also found no significant difference between male and female JS1 students’ interest and retention in Mathematics achievement scores. The study of Ifeanacho (2015) also revealed no gender differences in students’ interest and retention in Menstruation. Contrary to these findings Osafechiniti in Ogbonna (2014) ascertained that there exist a significant gender difference in favour of boys on computational problems while girls out performed boys in verbal problems. The educational aims, goals or objectives relied on the students’ achievement.

Achievement is the end product of all learning experiences (Stumm, 2012).

Stumm (2012) stated that achievement is one of the4 component of a curriculum which contained everything expected from the students at the end of any educational programmes. Achievement is the extent to which learners achieved their educational goals/objectives either in short term or long term. It is the outcomes that shows the extent to which learners have achieved learning goals (Aunuiah, 2012). Crow and Crow (2012) defined achievement as the extent to which learner is profiting from instruction in a given are of leaning. In other words, achievement is reflected by the extent to which skills and knowledge have been imparted to learners. Learners achievement specifiucally depend on the learning strategies disseminating to them. Achievement is an outcome of effectiveness of teaching and learning skills from the teachers to the students. This is so because it reflected to the extent in which the learner or instruction has achieved the educational goals (Lonieric, 2014).

Achievement is the knowledge acquires which was assessed by marks by a teacher or educational goals set by the students and teachers to be achieved/acquired over a specific period of time during schooling system (Cloniri, 2012). Runneta (2015) described achievement as the end points skills of what the students have acquired at a particular period of time which in turn assist then in future life exploration. Clokllic (2016) carried out an investigation on practical ways of teaching. Two practical ways (methods). Demonstration and guided-discovery were compared. It was observed that the students gained different practical experiences as they learnt practically because they have seen, touch and manipulate material to observe the results. It was therefore recommended that practical methods be employed in the teaching and learning.

**1.2 Statement of the Problem**

Mathematics is one of the core and compulsory subjects at the primary and secondary school levels even at the first year in tertiary educational general course.

In mathematics teaching and learning, it is important that suitable instructional approach should be used especially in the concept of practical lessons for effective acquisition of skills, retention of the concept and mastery of what is taught and learnt. Over the years, it has become a recurring situation that mathematics students keep on putting up poor achievement in the internal and external examination namely: West African School Certificate Examination (WASCE) and National Examination Council (NECO). These examination bodies are worried over the present condition of high percentage of failure in mathematics. WASCE chief examiners’ reports indicated that students’ performance in mathematics both in internal and external examination have remained consistently poor over the years (WASCE Annual Report 1998-2015). The Advocate of Education has put in the area that demands practical methods of teaching.

The continuous decline in the mathematics student’s performance in the Senior Certificate Examination (SSCE) has caused a serious concern among the mathematics teachers, school administration, stakeholders in education and researchers have made effort to identify the problem by posing the question “what is the appropriate method to be used in teaching\learning of mathematics and sciences for effective acquisition of skills and proper retention of concepts taught. This has aroused the interest of the researcher to investigate on effect of guided – discovery approach on mathematics students’ achievement and retention on the concept of geometry in Mkpat Enin Local Government Area.

**1.3 Purpose of the Study**

The purpose of this study was to explore the effect of guided-discovery approach on students’ achievement and retention on the concept of three dimensional shape.

Specifically, the purpose of this study was to:

1. Find out the effects of guided-discovery approach and expository approach on the achievement of student on three dimensional shape .
2. Find out the effects of guided-discovery approach and expository approach on students’ retention on three dimensional shapes.
3. Determine the influence of gender on student’s achievements on three dimensional shape taught using guided-discovery approach .
4. Determine the influence of gender on student’s retention on three dimensional shape taught using guided-discovery approach.
5. Determine student’s ability levels: high average and low when taught three dimensional shape using guided-discovery approach.

**1.4 Significance of the Study**

The result of the study may be beneficial to students, teachers, parents, curriculum developers, society, ministry of education as well as Government. The result of this finding may help the students to have greater scope in participating actively in classes. Since this approach of instruction involve learning by doing, observing, demonstrating and proceeding from concrete to abstract because such processes of learning thereby improving their academic achievement in mathematics. The findings may be of assistance to mathematics teachers in pointing out their strengths and weaknesses while in teaching and learning thereby make corrections where necessary. The result of the study may help enlighten the parent to take part fully in their children educational progress through the assignment that may be given at any mathematical construction after the mathematical models demonstration thereby providing, the basic necessity like money for their wards when they demand for it. The result of the study may help the curriculum developers by adopting an recommending the use of effective instructional approach that may be provided by this study: students’ achievement and retention relative to guided-discovery approach may provide a basic decision on whether to adopt the approach in our educational system or not.

The study may help the society at large to be self-employed (independent) through the skills and knowledge acquired at the mathematics models during schooling under the construction of learning materials processes for the users. The result of the study if communicated to the ministry of Education may help them to identify that effective instructional teaching approach provides better understanding of mathematics among the students’ thereby making them to employ and post professionally qualified mathematics teachers to public schools. It may also help them to understand that the use of mathematics models may enhance positive attitudes, interest, retention and achievement towards the learning of mathematics by the students therefore put into consideration, the construction of designated mathematics models with current patterns while budgeting for school establishment. The study result may help the proprietors to understand that lack of demonstration with manipulation of materials may render students’ interest, retention achievement in mathematics therefore, assist them to provide appropriate management skills or principles to both teacher and students by ensuring adequate motivation, directing communication, coordinating and planning among them. The result of the study may be of useful tool to government to make it compulsory for all mathematics teachers to attend an organized seminars, and conferences on the use of guided-discovery approach for practical based concepts.

**1.5 Research Questions**

The following research questions were used to guide the study:

1. What is the difference between the mean achievement scores of students taught three dimensional shape using guided-discovery approach and those taught by expository approach.
2. What is the difference between the mean retention scores of students taught three dimensional shape using guided-discovery approach and those taught using expository approach.
3. What is the difference between the mean achievement scores of male and female students taught three dimensional shape using guided-discovery approach.
4. What is the means retention scores of male and female students taught three dimensional shape using guided-discovery approach.
5. What is the mean achievement scores of students in ability levels, high, average and low when taught three dimensional shape using guided-discovery approach.

**1.6 Research Hypotheses**

The following hypotheses were formulated to guide the study:

1. There is no significant difference between the mean achievement scores of students taught three dimensional shape using guided-discovery approach and those taught using expository approach.
2. There is no significant difference between the mean retention scores of students taught three dimensional shape using guided-discovery approach and those taught using expository approach.
3. There is no significant difference between the mean achievement scores of male and female students taught three dimensional shape using guided-discovery approach .
4. There is no significant difference between the mean retention scores of male and female students taught three dimensional shape using guided-discovery approach.
5. There is no significant difference between the mean achievement scores of students ability level: high, medium and low when taught three dimensional shape using guided-discovery approach.

**1.7 Scope of the Study**

This study was carried out using Junior Secondary School One (JS1) Students in Mkpat Enin Local Government Area, Akwa Ibom State. This class was selected for this research because it is a foundation class where proper teaching approach is required for a sound and solid mathematical foundation. This study was restricted to the concept of geometry on three dimensional shape. The choice of the concept of three dimensional shape is based on the fact that not much study had been conducted on this area of mathematics in term of retention and achievement in Mkpat Enin Local Government Area. Evidence in the background also showed that contents in geometry were among the topics that were identified as difficult concept in Junior Secondary School mathematics for students and teachers. The topics in geometry as contained in the National mathematics curriculum for JS1 federal ministry of Education (FME, 2009) include.

1. Construction
2. Proof of basic theorems
3. Mensuration
4. Trigonometric Ratio

This study was also be delimited to guided-discovery approach, expository teaching approach, gender, retention and achievement. This study was delimited to the concept of geometry-three Dimensional shapes and constructions (paper folding).

**1.8 Limitations of the Study**

This study thereby posing accountable constrain to the generalization of the research to schools in other part of the study, this study will also be limited to two teaching approaches namely guided-discovery and expository approach. This study was also be limited to proofs of some basic theorems, trigonometric ratio and menstruation as geometry concept sub-topics.

**1.9 Assumptions of the Study**

It is assumed that geometry is taught in junior secondary one class. It is also assumed that geometry is included in Junior Secondary School (JSS) curriculum. Moreover geometry is a concept branded as difficult concept by junior secondary students.

**1.10 Operational Definition of Terms**

The following keywords were defined in the context of this research work by the researcher

* **Achievement:** This is an extent to which a learner has learned or what skills they have acquired and is usually measured through assessment like standardize test, performance assessment etc.
* **Retention:** This is the action of keeping something rather than losing it or stopping it. It is also an ability to remember things.
* **Geometry:** This is a branch of mathematics that deals with the measurement and relationship of lines, angles, surfaces and solids. It also the measurement and relationship of lines, angles, etc in a particular objects or shapes.
* **Gender:** This is the fact of being a male or female especially when considered with reference to social and cultural differences and not biological issues.
* **Concept:** This is an idea or a principle that is connected with something.
* **Guided-discovery Approach:** is an activity oriented teaching and learning approach in which students makes exploration on a particular thing.
* **Expository Approach:** is a conventional approach of teaching in which the students learn through memorization and recitation technique.

**CHAPTER TWO**

**REVIEW OF RELATED LITERATURE**

The review of related literature to this study were presented and discussed under three major sub -headings.

2.1 Theoretical Framework

2.2 Conceptual Framework

2.3 Empirical Framework

2.4 Summary of Reviewed Literature

**2.1 Theoretical Framework**

Different learning theories may be applied to a particular learning situation depending on the learners, environment and teachers as well as mode of learning. Wilson(2013), opined that teachers should capitalize on the strengths and weaknesses of each learning theory to maximize its proper utilization in every instructional approach. This study intends to focus three learning and teaching/instructional theories which are: problem-based learning theory, theory of meaningful learning and constructivist learning theory.

**2.1.1 Theory of Meaningful Learning by D. P. Ausubel (1968)**

This theory as propounded by D. P. Ausubel in 1968 states that learning is said to be meaningful. If students are able to link the pre-existence knowledge in their cognitive structure to the new materials learnt which are related to the existing information. This theory indicates that learning and assessment of what is learnt stick together and become the basis for the learners acknowledging their level of academic achievement. This theory also presuppose that the learning set when facilitated by an instructor and the facilitated effect is usually attributed to both the processing through which involves the teaching approach used and the assessment and then the product which is the academic achievements (Weisten, 2015). This theory also emphasize that the instructional approaches that are cognitive and performance–based promote meaningful learning because they demand evidences to prove high level of thinking and reasoning and the display of practical skills respectively. For meaningful leaning to take place the instructional approach or method should possess the following criteria, transparency, directness, effectiveness, fairness, completeness of the domain, description, practical value, meaningful and authentic reasoning task (Dorchy, 2015). This theory relates to this study in that it looks into how meaningful learning occurs when the teacher is the one controlling the teaching and learning process that is, while the learners are involved by asking questions and taking down notes that are relevant, the knowledge giver in the learning process is the teacher.

**2.1.2 Problem-Based Learning Theory by H. Barrows (1960)**

This theory as propounded by H. Barrows in 1960 states that complex problems encountered in the real world act as a stimulus for learning and for integrating and organizing learned and for integrating and organizing leaned information in ways that will ensure easy recall and application at to future problems. Problem-based theory emphasizes on providing students with challenges that helps to develop students ability to think critically, analyze problems, find and use appropriate learning resources. It also emphasizes that learners are progressively given more responsibility for their own education and they education (Catherine, 2016). This theory’s main focus is on how to urge learners to use high-level thinking skills which will require them on analyze, create, defend and evaluate their experiences that is, it does not focus problem-solving with a defined solution but it promotes the development of other desirable skills and attributes such as: knowledge acquisition group, collaboration and communication (Gasser).

The theory also indicates that learning should be self-motivated, less threatened for students to learn independently and also collaborative for the learners to also work in terms or group so as to develop team work spirit, and reinforce interpersonal relationship among the group members. This theory is related to this study because it shows that learning needs to be tasks-based where students are given a problem or challenges to analyze, create and from this process the students acquire knowledge and skills that they can apply in their future problems. It also reflected that learning should be such that give students opportunities to work in a collaborative setting and also to form self-directed learning habits through practice and reflection thereby promoting both self-directed motivation and interpersonal relationship among learners.

**2.1.3. Constructivist Learning Theory by Jean Piaget (1954)**

Constructivist learning theory as postulated by Jean Piaget in 1983 states that real world is constructed through understanding and experiencing things and reflecting/applying those experiences to solve problem. When doing this scientist try to reconcile the previous ideas and the experiences. In this process, questions are asked exploration is carried out and then the activities are experimented. It emphasize that constructivist teachers encourage students by allowing them to develop ideas, apply their experience and construct new inventions. Constructivism emphasizes on triggering students’ curiosity by making them to be engaged or involved in learning process as they apply their previous and existed knowledge to experimentation and bringing out conclusion while the instructor acts as a facilitator and motivator during the process (Wolf, 2015).

In the view of constructivists, learning is a constructive process in which learner build internal interpretations is continually open to modification forming the basis for their knowledge structure to be attached (Stepich and Newby 2017). This theory supports or relates to the study because it emphasizes that the instructional approaches/strategies to be used in science /mathematics teaching and learning should be such that it gives students opportunity to be engaged or involved in the learning process so as to promote acquisition of science process/practical skills.

**2.2 Conceptual Framework**

**2.2.1 Guided-discovery Approach**

Guided-discovery approach is an inquiring based learning approach which aims at boating children attainment (Chapman, 2011). This approach of teaching and learning focuses on the development and use of skills used are widely applied and employed by scientists and mathematician in solving problems involving preparation skills, questioning skills, transformation and interpretation. Inquiry employs step by step science process skills relevant to a particular area in teaching and solving problem in that area. The skills relevant to the theme “geometry” are adopted to form a model in this work includes:

1. Observation
2. Classification/identification
3. Measurement
4. Experimentation
5. Communication

The five-step model can be explained as follows:

**Step I. Observation:** This involve teaching students to acquire the skills to gather information there, the students learns and observe the objects collection based on the accurate and trained use of the senses.

**Step II. Classification/Identification:** In this step, students learn how to classify or identify objects (geometrical shapes) using sorting, grouping or ordering.

**Step III. Measurement:** In this step, the students learn how to measure the shape of any object using metre rule or any measuring instrument required.

**Step IV. Experimentation:** In this step, the students carryout their activities practically by doing, touching and manipulating of raw/materials to form or creates or construct both ideas/knowledge/structure: Example: construction of any example of three dimensional shapes.

**Step V. Communication:** Students learning information in many forms/ways such as drawing of any geometrical shapes. Example cubes, cones cylinder pyramid. Etc and construction of these three dimensional shapes.

The model can be diagrammatically presented thus:

**OBSERVATION**

**CLASSIFICATION/IDENTIFICATION**

**MEASUREMENT**

**EXPERIMENTATION**

**COMMUNICATION**

Guided-discovery as an inquiry based approach of instruction enable learners to be able to solve all other mathematical problems that are not taught in class (Joe-lins 2018).

Joe-lin (20018) opined that guided-discovery method of teaching assist students to learn that there are many different ways to learn not mainly to sit-down and listens but learning involves the ability to explore, think through an issue and reason logically to solve routine as well as non-routine problems. In addition, Joelins stated that guided discovery creates mathematical thinking and the activities builds language and social skill such as working together. The guided-discovery approach was originally designed to be individualized learning approach but due to less number of teachers with increasing number of achieve the level of inquiry required for the next topic. The students are given diagnostic test to ascertain the level of inquiry skills before moving onto more advanced levels (Karadimos, 2017).In using guided-discovery approach, teacher do not teach during the supplementary approach rather they guided and motivate (Murron, 2013).According to Murron (2013). The use of phraise is though an important part of the process, students do not progress to the next level until they are fully confident and proficient at the existing level.

Kwok (2015) found that guided-discovery has a greater emphasis on inquiry learning and less on teaching direction. This is an agreement with Lawis’s (2021) view of teaching when Lawis said that teaching is not a matter of pouring knowledge from one mind into another as one pours water from one glass into another. It is more like one candle igniting another each candle burns with its own fuel. The true teacher awakens a love for truth and beauty in the heart, not mind of a student after which the student moves forwards with powerful interest under the gentle guidance of the teacher. These kinds of teachers inspire love of mathematics. Another essential aspect of guided-discovery approach is communication (Marron, 2014). Murroon (2014) remarked that communication between students and teachers as well as the parents whether printed or nor printed also orally or nor orally a is crucial as this shows an element of devotions thereby led to the philosophy that every child has the potential to learn far beyond his or her parents expectations. It is the duty the duty of the teachers as well as educators to encourage each individual child (learner) to desire to enjoy learning and to be capable of studying whatever he or she wishes to do in the future.

Communication means talking with people and listening to them. It means findings ways to express children talks either parents teachers or friends. It helps them think about what they are doing and makes their own thoughts clearer. As a bonus, talking among children, improves their vocabulary and helps literacy and early reading skills as well. Therefore, in guided discovery method of instruction, a teacher who guides students to be able to organize interpreter information diagrammatically trains the learners to be able to communicate what they see on papers for others to see too (Murroon 2014). Gill (2018) describe guided-discovery as one of the practical activities approach of teaching that has a planned learning activity that deals with original or raw data in the act of finding solution to a problem. It involves first hand experiences with materials or facts derived from investigation or experimentation and this approach of learning forms and integral part of effective science teaching in the sense that, it encourages the students to derive various scientific laws and principles on their own as they get involved in the experimental work or activity.

Millar, (2017) describe guided-discovery approach as a teaching and learning approach that allows students use different discovery techniques in their scientific process, they develop ideas, pose questions, plan, investigate, make observations, use tools and equipment to gather information, analyzed data and make inferences. It is used on natural sciences such that concepts provided to students with practical tasks could enhance cognitive, affective and psychomotor skills development. Schneider, (2012) referred to guided-discovery as an instructional approach where students discover knowledge through the guidance of the facilitator, developing their own understanding as they interact with tools and equipment or environment while the role of the instructor is to provide suitable environment and a guide. Guided-discovery could also be called instructional learning and is characterized by convergent thinking by the learners while the instructor devices series of statement to guide the learners in logical steps as they make series of discoveries that lead to a single pre-determined goal (Okebukola, 2018). Bostock (2016) asserted that in guided-discovery approach of teaching, the teacher provide an instruction or a guide to following with a priority on making observations and gathering evidence which are done by the students so as to help them develop a deep understanding the nature of science, develop scientific attitude and acquire skills of scientific reasoning. Okoye and Nwagho (2015) indicated that guided-discovery is an activity-oriented teaching and learning approach in which students employ, observations, classification, investigation, experimentation critical interpretation of findings thus enhancing students’ practical performance in science learning

**2.2.2** **The Expository Teaching Approach**

In spite of many scientific teaching approaches recommended for teaching of mathematics achievement. The conventional teaching approach still strive in most o the secondary schools in Nigeria. (Ezeugo and Agwgah, 2012, Kurumeh, 2014). This approach have been identified to appear in effective and a major factor responsible for students’ poor achievement in mathematics. The Expository teaching approach characterized mathematics learning as that done through rote memorization of tables and formula. (Enukoha cited in Kurumen, 2014) noted that it gives little regards to the practical aspects of students’ life, has no room for in-cooperating new ideas, materials and strategies into teaching. Ernest (2014) noted that Expository approach of instructions does not help students in terms of achievement in mathematics. Assessment of learning using this approach is based on absolute which does not allow students connect the preset concept with the previous ones. This approach of teaching is highly de-emphasized and seen as inappropriate and does not seem to enhance students’ achievement and retention in mathematics.

Adebayo (2012) remarked that the teacher is faced with the teacher “teach all” policy which can neither creates rooms for students to construct their own ideas about s given concept, nor attempt to present and solve mathematical problems while exposing the concept of expository approach. Expository approach is a conventional approach of teaching in which students learn through memorization and recitation techniques and this helps students to develop their thinking abilities and decision-making skills. It focuses on role learning whereby the students sit down to listen to the teacher without or partial participation in the learning process. The students are only told what they need to know causing the student to stay focused on a particular topic. It involves presenting clear and concise information in a purposeful manner that allows the students to easily make linkage/connection from one concept to the next concept to be learnt (Slosson, 2013).

Mazur, (2017) stated that expository approach is a method of teaching in which instructors present materials (either verbal or printed form) to the learners and for the students the main activity they carry out is to take down as many notes as they can. Only few students have the ability, motivation and discipline to synthesize all the information delivered to them. This makes students to learn inactively in that they only become object and not subject during the learning processes. Oleh, (2015) saw expository teaching approach as an approach that involves the transmission of information in a single direction from the teacher as the source of knowledge to the students. One way communication path and it is dominated by the teacher’s explanation. The teacher has direct control over what is taught and the learners are presented with the information they are to learn, that is the teacher controls the students’ academic progress by managing what information is needed by the learner which they are to learn. The main emphasis of this approach is on the way of exposing the topic to the learners. The teacher first presents the subject matter logically, sequentially and in an organized pattern for easily understanding. Paris (2015) asserted that expository approach of teaching and learning is not suitable for science and mathematics teaching in that it only promotes memorization, cramming. Recitation and regurgitation of concepts instead of the manipulation of practical facilitations to acquire science skills. Paris also stated that this approach of teaching makes the students to become passive learners in that, they only sit, listen to the lesson and take notes where necessary without contribution their ideas. This leads to the learners receiving only a shallow understanding of the concepts or subject taught and learnt.

Ogananu (2015) indicated that the procedure for expository teaching approach is that the teacher begins the lesson by providing specific information and detail. This is done by arranging the lesson from general to specific, making the process to be deductive in nature. This in turn allows the students to understand the increasingly detailed explanation of the information and lick them to the previous knowledge and the next lesson ahead. The use of verbal instruction is that which dominates expository learning. Daphne (2012) indicated that expository approach is otherwise known a lecture approach it entails n oral presentation of information which could be to convey critical information history, background, theories and equation. It is mainly a one way method of information or communication that does of involves significant audience participation but relies upon passive learning. The effectiveness of expository learning approach is reflected in quick exposure to new material. Greater teacher control in the classroom clarification of learning material and facilitating large of learning material and places students in passive rather than active learners (Macasieb, 2016).

Suryabrata (2012) indicated that expository approach is such a direct explanation from the teacher to the students. Hence students’ capacity or ability is mostly listening ability which need concentration, focused understanding, linguistic, durable brain power, verification and responds to acquired information. Expository approach as a teaching approach is seen as the explanation of a topic to the students in which the teacher clarifies the content matter to the students by using feature simple devices, by change voice, changing position and facial expression. The teacher I that, there is a very little scope for learners’ by doing it does not take into consideration not help the students to develop the power of reasoning making it become monotonous to the students (Sharma, 2014).

**2.2.3 The Concept of Retention**

Azurabor (2019) defined retention as the process of maintaining availability of a replicated the acquired meaning into newly form said, retention is understood as one’s or ways of retrieving retained information from the memory.

Bennett and Rebello (2012) defined retention as having information stored in the long-term memory in such a way that it can be readily retrieved for example in response to standard prompts. Retention is to the human memory. The human memory is the process in which information and material is encoded, stored and retrieved in the brain. Retention of information is done in the memory stores therefore without human memory processes, retention of materials would not be possible. Information is retained in primary done so through active leaning repetition and recall. There are multiple of ways of improving engaging in learning. These depending on the nature of how the information was originally encoded into memory stores and whether the stored material is regularly retrieved and recalled (Spear, 2014). Retaining knowledge over a long time or team requires the information to be processed in such as way that the ideas is moved from short-term memory to long-term memory and then fix the new ideas with what had already been known. Some processes that promote retention of information are:

* Prior knowledge: This deals with what an individual had already known earlier on and this often help alert the learners and also the learners to areas that will need more attention.
* Re-presentation of Information: This entails revoking ideas from verbal to pictorial so as to re-conceptualize information and create multi-faceted memories that can easily be accessed.
* Interpretive Work: This is when learners actively engage their thoughts in order to process information.
* Practice at Retrieval: This involves generating information in different application with minimal cues using Socratic questioning to recall information promote remembering Remembering helps remembering: This deals with trying to remember answers to certain questions.

This help student’s recall the information when needed. The retention and retrieval of information in the memory require the information to be firmly embedded within a neural network through continuous repetition and connecting new information with old information. This process of repetition facilitates the process within the brain thus solidifying the connection between the short-term and the long-term for the material, learnt to be retained in the memory. When new information is learnt, the brain creates new neural pathway then; through continuous repetition of the material it is stored in the long term. Recall is to re-access previously learned information held in long-term memory stores. During this process the brain relays a specific pattern of neural activity that echoes the original perception of the events or information. Regular recalling of the stored information helps to improve memory retention. The more the material within the memory (Klimesch, 2013).

Retention is the ability to keep and remember as well as to recall or reproduce the acquired knowledge after some period of time might have elapsed it has been estimated that approximately 90% of what students learn when teaching someone else is retained, 75% of what they learn when they practice is retained 50% of what they learn when engaged in a group discussion is retained 30% of what they learn when they see demonstration of a practical concept is retained 20% of what they learned from audio-visual is retained 10% of what is learned when they learn from reading either textbooks, literature textbooks is retained and only 15% of what they learn from lecture is retained (D’ Souza, 2018).

**2.2.4 Concept of Gender**

Dee (2018) described gender as a differential attitude and behaviours between masculine and feminine groups. The masculine group is characterized as being powerful and full of strength while the feminine group is usually seen as weak vessel. Gender is also seen as the sociological and physiology characteristics that define a man or a woman. World Health Organization (WHO, 2017) indicated that gender is one of the features that incorporates patterns of behaviours, attitude and expectations associated with a particular sex either being a female or male. The differences have to do with parallel conventional stereotypes in terms of physical behaviour, styles of social interaction, academic motivation and choice. (Messener, Duncan and Cooky, 2013) Hyde. (2015). Asserted that one major difference in gender occurs in learning and education in which male and female students learn differently based on the subject and types of task/activities.

Kvara (2015) opined that gender is the differentiation of human kind into male and female as conditioned by socially learned soles, functions norms. Behaviour patterns and expectations associated with maleness and femaleness in the concrete society. Jameson (2015). Consider gender as the range of physical, mental and behavioural characteristics pertaining to the masculine or the feminine in relation to the masculinity or the femininity of an individual within a given society. The female students are better at verbalizing and verbal tasks while the male students are able to specially process information better thus have better advantage at multiple skills like motor, mental and manipulative skills, mathematical and abstract reasoning, processing, symbols and pictures and navigations and computer processing skills (Breakwell, 2013). Hornby (2015) referred to gender as a cultural and social construct that makes men different from men. Some of the highlighted construct are: The male have high social ability the females, structurally, men have muscular structure and are capable of facing different situations than females. Gender is also seen as social accused characteristics pertaining to and differentiating the males and females fin a society. It is that which define a man and a woman.

**2.2.5 Concept of Achievement**

An achievement in this study will be consider under educational perspective. Specially regarded as academic achievement. Academic achievement is the extent to which a learner has achieved either short-term or long term educational goals. It could be measured using students grades points average or by graduation. Santrock (2016) described academic achievement as what the students have learned or what skills they have acquired and it usually measured through assessment like standardize tests, performance assessment and portfolio assessment. It also make use of Cumulative Grade Point Average (CGPA).

Kyoshabia (2019) asserted that schools are established with the aim of imparting knowledge and skills to those who go through them and behind all, this is the idea of enhancing good performance because if left unchecked leads to poor academic performances among the learners. Lone (2016) saw academic achievement as the outcome of education which is reflected in the learner, teacher or instruction has achieved the educational goals. Academic achievement is the knowledge gained which is assessed by marks by a teacher and or educational goals set by the student and teachers to be achieved over a specific period of time (Narad and Abdullah, 2016). Crow and Crow (2017) described academic achievement as the extent to which learners is profiting from instruction in a given area of learning or in other reflected by the extent to which skills and knowledge have been imparted to learners. Academic achievement is seen as being wide ranging and covering a broad variety of educational and outcomes depending on the indicators, curricular based criteria like grades or performance on educational achievement test and cumulative indicators such as educational degrees and certificate. All these criteria mirror the intellectual capacity of a person. It is measured by Grade Point Average (GPA) or by standardized assessment designed for evaluation purpose and is used to determine whether a students can take part in higher education based on educational degrees the learners has acquires or attained (Stein Mayr, Weidinger, Meibner and Hirthwein, 2014).

Spinath (2012) referred to academic achievement as the performance outcomes in intellectual education, academic achievement is the most important pre-requisite for individual and societal prosperity, large scale scholastic achievement assessment provide overview of research or academic achievement, it is pointed out that school grade indicate the subject within the classroom which the students has performed better. That is the achievement of students in a given class is used as a frame of reference.

**2.3 Empirical Studies**

**2.3.1 Guided-Discovery Approach and Mathematics Students’ Achievement.**

Fort (2016) carried out a study on the effects of laboratory (practical) method of instruction on Junior Secondary School Students’ achievement in which guided-discovery approach was compared on mastery approach. The study employed quasi-experimental design. Three (3) research questions and three (3) null hypotheses were raised to guide the study. The study was conducted on four (4) Secondary Schools. In two (2) of the school intact classes of JS1 were assigned to treatment group while the other two (2) were assigned for control group. The treatment group was taught mathematics using guided-discovery approach while the control group was taught using expository teaching approach. Simple random sampling techniques was adopted in choosing the four secondary schools out which the JS1 students were selected. A total number of Two Hundred and Forty-Five (245) JS1 students were used as sample for the study. Mathematics Achievement Test (MAT) was used to collect data for the study. The data were analyzed using Mean, Standard Derivation and Analysis of Covariance (ANCOVA). The result revealed that practical approach had significant effects on students achievement in mathematics. It was recommended that, guided-discovery approach of teaching should be used to assessed students in mathematic especially in the area that require learning by doing.

Maizilwo (2013) carried out an investigation on impact of comparative and practical approaches on mathematic students’ achievement and practical proficiency in mathematic subject in selected rural schools in Ethiopia. Quasi-experimental control group interrupted time series design was employed. Data pertaining to these variables were collected from Three Hundred and Fifty-nine (359) students and Twelve (12) mathematics teachers in three (3) rural schools. A series of mathematic test and semi-structured questionnaire was used to collect data. Multi-variate analysis (two-way ANOVA) was used to anaysed the test scores exposed by teaching approaches and semi-structured questionnaire which was administered to comprehend factors that hamper the successful execution of cooperative learning. Hence, multi-variate analysis revealed that there was no significant (P>0.05) difference in the pre-test scores of the learner performance, however, there were significant difference (P<0.01) in the post-test results by teaching approaches but not by schools. The results exemplify that there was significant learning obtained via Cooperative Learning Accessing Demonstration (CLAD) followed by Cooperative Discussion Group (CDG). The results of the questionnaire survey showed that number of students, lack of practical equipment and other factors hamper consecutive execution of cooperative learning.

Lynch, Kupiers, Pyke and Szesse (2014) carried out a research on three (3) practical experiences and mathematics students’ learning. Post-test experimental design was adopted as a research design. Three (3) research questions and three (3) research hypotheses were formulated to guide the study. A sample size of Two Hundred (200) 2nd grade learners was used for the study. The instrument for data collection was continuous Assessment Test integrated Activity Checklist. Data obtained were analyses in percentages. Finding showed that over 95% of the students taught science was relevant to their lives and had high practical experiences as they actively participated in the lesson. It was concluded that, students need practical experiences for effective learning to take place.

Molla (2016) carried out and investigation on assessment of guided-discovery approach and demonstration in teaching approaches on mathematics achievement. Quasi-experimental design was adopted. A survey sample of Two Hundred (200) JS1 student in four schools was used. Three (3) research questions and three (3) research hypotheses was raised to guide the study. The instrument used to obtained data for the study was practical activity checklist. Analysis of variance (ANOVA) was used to analysed the data obtained. Result showed that there was no significant difference between the achievement of student assessed after being taught using practical approaches and those assessed after being taught using demonstration teaching approach.

Oden (2020) conducted a study on effects of guide-discovery and mathematics students achievement in Enugu North Local Government Area of Enugu State. The research design used was pre-test, post-test experimental design three (3) research questions and three (3) research hypotheses were raised for the study. The researcher used Three Hundred (300) students as the sample size. The instrument used for data collection was Practical Teachings Assessment Test (PTAT) which was developed by the researcher and the data obtained using this instrument were analysed using mean, Standard derivation and T-test statistics tools. Result showed that there was a positive effect of guided-discovery on mathematics students’ achievement.

**2.3.2 Expository Approach and Mathematics Students’ Achievement.**

Bary (2017) investigated the effects of exposing and demonstration approaches on teaching and learning among Junior Secondary Schools Students in Abia State Urban. An experimental research design was used to carry out the study. Research questions and research hypotheses were raised for the study. One Hundred and Fifty (150) JS1 students were sampled using stratified sampling techniques and used for the study. Questionnaire interviews were administered to the selected students used a mean data collection. The questionnaire was validated by expert. The reliability coefficient of 0.73 was adopted after trial testing, the questionnaire on thirty (30) students which were not part of the study. The study used t-test Pearson Product Moment Correlation (PPMC) to analysed the data obtained. Findings showed that the achievement of the students who were taught using demonstration approach was better than those taught using expository approach.

Wilder (2019) carried out a study on impact of problem-based and expository learning among Junior Secondary School Students in Kwara State. A quasi-experimental design was adopted for the study. Three (3) research questions and three (3) research hypotheses were formulated to guide the study. A sample size of One Hundred and Twenty (120) students from three (3) schools were sampled using sample random sampling techniques. The instrument for data collection was Mathematics Achievement Test. The instrument was faced and content validated and the reliability of the instrument was ascertained using tes-retest method. Data obtained were analysed using t-test and ANCOVA. Result revealed that there was a significant difference between students taught using problem-based learning and those taught using expository approach.

Jong (2017) examined the effect of expository and guided-discovery approaches on students’ achievement and attitudes towards mathematics in Illorin, Kwara State. The study adopted pure experimental research design. Three (3) research questions and three (3) research hypotheses were formulated to guide the study. A sample size of One Hundred (100) JS1 students who were sampled using random sampling techniques was used for the study. The instrument was validated by physics experts. The reliability coefficient of the instrument was obtained after using test-retest method and the reliability coefficient of 0.074 was obtained through PPMC analysis. Data obtained for the study were analysed using t-test statistics tool. Findings revealed that students taught using guided-discovery approach performed better than students taught using expository approach.

**2.3.3 Retention and Mathematics Students Achievement**

Cherney (2018) conducted a research on effects of active learning on student memory and retention level in Enugu State rural. The state adopted a survey research design and three (3) research hypotheses were raised to guide the study. A sample size of Three Hundred and Fifteen (315) students were selected and used for the study. The instrument used to measure the students level of retention was a cognitive test. Statistical tools used to analysed the data obtained were t-test, Chi-square and Analysis of Variance ( ANOVA). Findings showed that students using active learning had higher level of retention and remembering level across the introductory level and at upper level than those taught Mnemonics.

Blunt and Kar Picke (2017) examined a study on the effectiveness of using concept mapping as a retrural practical activity in mathematics learning. An experimental research design was adopted for the study. A sample size of 100 students were randomly selected and used for the study. The instrument used for data collection was given to answer assessment test which was given to two (2) groups of students two weeks after the learning session. In the study, one group were to read about mathematics topics and then creates a concept map without viewing the textbooks while the other group was to also read the topics and create the concept map with or without using the textbooks. After one week, the instrument was administered to the two (2) groups. T-test statistical tool was used to analysed the data obtained. Findings showed that student who created the concept map without textbooks had high retention ability in that they were involved in retrieved-based learning than those who were told to create the concept map with or without the textbooks. Mediavine (2016) carried out a study on different teaching approaches and long-term retention in Ilorin of Kwara State. The research design was an experimental research design four (4) research questions and four (4) research hypotheses were raised to guide the study. The sample used for the study comprised 200 students. A retention test was administered to the different groups which exposed to different teaching approaches. Data were analysed in percentages and t-test. It was observed that students exposed to discovery approach had 75% average retention level, those taught using discussion method had 50% average retention, those taught using demonstration had 30% retention level. While those taught using exposing approach had only 5% average retention level.

**2.3.4 Gender and Mathematics Students’ Achievement**

Jacobs (2016) researched on the discovery learning experiences gained and students’ gender differences in Anambra State Urban. The research design used was non-randomized quasi-experimental design. One Hundred and Fifty (150) JS1 students was used to formed the sample size. Discovery Learning Experiences Assessment Rating Scale (DLEARS) was the instrument used for data collection. The instrument was validated and reliability using test to test method. Data collected were analysed exist gender difference between the male and female students in relations to performances and the level of discovery experiences gained. Boston (2019) conducted a study on gender gap and students’ achievement in mathematics. Experimental research design was used for the study. A sample size of 150 JS2 students was adopted for the study. The instrument used for data collection were Mathematics Achievement Test and Cognitive Ability Test (CAT). Data were analysed using t-test. Findings revealed that there was performance difference between male and female students based on Self concept, Ability, Experiment and Internal motivation.

Takedia and Homberg (2020) examined effect of gender on group work and mathematics student achievement in Edo of Benin City. True experimental design was adopted for the study. Three (3) research hypotheses were developed and used for the study. The instrument for data collection was Practical Performance Rating Scale (PPRS). A sample size of Two Hundred (200) JS2 students was used for the study. The analyses were based on group performance, Data Collected were analyses using Analysis of Variance (ANOVA). Findings showed that the performance of all male groups was better than the performance of groups consisting female students.

Mealy (2014) conducted a study on gender influence and student performance in mathematics learning. Quasi-experimental research design was adopted for the study. Two (2) research questions and hypotheses were formulated to guide the study. A sample size of 150 JS1 students were used for the study. Instrument used for the study so as to collect data was Skill Acquisition Test (SAT). The instrument is validated and the reliability ensured. Data collected were analyzed using t-test statistical tool.

**2.4 Summary of Review of Related Literature**

The review of related literature was done under three broad headings; theoretical framework, conceptual framework and empirical studies. Under theoretical framework three (3) theories were reviewed which are theory of meaningful learning, problem-based learning theory and construction learning theory. Each of the Theory indicated the need for active involvement of students in the teaching and learning process. Under conceptual framework, the concept of guided-discovery approach, expository approach, retention, gender and academic achievement were reviewed. Each concept reviewed what different past scholars posited or how they described each of the concepts. For empirical studies, different research works carried out by previous researchers were reviewed under guided-discovery approach and students’ academic achievement.

In each research work reviewed, the researcher stated the design used, a sample size used for the study, the procedures taken and the findings obtained at the end .Doing, touching and manipulating of raw/material to form, create or construct both ideas, knowledge/structure. Example; construction of any example of three dimensional shapes.

**CHAPTER THREE**

**RESEARCH METHOD**

This chapter focused on the design of the study, area of study, population of study, sample and sampling technique, instrument for data collection, scoring, experiment procedures, method of data analysis, validation of instruments, reliability of instrument, decision rule and ethical issues.

**3.1 Design of the Study**

The design adopted for this study was quasi-experimental design. Specifically pre-test, post-test, non-equivalent control group designs were adopted for the study. It was considered appropriate for this study because intact classes were used for both experimental and control group. This design also allows for manipulation of independent variables which were the teaching approaches and gender so as to observe the corresponding effects on dependent variables which were retention and mathematics achievement thereby establishing cause effect relationship between the dependent and independent variables.

**3.2 Area of the study**

This study was conducted in Mkpat Enin Local Government Area of Akwa Ibom State Mkpat Enin Local Government Area is located in the south-south geopolitical Zone of Nigeria. It is located at an attitudes of approximately 185 metre (607ft) above sea level and coordinates of 040441 and 040442 North of latitude East west between longitude 7044 and 07055.Mkpat Enin Local Government Area has a land mark of 322.325 square kilometer (124.461 sqm) and it’s the second largest local Government in Akwa Ibom State .Mkpat Enin is bounded by Oruk Anam and Ikot Abasi Local Government Area to the North, Etinan and Onna on the South, Eastern Obolo on the West and part of Oruk Anam on the East. The population based on the 2006 census was 178036.This Area is rich in oil and natural gas. The oil was discovered in Ikot Akpan Ekop forest as early 1953.The forest reserves in Mkpat Enin Local Government Area are timber and palm produced .It is the Local Government which one of the campuses of Akwa Ibom State University is located. Mkpa Enin has four (4) clans and eighty-seven (87) villages. Occupationally, the people of this Local Government Area engage themselves in different activities such as farming, trading, teaching and other civil service jobs. The majority of the people from this Area relied on farming and petty trading. The researcher decided to carryout research in this area (Mkpat Enin Local Government Area) because of high rate of failure in mathematics Examination as reported by chief examiner for west African Examination Council (WASCE) in 2020.

Educationally, the local government has a total number of sixteen (16) public secondary schools and the total enrollment of students are 11,090 and 146 teachers 88 males and 58 females with ten (10) mathematics teachers. Out of the sixteen public secondary schools, one school does not have both sexes (only girls) which is Adiaha-obong secondary school Ikot Ekop, Mkpat Enin.

**3.3 Population of the Study**

The population of the study comprises all the junior secondary one (JS1) students in all the sixteen (16) public secondary schools that are co-educational in Mkpat Enin Local Area of the 2021/2022 academic session. The total enrollment of students in JS 1 were 1985 from the sixteen public secondary schools. (Local Education Committee, 2021, Mkpat Enin Branch).

**3.4 Sample and Sampling Technique**

Purposive sampling technique was used to select the sample for the study. The researcher purposively select four schools that met the criteria stated below:

1. Schools that have at least two experienced/ qualified mathematics teachers
2. Schools that run both junior and senior secondary sections
3. Schools that register candidates for JSSCE, WASCE and NECO for the past fourteen years. Two hundred (200) JSS1 students formed the sample of the study. Two schools were used for experimental group while the other two schools for control group. The Sampling frame for the study can be seen as shown below:

|  |  |  |  |
| --- | --- | --- | --- |
| **Schools** | **No. of Male** | **No. of Female** | **Total** |
| A | 26 | 25 | 51 |
| B | 24 | 28 | 52 |
| C | 23 | 24 | 47 |
| D | 24 | 26 | 50 |
|  | | | 200 |

**3.5 Instrument of the Study**

The instrument for this study includes:

1. Mathematics Achievement Test (MAT)
2. Cognitive Ability Test (CAT)

Each instrument contains two demographic information about the students while section B consist of twenty (20) objective questions with three (4) options lettered A-D and items reflected the concepts of geometry (three dimensional shapes) regarded as Mathematics Achievement Test (MAT) while the Cognitive Ability Test (CAT) was constructed such that the ability level of the students were tested. The Retention Test (MRT&CRT) were used to obtain retention scores which was the reshuffled version of the mathematics achievement test and Cognitive Ability Test.

**3.5.1. Validation of Instrument**

The instrument after being constructed by the researcher with the use of junior secondary school curriculum on the concept of Geometry under three Dimensional shapes was given to experts in the field of Mathematics education professionals in test and measurement and as well as the supervisor for validation. The instruments were given face and content validation such that the validators were given the instrument alongside with JSS Mathematics curriculum to crosscheck if the items were in line with the content of three Dimensional shapes.

Thus, in the course of validating the instrument, corrections were effected such that some questions were dropped on them hence, reducing Mathematics Achievement Test (MAT) of 25 to 20 Questions and Cognitive Ability Test (CAT) of 20 to 16 Questions before distributed to respondents. The professionals that carried out the validation process were members of university of Uyo, Uyo.

.**3.5.2 Reliability of Instrument**

In testing for the reliability of the instrument, the Cognitive Ability Test was trial tested using (30) Js1 students who possessed the characteristics of the students used for the study but were not part of the students that took part in the study. Data obtained from test-retest method were analyzed using Pearson product moment correlation (PPMC) and a reliability coefficient of 0.75 was obtained. While the Mathematics Achievement Test (MAT) was trial tested using the same (30) Js1 students that took the Cognitive Ability Test (CAT); thus, the Data obtained from test-retest method were analyzed using Pearson product moment correlation (PPMC) and reliability coefficient of 0.82 was obtained. While the Retention Test (CRT& MRT) were tested after two weeks of the research completion and Data obtained was analyzed using PPMC and reliability coefficient were obtained.

**3.5.3. Scoring of the Instrument**

The Cognitive Ability Test & Mathematics Achievement Test contained two sections: section A & B. section A contained the Demographic data while section B contained twenty (20) objectives Questions for MAT and 16- questions for CAT. Each question answered correctly was scored 1 mark while the wrong answer was scored zero (0) point.

**3.6 Experimental Procedure**

**3.6.1 Preliminary Procedure**

This research work was operated using four weeks, for the researcher to carry out the study, the four schools that met the criteria were selected and were visited. At first visitation, the researcher met the schools’ principals and declared the purpose of being in the school and obtained permission from the principals of those schools. At the next visitation, the researcher met the principals of the schools who introduced the researcher to the mathematics teachers telling them to be of assistance to the researcher. The teacher in - charge of the mathematics unit of each of the school took the researcher to the Js1 block and class where the researcher picked one of the Js1 classes to be used for the study. At the third visitation to each school selected for the study, the students in the class to be used for the study were given orientation on what the researcher had come to do. During the visitation process, the researcher chose one arm of Js1 classes of the selected school and trial tested them using the research instruments (CAT & MAT) so as to evaluate the students’ mastery of three dimensional shapes contents and affluence with the use of skills. The trial tested students did not take part during the normal presentation of lesson. Also, the researcher visited two schools per week to present each topic,. the experimental school was visited on Mondays while the control school was assigned on Wednesdays so as to carry out the same topic each week.

Finally, after two weeks of the presentation, the researcher went back to the schools used for the study and administered retention test (MRT & CRT) which were a reshuffle version of MAT & CAT. Since this study involved students’ retention so as to test the retention level of the students when using practical teaching method to teach the students may be effective. The scripts were collected by the researcher and parceled for Data Analysis.

**3.6.2 Method of Data Collection**

Before lessons began in each school, the researcher administered a pre- test in each school assigned for the study so as to evaluate students’ mastery of three Dimensional shapes. In the next visitation, students were taught the concept of three Dimensional shapes in the school assigned to be taught using Guided- Discovery Approach. For the first week, the researcher introduced content of three Dimensional Shape which was basic properties of cubes and cuboids. The researcher introduced the lesson by defining and describing the shapes of a cube and cuboid. The researcher also stated the properties of cubes and cuboids. The students were then given practical guide (shape blocks and plane sheet) to follow so as to state out practical properties of cubes and cuboids. Thus, the researcher acted as a facilitator during the students learning process. On the second week, the researcher introduced another sub-topic which was basic properties of pyramids and cones. The students were again exposed to sample of shape blocks to view and state out practical properties of pyramids and cones. On the third week, the researcher introduced another sub-topic which was basic properties of cylinder and spheres, the researcher provided the students with sample of shape blocks so as to guide the student to view and state out basic properties of cylinders and spheres. On the fourth week, researcher introduced the last sub-topics which was surface area and volume of cubes and cuboids. The researcher guides the students to determine the edges, faces and vertices of cubes and cuboids. And then derive the formula to calculate surface area and volume of cube and cuboids. Thus, the researcher acts as a facilitator while the students were calculating.

At the end of the fourth week, MAT & CAT were administered to the students used for the study. The students returned the scripts to the researcher. In the school assigned to be taught using expository method, the researcher taught the concepts of three dimensional shape to the students in the class verbally or theoretically without any practical activities for the four weeks. At the first visitation, the researcher introduced the lesson by stating the concept of three dimensional shape. At this point, the students were taught without any practical activity but the concept was verbally and chalkboard analyzed. On the first week, the researcher introduced the contents of three dimensional shape which was basic properties of cubes and cuboids. The researcher taught the students without any practical activity but only explained the concept and properties of cubes and cuboids. On the second week, the researcher introduced basic properties of pyramids and cones. The researcher only described the shapes and shown them verbally without any activities for the students to also involved in the lesson. On the third week, the researcher introduced basic properties of cylinder and spheres, the researcher only described the shapes and shown them verbally without any activity for the students to be involved in the lesson. On the fourth week, the researchers introduced surface area and volume of cubes and cuboids. The researcher also introduced and taught the students verbally with the used of chalkboard by writing down the formula used in calculating surface area and volume of cubes and cuboids.

At the end of the fourth week, MAT and CAT were administered to the students used for the study. The students answered the questions and returned the scripts to the researcher. To test retention ability of the students, after two weeks, the researcher, went back to the schools in which students were taught using Guided Discovery Approach and schools in which students were taught using Expository Approach and gave the students in the classes that were used for the study a Retention Test (MRT&CRT) which were a reshuffled version of the MAT&CAT that is the numbering and the items had been alternated to find out if the students could remember what they had learned after two weeks. The students answered the questions and returned the script to the researcher.

**3.7 Method of data Analysis**

Data collected using the instruments were analyzed with respect to the research questions posed and the hypotheses formulated for the study. Mean and Standard Deviation were used in answering the research questions while Analysis of Covariance (ANCOVA) was used to test the hypotheses formulated for the study at level of significance.

**3.8 Decision Rule**

The decision to accept or reject the hypotheses (s) stated is with reference to the p-value. If the F-value is greater than the p-value at 0.05 level of significance the hypothesis was rejected and vice versa.

**3.9 Ethical Issues**

The researcher overcomes some ethical issues or challenges by taking permission from school principals. During the study students will be given freedom to express themselves by asking questions for more clarification from the researcher. The researcher ensures that the procedures to obtain data are not physically and emotionally harmful to the students. Also the researcher endeavors to give all the students equal and similar treatment, in that, there is no favoritism. No information will be concealed from the participants, everything or procedure will be kept open for the students to be able to decide.

**CHAPTER FOUR**

**RESULT AND DISCUSSION**

This chapter discusses the results, discussion of results and summary of findings.

**4.1 Results**

The results of this research work are presented in tables in order of the research questions and hypotheses which were tested at 0.05 level of significance.

**Answering of Research Questions**

**4.1.1 Research Question One**

What is the differences between mean achievement scores of students taught 3-dimensional shapes using guided discovery approach and those taught by expository approach.

**Table 4.1: Summary of mean and standard deviation of pre-test and post test scores of students taught using Guided-Discovery Approach and those taught using Expository Approach.**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Variables | N Pre-test | | Scores | Post- test | Score | | Mean gain |
|  |  |  | SD |  | SD | Mean |  |
| Student taught using Guided-discovery approach | 75 | 32.10 | 9.52 | 83.52 | 8.35 | 41.85 |  |
|  |  |  |  |  |  |  | 6.18 |
| Student taught using Expository approach | 80 | 29.32 | 5.77 | 56.82 | 9.62 | 35.67 |  |

Data presented in the table 1 shows that post- test mean score for students taught using guided- discovery approach was 83.52 was higher than the post-test mean score of students taught using expository approach. It also showed that the Standard Deviation for the post test scores of student taught using guided discovery approach was 9.52 was high than that of expository approach in was 8.35. Also, the mean gain score of student taught using guided -discovery approach was 41.85 and was greater than that of those taught using expository approach which was 35.67. The mean gain score of post – test between students taught using guided-discovery approach and expository approach was 6.18. This implies that students taught using guided- discovery approach had better difference than those taught using expository approach.

**4.1.2 Research Questions Two**

What is the difference between the mean retention scores of students taught three-dimensional shape using guided-discovery approach and those taught using expository approach.

**Table 4.2: Summary of mean and standard deviation of retention scores of students taught three-dimensional shape using guided-discovery approach and those taught using expository approach.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variables** | N | **Retention scores**  SD | | **Mean gain** |
| Students taught using guided-discovery approach | 75 | 63.20 | 8.56 | 30.05 |
| Students taught using expository approach | 80 | 33.15 | 5.23 |  |

In table 2, result shows that the mean retention score of students taught using guided-discovery approach being 63.20 was higher than the mean retention score of students taught using expository approach being 33.15. The Standard Deviation for retention scores of students taught using guided-discovery approach being 8.56 was higher than that of those taught using expository which was 5.23. This indicated that student taught three dimensional shape using guided-discovery approach retained the concept better than those taught using expository approach.

**4.1.3 Research Questions three**

What is the difference between the mean achievement scores of male and female students taught three-dimensional shape using Guided-Discovery Approach.

**Table 4.3: Summary of mean and standard deviation of pre-test and post- test scores of male and female students taught using Guided-Discovery Approach**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Variables** | N | **Pre-test Score** | | **Post-test Scores** | **Mean Gain** | |
|  |  |  | SD |  | SD |  |
| Male students | 20 | 30.61 | 6.67 | 85.10 | 19.35 | 56.30 |
|  |  |  |  |  |  | 28.45 |
| Female students | 25 | 36.31 | 12.70 | 58.05 | 11.06 | 27.85 |

In table 3, the post-test mean score which was 85.10 for male students taught 3-Dimensional Shape using Guided-Discovery Approach was higher than the post-test mean scores of female student taught three dimensional shape using guided-discovery approach being 58.05. The Standard Deviation for post test scores of male students being 19.35 was higher than that of the female student being 11.06. Also the mean gain score of the male students being 56.30 was higher than that of their female counterpart being 27.85. The mean gain score for post test between male and female student taught three dimensional shapes using guided-discovery approach was 28.45. This therefore implies that the male students’ achievement was better than that of their female counterparts.

**Research Question Four**

**4.1.4** What is the differences between the mean retention scores of males and female students taught three dimensional shape using guided-discovery approach.

**Table 4.4: Summary of mean and standard deviation of retention scores of male and female student taught three dimensional shape using guided-discovery approach.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variables** | **N** | **Retention** | **Scores** | **Mean gain** |
|  |  |  | SD |  |
| Male students | 20 | 75.12 | 9.42 |  |
|  |  |  |  | 40.65 |
| Female students | 25 | 34.47 | 6.32 |  |

In table 4, result shows that the mean retention score, of male students being 75.12 was higher than the mean retention scores of female students which was 34.47.

The standard deviation for retention scores of male students was 9.42 was higher than that of female students being 6.32. The mean gain score on retention between males and female students taught three dimensional shape using guided-discovery approach was 40.65.

This indicated that the male students retained better than that of their female counterparts.

**4.1.5 Research Question Five**

What is the differences between the mean achievement scores of students in ability levels: high, medium and low when taught three dimensional shape using guided-discovery approach.

**Table 4.5 Summary of Mean and Standard Deviation of Students’ ability level: high average and low when taught three dimensional shape using guided-discovery approach**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Variable** | **N** | **Pre-test** | | **Post-test** | | **Mean gain** |
| High | 40 |  | SD |  | SD |  |
|  |  | 5.42 | 2.56 | 25.10 | 4.10 | 20.28 |
| Average | 85 | 7.32 | 3.10 | 16.31 | 2.90 | 8.99 |
| Low | 70 | 2.81 | 1.77 | 18.10 | 1.2 | 15.29 |

In table 5, The mean achievement scores of high, average and low ability students taught three dimensional shape using guided-discovery approach are 20.28, 8.99 and 15.29 respectively. This showed that high ability students taught three dimensional shape using guided-discovery approach had the best mean achievement score followed by low ability students and average ability students had the least mean achievement scores.

**4.2 Testing the Hypotheses**

**Hypothesis One**

There is no significant difference between the mean achievement scores students taught three dimensional shape using guided-discovery approach and those taught using expository approach.

**Table 4.6: Summary of Analysis of Covariance (ANCOVA) of Students Post test scores taught using guided-discovery approach and those taught using expository approach.**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Source | Type III sum of squares | df | Mean square | f-value | Sig. | Decision at p 105 alpha level |
| Corrected model | 2322.3319 | 2 | 1251.631 | 26.425 | .000 | S |
| Intercept | 22226.120 | 1 | 22226.120 | 352.291 | .000 | S |
| Pre-test (Covariate) | 16.455 | 1 | 16.455 | .468 | .635 | NS |
| Groups | 2395.877 | 1 | 2395.877 | 42.475 | .000 | S |
| Error | 3528.798 | 93 | 48.328 |  |  |  |
| Total | 463017.000 | 96 |  |  |  |  |
| Corrected Total | 6052.205 | 95 |  |  |  |  |

a. R squared = .362 (Adjusted R squared = .345)= significant at p .o5 alpha level

In table 6, the calculated f-value for the effect of guided-discovery approach and expository approach (treatment) at 1,95 is 48.328 while its corresponding calculated level of significance is.000. since the level of significant is less than 0.05 alpha level of significant in the decision is based. This implies that there was a significant different between mean scores of student taught three dimensional shape using guided-discovery approach and those taught using expository with this observation. Null hypothesis

**Hypothesis Two**

There is no significant differences between the mean retention scores of student taught three dimensional shape using guided-discovery approach and those taught using expository approach.

**Table 7: Summary of analysis of covariance (ANCOVA) of students retention scores taught using guided-discovery approach and those taught using expository approach with post test scores as covariate.**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Source | Types III sum of squares | df | Mean square | F -value | Sig. | Decision at p .05 alpha level |
| Corrected model | 8185. 935 | 2 | 4538.455 | 56.216 | .000 | S |
| Intercept | 1354. 926 | 1 | 1354.926 | 15.795 | .000 | S |
| Post-test (Covariant) | 43. 732 | 1 | 43.732 | .532 | .412 | NS |
| Retention groups | 5278. 132 | 1 | 5378.321 | 65.384 | .000 | S |
| Error | 6841. 785 | 93 | 72.035 |  |  |  |
| Corrected Total | 15188. 678 | 95 |  |  |  |  |

a. R squared = .462 (Adjusted R squared = .435 = significant at p) .05 level, NS= Not significant at p .05 alphal level.

In table 7, the calculated F-ratio for the effect of guided-discovery approach and Expository Approach on retention scores (treatment) at 1, 96 is 65.384 while its corresponding calculated level of significant is .000. since the corresponding calculated level of significance is less than .50 alpha level of significance in the decision is based, the null hypothesis is rejected. This indicated that there was a significant difference between retention scores of students taught three dimensional shape using guided-discovery approach and those taught using expository approach.

**Hypothesis Three**

There is no significant difference between the mean achievement scores of male and female students taught three dimensional shapes using guided-discovery approach.

**Table 8: Summary of Analysis of Covariance (ANCOVA) of male and female students post scores taught using guided-discovery approach with pre test scores as covariance**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Source | Type III  sum of squares | df | Mean square | F –value | Sig. | Decision at p .05 alpha level |
| Corrected model | 1010. 752 | 2 | 414. 327 | 13. 812 | .000 | S |
| Intercept | 8170. 417 | 1 | 8170. 417 | 265. 183 | .000 | S |
| Guided discover | 15. 412 | 1 | 15. 412 | .477 | .476 | S |
| Pre-test (Covariate) | 15.412 | 1 | 15. 412 | .477 | .476 | S |
| Gender | 887. 662 | 1 | 887.662 | 28.275 | .000 | S |
| Error | 1332. 357 | 43 | 32. 982 |  |  |  |
| Total | 258567.000 | 46 |  |  |  |  |
| Corrected Total | 2343. 213 | 45 |  |  |  |  |

a. R squared = .414 (Adjusted R squared = .375 = significant at p .05 alpha level)

In table 8, the calculate F-value for the effect of guided-discovery approach on male and female students (treatment) at 1, 43 was 32. 982 while its corresponding significance is less than .05 alpha level of significance in which the decision is based. It implies that there is a significant different between the mean scores of male and female students taught three dimensional shape using guided-discovery approach. Therefore, the null hypothesis 3 was rejected.

**Hypothesis Four**

There is no significant difference between the mean retention scores of male and female students’ taught three dimensional shapes using guided-discovery approach.

**Table 9: Summary of analysis of variance (ANCOVA) of students’ retention scores taught three dimensional shapes using guided-discovery approach with post test score as covariate.**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Source | Type III  sum of square | df. | Mean square | F-value | Sig. | Decision at p .05 alpha level |
| Corrected model | 7285. 725 | 2 | 5487. 379 | 51.125 | .000 | S |
| Intercept | 1172. 811 | 1 | 1172. 811 | 17. 992 | .000 | S |
| Post test covariate | 52. 112 | 1 | 52. 112 | .643 | .523 | NS |
| Retention group | 9785. 131 | 1 | 9785. 131 | 61.512 | .000 | S |
| Gender | 779. 442 | 1 | 779. 442 | 75.136 | .000 | S |
| Error | 8172.851 | 43 | 72. 056 |  |  |  |
| Total | 179359.000 | 46 |  |  |  |  |
| Corrected Total | 15099.812 | 45 |  |  |  |  |

a. R squared = .679 (Adjusted R squared = 672) significant at p .05 alpha level.

Result in table 9 shows that the calculated F-value for the effect of guided-discovery approach on students’ retention scores (treatment) at 1, 95 is 61. 512 while its corresponding calculated level of significance is .000. Since the corresponding calculated level of significance is less than 0.05 alpha level of significance in the decision is based. This implies that there is a significant different between the retention score of male and female students’ taught three dimensional shapes using guided-discovery approach. Therefore, the null hypothesis was rejected.

**Hypothesis Five**

There is no significant difference between the mean achievement scores of students’ ability level: High, Average and low when taught three dimensional shapes using guided-discovery approach

**Table 10: Analysis of covariance (ANCOVA) of achievement scores by ability level.**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Source | Type III  sum of squares | df | Mean square | F-value | Sig. | Decision |
| Corrected model | 443. 2879 | 2 | 147. 768 | 19. 735 | .000 |  |
| Intercept | 1335. 125 | 1 | 1335.125 | 185.557 | .000 |  |
| Pre test covariate | 93.337 | 1 | 93. 337 | 12. 500 | .000 |  |
| Ability | 162. 223 | 2 | 7. 053 |  |  |  |
| Error | 591. 907 | 93 |  |  |  |  |
| Total | 16912.000 | 96 |  |  |  |  |
| Corrected total | 856.818 | 95 |  |  |  |  |

a. R squared = .475 (Adjusted R square = 453) significant at p .05 alpha level

Result in table 10 show that the calculated p-value 0.000 less than the alpha level 0.05

Therefore, null hypothesis five is rejected. This implies that there exist a significant different between the achievement scores of high, average and low ability students’ taught three dimensional shapes using guided-discovery approach.

As regards the direction of significant, the scheffe post hoc indicates as follows.

**Table 4.11: Summary of scheffe post hoc test of students’ achievement scores by cognitive ability**

|  |  |  |  |
| --- | --- | --- | --- |
| (I) Ability level of students’ | (J) Ability level of student | Mean different (I-J) | Sig. |
| High | Average | 3.243 | .000 |
|  | Low | 2.256 | .390 |
| Average | High | -3.243 | .000 |
|  | Low | -1.256 | .015 |
| Low | High | -2.256 | .390 |
|  | Average | 2.142 | .015 |

Alpha = .05

The means for group in homogeneous subset as played in table 11 indicate that student’s of high ability retained significantly better than those of average and low ability level. The comparison between the retention scores of average and low ability students was significant; that high and low ability students’ was not signed while that of high and average was not significant.

**4.2.1 Findings of the Study**

Findings from the results are discussed in order of the hypotheses.

Findings from analyzing data, hypothesis one indicated that students taught using Guided-Discovery Approach performed better than those taught using Expository Approach.

Findings for hypothesis two showed that male students out performed than their female counter part when taught three dimensional shape using Guided-Discovery Approach.

Findings for hypothesis three indicated that students taught three dimensional shape using Guided-Discovery Approach retained more than those taught using Expository Approach.

Findings for hypothesis four showed that male students retained more than the female counterparts when taught three dimensional shape using Guided-Discovery Approach.

Findings for hypothesis five showed that students’ with high ability level performed better than the average students’ and the average student’s perform higher than the low ability students.

**4.3 Discussion of Findings**

Findings of the study are discussed according to the hypotheses.

Findings for hypothesis one indicated that students taught three dimensional shape using Guided-Discovery Approach performed better than those taught using Expository Approach.

This indication is due to the fact that students’ taught three dimensional shape using Guided-Discovery Approach out performed those taught using Expository Approach. The findings coincide with the findings of Oden (2020) who indicated that Guided-Discovery Approach had positive effect on the academic achievement of students’ taught three dimensional Shape especially using activity based learning or students’ involvement in that they are given opposite to control their learning event and utilize the available resources so as to acquire new knowledge during the process.

Findings for hypothesis two showed that students’ taught using Guided-Discovery Approach retained better than those taught using Expository Approach. This alignment with Bells (2018) who asserted that guided discovery approach allows students’ to acquire practical experiences, development significant thinking ability, increases their understanding of the complexity and ambiguity of their involvement during learning process.

Findings for hypothesis three showed that male students out performed than the female students when taught three dimensional Shape using Guided-Discovery Approach. This findings complements Hyde (2015) assertion which indicated that one major different in gender occur in learning and education in male and female students learning different based the subject and type of task/activity tasks that male students are able to spastically process information, thus, having better advantage at multiple skills acquisition than their female counterparts while the female students’ tend to show better performance when it comes to cognitive communicative and conventional learning.

Meally (2018) also indicated that male students’ were actively involved in practical classes than the female students, thus, leading to effective acquisition of science skills among the male students than the female students. Findings for hypothesis four showed that the male students’ retained more than the female students’ when taught Three Dimensional Shape using Guided-Discovery Approach. This coincide with the asserted of Kahana (2014) who stated that the ability to retained and retrieved information is related to the type of instructional approach used during the learning process, that is, those approaches of teaching that promote hand on, mind-on coordination enhances retention of information than just the using of verbal instruction strategies.

Findings for hypothesis five showed that the cognitive ability level of student wholly depend on the teaching approaches. This agrees with the assertion of Griffiths (2017) who asserted that instructional strategies used often have greater effects on the academic achievement of learners and that the utilizations of appropriate institutional approaches should be encourage among instructors.

**CHAPTER FIVE**

**SUMMARY, CONCLUSION AND RECOMMENDATION**

This chapter was discussed under summary of findings, conclusion, implications of findings, contribution to knowledge, recommendations and suggestions for further studies.

**5.1 Summary of Findings**

The research carried out was “Effect of Guided- Discovery Approach on Mathematics Students’ Achievement and Retention on the Concept of Geometry in Mkpat Enin L.G.A .Five (5) research questions and five (5) research hypotheses were raised to guide the study. The research design adopted for the study was a quasi-experimental research design, specifically, pre-test, post test, non-equivalent group design. Past research works and literatures were reviewed under the theoretical, conceptual frame work and empirical studies. A sample of two hundred (200) JS1 students were selected from four (4) coeducational public secondary schools. The instrument used for data collection were Mathematics Achievement Test (MAT), Cognitive Ability Test (CAT) and as well as Retention Test (MRT&CRT), the Mathematics Achievement Test (MAT) and CAT were validated by experts in mathematics education and Test and measurement. The reliability coefficient for MAT being 0.75 Was obtained from test -retest method while CAT reliability coefficient of 0.82 was obtained still from test -retest method and correlation of data using Pearson Product Moment Correlation (PPMC). Data obtained were analyzed using Mean and Standard Deviation to answer research questions while Analysis of Covariance (ANCOVA) was used for hypotheses testing.

Findings showed that academic achievement of students taught using guided discovery approach was better than that of those taught using Expository Approach.

Findings also showed that students’ taught using Guided-Discovery Approach performed better than those taught using Expository Approach. Findings also showed that students’ taught using Guided-Discovery Approach retained what they learned better than those taught using Expository Approach.

Findings also showed that male students’ out performed more than their female counterparts when taught using Guided-Discovery Approach. Findings also indicate that student taught using Guided-Discovery Approach retained the concept better than those taught using expository approach. Findings also showed that students’ cognitive ability level wholly depend on the teaching approaches used by the instructors, from the findings, it was recommended among others, that mathematics teachers should adopt the utilization of guided discovery approach as the instructional approach when teaching the students’ mathematics especially concept that involved practical that is hands-one mind on so as to promote acquisition of the basic science process skills.

**5.2 Conclusion**

The following conclusions were made at the end of the study:

1. There is a significant difference between the mean scores of students’ taught using Guided-Discovery Approach and those taught using Expository Approach.
2. There exist a significant difference existing between the retention scores of students’ taught using Guided-Discovery Approach and those taught using Expository Approach.
3. There exist a significant difference between the mean score of male and female students’ taught 3-Dimensional Shape using guided- discovery approach.
4. There is a significant difference existing between retention scores of male and that of their female counterparts.
5. There exist a significant difference between the mean scores of students’ ability level: high, average and low when taught 3-Dimensional Shape using Guided-Discovery Approach.

**5.3 Educational Implications of the Findings**

From the findings of the study, it implies that:

1. Instructional Approaches used in the teaching and learning of mathematics mostly, concept that needs hands- on activities do have significant effects on the academic achievement of the students.
2. The kind or type of instructional approaches used to teach concepts in mathematics have either positive or negative influence on students’ retention of the information transferred .
3. Gender is also influenced by the types of instructional approaches used during teaching and learning processes.
4. Students’ cognitive ability level depends on the types of teaching approaches used by the instructors.

**5.4 Contribution to Knowledge**

This study has made certain contributions to knowledge by alerting the instructors on the utilization of appropriate/suitable instructional approaches when teaching students’ an hands- on activities concept in mathematics and that students’ would always be actively involved in mathematics especially when learning is practically carry out.

**5.5 Recommendation**

The following recommendations were made from the study:

1. Instructors should use instructional approaches that promote hands-on & minds -on coordination and acts as facilitator giving the students’ opportunities to control their learning environment.
2. Learners should always be actively involved in science/mathematics learning as it will help them acquire the science skills for the development for science and technology .
3. Ministry of Education (State and federal level) should conduct seminars and conference to train science/mathematics teachers on the use of appropriate instructional approaches in the teaching .
4. Government should finance the building of well equipped science/mathematics laboratory in public secondary schools to help accomplish effective teaching/learning of practical concept.

**5.6 Suggestion for Further Studies**

The following suggestions were made to help other researchers carry out other researches

1. Guided- Discovery Approach should be compared with other practical based approaches.
2. Effects of practical based approaches on students’ interest should be carried out.
3. Students’ achievement of the same gender from different schools when taught using guided- discovery approach should be carried out/compared.

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**APPENDIX I**

**TABLE BLUE PRINT ON THE CONCEPT OF THREE DIMENSIONAL SHAPE**

**OBJECTIVE LEVELS**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **S/N** | **Learning Content** | **Knowledge 35%** | **Comprehension 35%** | **Application 30%** | **Total 100%** |
| 1. | Properties of cubes and cuboids (20%) | 1 | 1 | 1 | 3 |
| 2. | Properties of pyramids and cones (25%) | 2 | 2 | 2 | 6 |
| 3. | Properties of cylinders and spheres (15%) | 1 | 1 | 1 | 3 |
| 4. | Surface Area and Volume of Cubes and cuboids (40%) | 3 | 3 | 2 | 8 |
| Total | 100% | 7 | 7 | 6 | 20 |

**APPENDIX II**

**UNIT LESSON PLAN FOR JS1 MATHEMATICS GEOMETRY SECOND TERM, WEEK FOUR**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Lesson** | **Sub-topics** | **Performance objective** | **Content** | **Teacher activities** | **Student activities** | **Teaching materials** | **Evaluation** |
| Geometry | The solid shapes | Students will able to:   1. Identify the properties of cube and cuboids. 2. Identify the properties of pyramids and cones 3. Identify the properties of cylinders and spheres 4. Find the surface area and volume of cubes, cuboids and cylinder | 1. Basic properties of cubes and cuboids. 2. Basic properties of pyramids and cones 3. Basic properties of cylinders and spheres 4. Surface area and volume of cubes and cuboids | 1. The teacher asks students to bring cubes and cuboids to the class. 2. The teacher leads students to discover the properties of cubes and cuboids 3. The teacher asks students to bring biro cover (cone) and shapes of cones and pyramids. 4. The teacher guides students to determine the edges, faces and vertices of pyramids and cone. 5. The teacher will lead the students to appreciate that trigonometric ratios can be use in finding lengths and distances. 6. The teacher guides students to discover the properties of cylinders and spheres. 7. The teacher leads students to derive the formula for finding the volume of a cube and cubcid. 8. The teacher guides students to use the formula to calculate the volume of a cube and cuboids. | 1. Student discover the number of faces, edges and vertices of cubes and cuboids and that cubes have equal faces while opposite faces of a cuboids and equal. 2. Students determine the number of edges, faces and vertices of pyramids and cones. 3. Students discover the properties of cylinders and sphere . 4. Students derived the formula for finding the volume of a cube and cuboids. 5. The students use the formula to calculate the surface area and volume of cube and cuboids. | Shape blocks and ruler. | Student to:   1. Identify the number of faces and vertices of the given cube. 2. Identify the number of edges and faces of a cuboids. 3. Identify the number of faces, edges and vertices of a given pyramid and cone. 4. Identify the properties of a given cylinder and sphere. 5. Find the surface area and volume of a given cube, cuboids and cylinders. |

**APPENDIX III**

**LESSON NOTE FOR EXPERIMENTAL GROUP USING**

**GUIDED–DISCOVERY APPROACH**

**Week 1**

**Subject:** Mathematics

**Class:** Jss1

**Topic:** Geometry

**Sub-Topic:** Three Dimensional Shapes

**Lesson 1:** Basic properties of cubes & cuboids

**Duration:**  40 Minute

**Gender:**  Mixed

**Instructional Materials:** Sample of Shapes Blocks and plane sheet paper,

**Behavioral objectives:** During and at the end of the lesson, the students should be able to:

1. Describe cubes and cuboids shapes
2. State the basic properties of cubes and cuboids
3. Construct cube and cuboids using paper folding method

**Previous knowledge:** The students have learnt 2-dimensional shapes.

**Introduction:** The researcher introduced the lesson briefly by stating the meaning of 3- dimensional shape with examples

**Presentation:** The researcher presented the lesson using the steps below:

|  |  |  |
| --- | --- | --- |
| Content | Researcher’s Activities | Student’s Activities |
| Description of cubes and cuboids | The researcher enquired from the students to mention any Three Dimensional objects they observed after brief description thus, cubes has square shapes for all its faces while cuboids has rectangles. The researcher explained intensively by stating features of cubes & cuboids such as faces edges and vertices by showing them | The students responded by mentioning object that are 3-Dimensional shape such as, pen cover, carton; Maggi cubes, water tanks, buckets, Milo tin, etc with the feedback gotten from the researcher. |
| Properties of cubes | The researcher leads the students to discover the properties of cubes and cuboids by using the concrete materials given to them.  Thus: properties of cubes: all its faces are square shapes. | The students were able to discover number of faces, edges & vertices of cubes ;and that cubes have equal faces while opposite faces of cuboids are equal. |
| It has 6 squared / equal faces  It has 12 straight equal in length  It has 8 corners/vertices |
| Properties of cuboids | The researcher guided the students to identify various properties of a cuboids using the concrete materials given to them; The properties are ;  It has 6 rectangular shaped faces  It has 12 edges or lines  It has 8 corners or vertices | The students discover that opposite faces of cuboids are equal and illustrated experimentally as guided by the researcher. |
| Construction of cubes and cuboids using paper folding method | Researcher guided/supervised the students to construct cubes and cuboids using paper folding method after brief illustration. | The students constructed cubes and cuboids using plane sheet as was illustrated by the researcher |

**Evaluation:** The researcher asked the students questions as stated below:

1. Mention any real life object of cube & cuboid
2. State the properties of
3. Cube
4. Cuboid

3. Which other material can be used to construct a cube and cuboid.

**Summary:** The researcher summarizes the lesson briefly by stating out the vital point of the lesson to the students.

**Conclusion:** The lesson was concluded by the researcher after making corrections for students in the above evaluation.

**Assignment:** construct a cube and cuboid using an empty carton

**LESSON NOTES FOR EXPERIMENTAL GROUP USING**

**GUIDED-DISCOVERY APPROACH**

**Week 2**

**Subject:** Mathematics

**Class:** Jss1

**Topic:** Geometry

**Sub-Topic:** Three Dimensional Shape

**Lesson 2:** Basic properties of pyramids & Cones

**Gender:** Mixed

**Duration:** 40 minutes

**Instructional Materials:** Sample of Shapes Blocks and plane sheet paper.

**Behavioral Objectives:** During and at the end of the lesson, the students should be able to:

i. Identify the properties of a pyramid

ii. State the properties of a cone

iii Construct pyramids and cones

**Previous knowledge:** The students have learnt 2-dimensional shapes.

**Introduction:** The researcher introduced the lesson briefly by stating the meaning of 3- dimensional shape with examples

**Presentation:** The researcher presented the lesson using the steps below:

|  |  |  |
| --- | --- | --- |
| Content | Researcher’s Activities | Student’s Activities |
| Description of Pyramid | Researcher described the shape of pyramid to the students using concrete materials. It has four difference bases, namely:   1. squared base pyramid 2. triangular base pyramid 3. a rectangular based pyramid 4. a hexagonal based pyramid | The students carefully viewed the shapes as was showed to them by the researcher |
| Description of a cone | The researcher described the shape of a cone by showing them the shape blocks of a cone |
| Properties of pyramid | the researcher guided the students to identify various properties of pyramid using concrete materials given to the as follows:   1. square base pyramid: it has 5 faces, the 4 sided faces, the 4-sided faces are triangular while the base face is a square   it has 8 straight edges   1. A triangular based pyramid   it has 4 triangular shapes  it has 4 vertices  it has 6 straight edges   1. A rectangular based pyramid   it has 5 faces  it has 5 vertices  it has 8 straight edges   1. Hexagonal based pyramid   it has 7 faces  it has 7 vertices  it has 12 straight edges | The student discovered the properties of pyramid and illustrated experimentally as guided by the researcher. |
| Properties of a cone | The researcher guided the students to identify various properties of a cone using the concrete materials given to them as follows: A cone has a circular base and slanting sides and pointed at the other end or at the top called its vertices. It properties are:  It has two faces, one curved & the other circular.  It has a curved edge  It has one corner or vertex. | The students state various properties of a cone and illustrated especially as guided by the researcher. |
| Construction of pyramid and cone | The researcher guided the students to construct pyramid and cone using paper folding method after brief illustration using plane sheet | The students constructed the pyramid & cones as was illustrated by the researcher using plane sheet |

**Evaluation:** The researcher evaluated the students after the lesson with the following questions.

1. Mention four types of pyramid and their properties
2. State three properties of a cone

Thus, the students responded as was given to them by the researcher.

**Conclusion:** The lesson was concluded by the researcher after making correction for students on the above evaluation.

**Assignment:** Construct a cone and pyramid using cardboard paper.

**LESSON NOTES FOR EXPERIMENTAL GROUP USING GUIDED-DISCOVERY APPROACH**

**Week 3**

**Subject:** Mathematics

**Class:** Jss1

**Topic:** Geometry

**Sub-Topic:** Three Dimensional Shape

**Lesson 3:** Basic properties of Cylinder & Spheres

**Gender:** Mixed

**Duration:** 40 minutes

**Instructional Materials:** Sample of Shapes Blocks and plane sheet paper.

**Behavioral Objectives:** During and at the end of the lesson, the students should be able to:

i. Identify the properties of a cylinder

ii. State the properties of a sphere

iii Construct a cylinder and sphere

**Previous knowledge:** The students have learnt 2-dimensional shapes.

**Introduction:** The researcher introduced the lesson briefly by stating the meaning of 3- dimensional shape with examples

**Presentation:** The researcher presented the lesson using the steps below:

|  |  |  |
| --- | --- | --- |
| Content | Researcher’s Activities | Student’s Activities |
| Description of a cylinder | The researcher described the shape of a cylinder to students by showing them sample of it: thus.  It is a shape with 2 circular ends & a long curved side | The students carefully observed the researcher. |
| Description of sphere | Described the shape of a sphere to the students by showing them sample of a sphere.  It is a perfectly round shape, example; ball, egg, etc. |
| Properties of a cylinder | Guides the students to discover/identify the properties of a cylinder as stated below:  It has 3 faces, 2 circular and 1 curved  It has no vertices or corners.  It is made of one rectangle & 2 circles | Identify the number of faces& edges & discovered that cylinder has no vertices. the std identify various properties of cylinder and illustrated epically as guided by the researcher. |
| Properties of spheres | The researcher guided the students to identify various properties of a sphere using the concrete materials given to them. As:  It has one circular face  It has no corner or vertex | The students stated various properties of a sphere and illustrated experimentally as guided by the researcher |
| Construction of a cylinder & sphere | The researcher constructed the shape of a cylinder & sphere to the students using paper folding method | The students constructed the shapes of cylinder and sphere as was illustrated by the researcher using plane sheet |

**Evaluation:** The researcher evaluated the students after the lesson with the following question.

1. Mention 3 properties of a cylinder
2. State two properties of a sphere

Thus: the students responded as was given to them by researcher

**Conclusion:** The researcher concluded the lesson after making corrections for the student on the above evaluation.

**Assignment:** construct a cylinder and sphere using plane sheet

**LESSON NOTES FOR EXPERIMENTAL GROUP USING GUIDED-DISCOVERY APPROACH**

**Week 4**

**Subject:** Mathematics

**Class:** Js 1

**Topic:** Geometry

**Lesson 4:** Surface Area and Volume of a cube & cuboids

**Gender:** Mixed

**Duration:** 40 minutes

**Instructional Materials:** Sample of Shapes Blocks and plane sheet paper.

**Behavioral Objectives:** During and at the end of the lesson, \students should be able to:

1. Determine the surface area and volume of a cube
2. Determine the surface are and volume of a cuboids

**Previous knowledge:** The student have learnt properties of cubes and cuboids

**Introduction:** The researcher introduced the lesson briefly by asking the students to state the properties of a cube & cuboid

**Presentation:** The researcher presented the lesson as shown below

|  |  |  |
| --- | --- | --- |
| Contents | Researcher’s Activities | Student’s Activities |
| Surface Area and volume of cube | The researcher guided the students to discover the formula for surface area and volume of a cube as shown: let ‘a’ represent length, breadth and height of the cube, so the area of each face = a2 And since a cube has 6 faces we have.  Total surface of a cube = 6 (side)2 =6a2  Lateral surface Area = 4 (side)2 =a2  Volume of a cube = (side)3 =a3 | The students carefully observed the researcher on the chalkboard  Thus:  The students discover the  formula of a cube as guided by the researcher |
| Worked example | The researcher gave a problem of a cube to solve by applying the formula they discover as follow: |  |
|  | Example 1 :find the surface area of a cube having its sides equal to 9cm in length.  Let the length be a, and a is given as 9  Surface Area = 6a2  Where a =9, we have 6 × 92 =  729 cm2  thus, the researcher gave another problem of a cube to the students to solve by applying the formula they discovered.  Example 2: cube has a length of 8cm, calculate the surface area and volume of the cube . | The students solved the problem by applying the formula they discovered    The students applied the formula in solving the problem  The students solved the problem by applying the formula they discovered  let length be a and a = 9 surface area = 6a2  6×92 = 6×81 = 486cm2  Volume of cube =1×b× h = a×a×a = a3 =93 = 729cm3 |
| Surface Area and volume of a cuboid | The researchers guided the students to discover the formula of finding surface area and volume of cuboids as shown: A cuboid with length, l; (width) breadth, b and height, h  . The total surface area = 2 (L × B + breath × height+ length × height)  Lateral surface Area = Length + Breadth × Height  Diagonal of a cuboid = | The students discovered the formula of cuboids as illustrated by the researcher |
| Worked example | The researcher solved an problem using the formula.  The problem implies: if the length, breadth and height of a cuboid are 7cm, 3cm and 5cm. then find its total surface area.  Solution:  Given: length, L = 7cm, Breadth, b = 3cm and Height, h = 5cm  Total surface Area = 2 (Lb+bh+Lh)  2(7×3+3×7+5)  2(21+9+35) 2(65)=130cm2 | The student carefully observed the researcher |
|  | The researcher gave the students their problem to solve by themselves  Thus: The length, breadth and height of a cuboid are 7cm, 3cm, and 5cm then find its volume | The student solved the by applying the formula they discovered  working:  Given: Length, L + 7cm, Breadth, b + 3cm and Height, h + 5cm  Volume of cuboid = L×b×h  7×3×5 = 105cm3 |

**Evaluation:** The researcher evaluated the students after the lesson with the following questions;

1. If the length, width and height of a cuboids are 6am 2am and 4cm. find the surface area and volume of a cuboids.
2. If the side of length of the cube is 8cm, then find the surface area volume of a cube

**Thus:** the students responded as was solved to them by the researcher.

**Conclusion:** The researcher concluded the lesson after making corrections on the evaluation.

**APPENDIX IV**

**LESSON NOTES FOR CONTROL GROUP USING EXPOSITORY LEARNING APPROACH**

**Week 1**

**Subject:** Mathematics

**Class:** J.S.1

**Topic:** Geometry

**Sub-topic** Three Dimensional Shape

**Gender:** Mixed

**Lesson1:** Basic Properties of cubes and cubes

**Duration:** 40 minutes

**Instructional Materials:** Chart showing three dimensional shapes and shape blocks

**Behavioural Objectives:** During and at the end of the lesson ,the students should be able to:

1. Describe a cubes and cuboid
2. Identify the properties of cube
3. State the properties of cuboid
4. Construct the shape of cube and cuboid using plane sheet

**Entry Behaviour:** The students have learnt 2 – Dimensional objects such as square

Introduction: The researcher introduced the lesson briefly by stating out the definition of three Dimensional shapes with Examples.

**Presentation:** The researcher presented the lesson using the steps below:

**Step 1:** Description of cubes and cuboids

The researcher tested the students previous knowledge by asking them questions to identify solid shapes in their environment after brief explanation. Thus, described to them, how the shapes of cubes and cuboids look like and mentions the examples to them. The researcher then described to them intensively the physical structure of cubes cuboids around them. The students responded by mentioning the objects that are examples of cubes and cuboids.

**Step I1: Properties of Cubes**

**Researcher’s Activity:**  The researcher stated the properties of cubes to the understanding and hearing of the students as follows.

1. All it faces are square shapes
2. It has 6 squared/equal faces
3. It has 12 straight edges equal in length
4. It has 8 corners/vertices

**Student’s Activity:** The students listen attentively as the researcher stated out and explained the various properties of cube and they responded by reciting after the researcher.

**Step III: Properties of cuboids**

**Researcher’s Activity:**  The researcher stated out and explained the properties of cuboid to the hearing and understanding of the students as follows:

1. It is a solid which has rectangles for all its faces
2. It has 6 rectangular shaped faces
3. It has 12 edges or lines
4. It has 8 corners or vertices

**Student Activity:** The students listen attentively as the researcher explained the properties of a cuboid and they responded by reciting after the researcher.

**Step 1V: Construction of Cubes and Cuboid using Plane Sheet**

The researcher illustrated to the students how cubes and cuboids can be make using plane sheet paper.

**Evaluation:** The researcher evaluated the students after the lesson with the following questions.

1. Name 3 real life object of cubes and cuboids
2. State 3 properties of a cube
3. Mention 3 properties of a cuboid

**Student’s Activity:** The students responded as was given to them by the researcher in the class.

**Conclusion:** The researcher concluded the lesson after making corrections with the students on the questions.

Assignment: Construct a cube and cuboid using an empty carton

**LESSON NOTES FOR CONTROL GROUP USING EXPOSITORY LEARNING APPROACH**

**Week 2**

**Subject:** Mathematics

**Class:** J.S.1

**Topic:** Geometry

**Sub-topic** Three Dimensional Shape

**Gender:** Mixed

**Lesson 2:** Basic Properties of Pyramids and cones

**Duration:** 40 minutes

**Instructional Materials:** Chart showing three dimensional shapes and shape blocks

**Behavioural Objectives:** During and at the end of the lesson, the students should be able to:

1. Describe and identify the properties of pyramids
2. Describe and state the properties of cones
3. Construct the shape of pyramid and cones using paper folding method.

Previous Knowledge –The students have learnt basic properties of cubes and cuboids.

**Introduction:**  The researcher introduced the lesson briefly by asking the student questions based on the concept of three dimensional shapes .

**Presentation:** The researcher presented the lesson using the steps below:

**Step I:** Description of pyramids and cones.

**Researcher’s Activity:** The researcher described to the students that, a pyramid is a solid shape with a triangular, square, rectangular base and sloping sides meeting at one vertex called the apex. Also, It has four basic types, namely:

1. Square base pyramid
2. Rectangular based pyramid
3. Triangular based pyramid
4. Hexagonal based pyramid

**Students Activity:**  The students listen attentively as the researcher described the shapes of pyramid and its types to them.

**Step II:** Propertied of pyramid

**Researcher’s Activity:** The researcher stated out and wrote down the properties of pyramid on the chalkboard according to its types.

**Properties of Square Based Pyramid.**

1. It has 5 faces, the 4 – sided faces are triangular while the base face is a square.
2. It has 5 vertices
3. It has 8 straight edges

**Properties of Triangular Pyramid**

1. It has 4 triangular shapes
2. It has 4 vertices
3. It has 6 straight edges

**Properties of Rectangular Pyramid**

1. It has 5 faces
2. It has 5 vertices
3. It has 8 straight edges

**Properties of Hexagonal Pyramid**

1. It has 7 faces
2. It has 7 vertices
3. It has 12 straight edges

**Student’s Activity :**  The students listen attentively as the researcher explained and wrote down each types of pyramid with its properties.

**Step III:** **Description of a Cone**

**Researcher’s Activity:** The researcher described to the student how a cone look like by showing them too. Also, stated out its definition thus: A cone is a solid shape which usually has a circular base and slating sides and pointed at the other end or at the top Called its vertices.

**Student’s Activity:** The students listen attentively as the researcher described the shape (cone) to them.

**Step Iv: Properties of a Cone**

**Researcher’s Activity:**  The researcher stated out and wrote down the properties of a cone. Thus:

1. It has two faces, one curved and the other circular A it has a curved edge
2. It has one corner or vertex.

**Student’s Activity:**  The students listen attentively as the researcher stated out the shape (cone) properties.

**Step V: Construction of a pyramid and cone.**

**Evaluation:** The researcher evaluated the students after the lesson with the following questions:

1. Mention four types of pyramid with at least two each
2. Mention three properties of a cone

**Students Activity:** The students responded as was given to them by the researcher.

**Conclusion:** The researcher concluded the lesson after brief summary and correction making of the evaluation.

Assignment: Construct a cone and pyramid using cardboard paper

**LESSON NOTES FOR CONTROL GROUP USING EXPOSITORY LEARNING APPROACH**

**Week 3**

**Subject:** Mathematics

**Class:** J.S.1

**Topic:** Geometry

**Sub-topic** Three Dimensional Shape

**Gender:** Mixed

**Lesson 3:** Basic Properties of Cylinder and Spheres

**Duration:** 40 minutes

**Instructional Materials:** Chart showing three dimensional shapes and shape blocks

**Behavioural Objectives:**  During and at the end of the lesson, the student should be able to:

1. Describe and identify the properties of a cylinder
2. Describe and identify the properties of a sphere
3. Construct a cylinder and sphere using paper folding method

**Entry Behaviour:** The student have learnt the Properties of pyramid and cone.

**Introduction:** The researcher introduced the lesson briefly by revising the previous lesson.

**Presentation:** The researcher presented the lesson using the steps below:

**Step I:**  Description of a Cylinder

**Researcher’s Activity:** The researcher described the physical outlook of a Cylinder to the student. Hence, A cylinder is a solid shape with 2 circular ends and a long curved side with Examples:

**Students Activity:** The student listens attentively and involved in mentioning the excamples of a cylinder with the researcher.

**Step II:** Properties of a Cylinder

**Researcher’s Activity:** The researcher stated out and wrote down the properties of a cylinder. Thus:

**The Properties of a Cylinder are:**

1. It has 3 faces, 2 circular and 1 curved
2. It has no vertices are corners
3. It is made of one rectangles and 2 circles

**Student’s Activity:**  The student listens attentively as the researcher stated out the properties of a cylinder and responded by reciting after the researcher.

**Step III:** Description of a Sphere

**Researcher’s Activity:** The researcher described to the student the physical outlook of the shape (sphere) with examples. Thus: A sphere is a solid shape with a perfectly round shape. Examples. ball, egg, etc.

**Student’s Activity:**  The students listen attentively and responded by mentioning other examples of a sphere.

**Step IV:** Properties of a Sphere

The researcher stated out and wrote down the properties of a sphere. Thus:

1. Sphere has one circular face
2. It has no corner or vertices
3. It has no straight lines or edges

**Student’s Activity:**  The student responded by reciting after the researcher.

**Step V:** Construction of cylinders and spheres.

The researcher illustrated to the student how cylinder and sphere can be make or formed using paper folding method.

**Student’s Activity:** The student attentively observed what the researcher was showing them.

**Evaluation:** The researcher evaluated the lesson by asking the students the following questions.

1. Mention 4 properties of a cylinder
2. Mention 3 properties of a sphere

**Student’s Activity:**  The student responded as was given to them by the researcher.

**Conclusion:**  From the feedback gotten from the student in evaluation, the lesson was concluded by the researcher with the summary of the entire topic.

Assignment: Construct a cylinder and sphere using plane sheet paper.

**LESSON NOTES FOR CONTROL GROUP USING EXPOSITORY LEARNING APPROACH**

**Week 4**

**Subject:** Mathematics

**Class:** J.S.1

**Topic:** Geometry

**Sub-topic** Three Dimensional Shape

**Gender:** Mixed

**Lesson 4:** Surface Area and Volume of a cube and cuboids

**Duration:** 40 minutes

**Instructional Materials:** Chart showing three dimensional shapes and shape blocks

**Bahavioual Objectives:** During and at the end of the lesson, the students should be able to:

1. Determine the surface area and volume of a cube
2. Determine the surface area and volume of a cuboid

**Previous Knowledge:** The students have learnt properties of cubes and cuboids.

**Introduction:** The researcher introduced the lesson briefly by asking student questions on the previous knowledge and then introduced the present lesson.

**Presentation:** The researcher presented the lesson using the steps below:

**Step I :** Surface Area and Volume of a cube

**Researcher’s Activity**: The researcher explained and wrote down the formula for surface Area and volume of a cube to the understanding of the student as shown below:

Total Surface Area of a Cube = 6(Sides) 2

Lateral Surface Area = 4(Side) 2

Volume of Cube = (Side)3

**Student Activity:**  The student observed attentively and writes down the formula in their exercise book.

**Researcher’s Activity:** The researcher solved problems on the lesson to the understanding of the students. Thus; Worked Example: Find the surface Area of a cube having its sides equal to 9cm Length.

**Working:** Given, Length “a” = 9cm

Surface Area of Cube = 6a2

6 x 92  92 = 81, 6 x 81 486cm2

**Example:** A cube has a length of 9cm, Calculate its surface area Length of the diagonals and volume of the cube.

**Solution:** Surface area 6a2 6 x 92 = 92 = 81, 6 x 81 486cm2

Volume of cube a3

a 9, (9)3  = 729cm3

**Student’s Activity:**  The students carefully observed the researcher solving the problem on the chalkboard.

**Step II:**  Surface Area and Volume of Cuboid.

**Researcher’s Activity:**  The researcher explained the formula of the surface area and volume of a cuboid to the understanding of the student as stated below:

Total surface area = 2 (length x Breadth + Breadth x Height + L x H)

Lateral Surface area = 2 height (L x B)

Volume of cuboid = L x B x H

Diagonal of cuboid =

**Student’s Activity:**  The students carefully observed the researcher.

**Researcher’s Activity:** The researcher wrote down problem to be solved on the board as stated below:

**Worked Example 1:**  If the length, breadth and height of a cuboid are 7cm, 3c, and 5cm. Then find its total surface area?

**Working 1:**

Given: Length, L 7cm, Breadth, B 3cm and Height, H 5cm

Total surface area = 2(1b + bh + 1b) 2 (7x3 + 3 x 3 + 7x 5) binding

2 (21 + 9 + 35)

2 (65)

130cm2

**Researcher’s Activity:** The researcher gave the student their own problem to solve using the formular:

**Students Activity:** If the Length, Breadth and Height of a cuboid are 7cm, 3cm and 5cm. then find its volume.

**Working 2:**

**Student Activity:**  The student solve the problem as was shown

Given, L = 7cm , B = 3cm and H = 5cm

Volume of cuboid = L x B H 7 x 3 x 5 105cm3

Therefore, The volume of cuboid = 105cm3

**Evaluation:**  the researcher evaluated the student after the lesson with the following questions.

1. If the length, width and height of a cuboid are 6cm, 2cm, and 4cm. Find its surface area and volume
2. If the side length of a cube is 8cm. Find the surface area and volume of a cube.

**Students Activity:**  The student responded as was done during the lesson.

**Conclusion:** From the feedback gotten from the students on the evaluation, the lesson was concluded by researcher with a briefly summary of the entire topic

**APPENDIX V**

**MATHEMATICS ACHIEVEMENT TEST (MAT)**

Name of school:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Students Serial Number:**\_\_\_\_\_\_\_\_\_\_\_**

**Gender:** Male:Female: **Time:** 40 Minutes

**Instruction:** Choose the correct option.

1. Which solid figure would this net make? (a) Cube (b) Cone (c) Cuboids (d)sphhere

2. How many faces does a rectangular pyramid have? (a) 4 (b) 5 (c) 6 (d)8

3. How many faces does a triangular pyramid have? (a) 5 (b) 4 (c) 3 (d)6

4. How many edges does a rectangular pyramid have? (a) 12 (b) 8 (c) 6 (d)5

5. Which two dimensional shape would be created by slicing this cone vertically through the

apex (a) circle (b) triangle (c) ellipse (d)no correct option

6. Which 3 dimensional shape has 5 vertices? (a) Triangular prism (b) Square pyramid

(c) Triangular pyramid (d)spheres

7. Which types of three-dimensional figures have no vertices? (a) Cylinders and spheres

(b) Circles and cones (c) Cylinders and pyramids (d) c and a

8. How many squares would a net of a cube have? (a) 4 (b) 6 (c) 8 (d) 10

9. What 2 dimensional shape would be created by slicing this cylinder horizontally?

(a) Square (b) Circle (c) Rectangle (d) Triangle

10. A triangular prism is made up of (a) Two rectangles and two triangles (b) Three

triangles and two rectangles (c) Two triangles and three rectangles (d) one square a triangle

11. How many flat surfaces does the cylinder have? (a) 1 (b) 2 (c) 0 (d) none

12. A Christmas present is being wrapped before the holidays. The box is 13 inches wide, 9 inches tall and 17 inches long. What is the surface area of the box? (a) 982 square inches (b) 442 square inches (c) 676 square inches (d) 76cm

13. What is the total surface area of a rectangular prism that is 6 feet wide, 4 feet high, and 7 feet long? (a) 168 square feet (b) 188 square feet (c) 98 square feet (d) 17sq

14. How many edges does a rectangular pyramid have? (a) 12 (b) 6 (c) 8 (d)16

15. Find the surface area of a cube where e = 3cm. (a) 54 cm 3 (b) 57 cm 3 (c) 540 cm (d) 40cm

16. A square pyramid is sliced parallel to its base and the top removed. When viewed from the top, what two-dimensional shape would be seen? (a) Square (b) Triangle (c) Trapezoid (d)pyramid itself

16. Surface area of solid can be measured with its unit as? (a) CM (b) Kg (c)Km (d)sq

17. Each face of a cuboid is in the shape of a? (a)Triangle (b) Rectangle (c) Square (d)circle

18. Egg is a real life object of which of the shape below: (a) sphere (b) Ball (c) solids (d) plane

19. Ball is an example of Three Dimensional shapes as a real life object of ? (a) circle (b)cone (c) plane shapes. (d)no correct option

20. How many vertices and edges does a cube has? (a) 4 vertices and 6edges (b) 6 vertices and 12 edges (c) 6 edges and 6 vertices (d) 8 vertices and 6 edges

**APPENDIX IX**

**MARKING SCHEME FOR (MAT)**

1. C

2. B

3. D

4. C

5. A

6. B

7. C

8. B

9. A

10. B

11. C

12. A

13. B

14. A

15. A

16. D

17. A

18 C

19. B

20. C

**APPENDIX VI**

**INSTRUMENT 2**

**Cognitive Ability Test (CAT)**

Name of school:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Students Serial Number: **\_\_\_\_\_\_\_\_\_\_\_**

**Gender: Male: Female:**  **Time:** 40 Minutes

**Instruction:** Choose the correct option.

3

12

366

9

8

72

Sample:

find the values missing:

50

5

9.

10

5

A. 12 B. 10 C. 5 D. 11 A. 15 B. 5 C. 10 D. 0

9

4

16

4

10.



A . 13 B. 5 C. 36 D. 14 A. 12 B. 20 C. 18 D. 4

7

63

5

30

11.

A. 54. B. 9 C. 70 D. 0 A. 6 B. 30 C. 5 D. 35

2

26

12.

2

9



A. 28 B. 24 C. 13 D. 9 A. 11 B. 7 C. 18 D. 17

3

27

13.

1. 4 12

A. 16 B. 8 C. 3 D. 48 A. 24 B. 9 C. 30 D. 33

84

12

14.

66

1. 6

A. 72 B. 60 C. 10 D. 11 A. 12 B. 80 C.72 D. 64

15.

8

64

8

42

16.

A. 6 B. 35 C. 49 D. 8 A. 8 B. 72 C. 56 D. 7

**APPENDIX VII**

**MARKING SCHEME FOR (CAT)**

1. A

2. C

3. A

4. A

5. A

6. A

7. B

8. A

9. B

10. C

11. B

12. A

13. B

14. A

15. C

16. B

**APPENDIX VIII**

**MATHEMATICS RETENTION TEST (MRT)**

Name of school:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Students Serial Number:**\_\_\_\_\_\_\_\_\_\_\_**

**Gender:** Male:Female: **Time:** 40 Minutes

**Instruction:** Choose the correct option.

1. Find the surface area of a cube where e = 3cm. (a) 54 cm 3 (b) 57 cm 3 (c) 540 cm 2

2. A square pyramid is sliced parallel to its base and the top removed. When viewed from the top, what two-dimensional shape would be seen? (a) Square (b) Triangle (c) Trapezoid

3. How many squares would a net of a cube have? (a) 4 (b) 6 (c) 8 (d) 10

4. What 2 dimensional shape would be created by slicing this cylinder horizontally? (a) Square (b) Circle (c) Rectangle

5. A triangular prism is made up of (a) Two rectangles and two triangles (b) Three

triangles and two rectangles (c) Two triangles and three rectangles

6. How many flat surfaces does the cylinder have? (a) 1 (b) 2 (c) 0

7. A Christmas present is being wrapped before the holidays. The box is 13 inches wide, 9 inches tall and 17 inches long. What is the surface area of the box? (a) 982 square inches (b) 442 square inches (c) 676 square inches

8. How many faces does a rectangular pyramid have? (a) 4 (b) 5 (c) 6

9. How many faces does a triangular pyramid have? (a) 5 (b) 4 (c) 3

10. How many edges does a rectangular pyramid have? (a) 12 (b) 8 (c) 6

11. Which solid figure would this net make? (a) Cube (b) Cone (c) Cuboids

12 Which two dimensional shape would be created by slicing this cone vertically through the apex (a) circle (b) triangle (c) ellipse

13. Which 3 dimensional shape has 5 vertices? (a) Triangular prism (b) Square pyramid

(c) Triangular pyramid

14. Which types of three-dimensional figures have no vertices? (a) Cylinders and spheres

(b) Circles and cones (c) Cylinders and pyramids

15. What is the total surface area of a rectangular prism that is 6 feet wide, 4 feet high, and 7 feet long? (a) 168 square feet (b) 188 square feet (c) 98 square feet

16. How many edges does a rectangular pyramid have? (a) 12 (b) 6 (c) 8

17. Ball is an example of Three Dimensional shapes as a real life object of ? (a) circle (b)cone (c) plane shapes. (d)no correct option

18. Each face of a cuboid is in the shape of a? (a)Triangle (b) Rectangle (c) Square (d)circle

19. How many vertices and edges does a cube has? (a) 4 vertices and 6edges (b) 6 vertices and 12 edges (c) 6 edges and 6 vertices (d) 8 vertices and 6 edges

20. Egg is a real life object of which of the shape below: (a) sphere (b) Ball (c) solids (d) plane

**APPENDIX IX**

**MARKING SCHEME FOR (MRT)**

1. C

2. B

3. A

4. C

5. A

6. B

7. C

8. B

9. A

10. B

11. A

12. A

13. A

14. A

15. A

16. B

17. A

18 C

19. B

20. D

**APPENDIX X**

**COGNITIVE RETENTION TEST (CRT)**

Name of school:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Students Serial Number: **\_\_\_\_\_\_\_\_\_\_\_**

**Gender: Male: Female:**  **Time:** 40 Minutes

**Instruction:** Choose the correct option.

3

12

366

9

8

72

Sample:

find the values missing

3

27

8.

1. 4 12

A. 16 B. 8 C. 3 D. 48 A. 24 B. 9 C. 30 D. 33

84

12

9.

66

2. 6

A. 72 B. 60 C. 10 D. 11 A. 12 B. 80 C.72 D. 64

3.

8

64

8

42

10.

A. 6 B. 35 C. 49 D. 8 A. 8 B. 72 C. 56 D. 7

50

5

11.

10

5

4.

A. 12 B. 10 C. 5 D. 11 A. 15 B. 5 C. 10 D. 0

9

4

16

4

12.

5.

A . 13 B. 5 C. 36 D. 14 A. 12 B. 20 C. 18 D. 4

7

63

5

30

13.

6.

A. 54. B. 9 C. 70 D. 0 A. 6 B. 30 C. 5 D. 35

2

26

16.

2

9

15.

A. 28 B. 24 C. 13 D. 9 A. 11 B. 7 C. 18 D. 17

**APPENDIX XI**

**MARKING SCHEME FOR CRT**

1. A

2. C

3. A

4. A

5. A

6. A

7. B

8. A

9. B

10. C

11. B

12. A

13. B

14. A

15. C

16. B