EFFECTS OF GEOMETRICAL INSTRUCTIONAL MODELS ON MATHEMATICS STUDENTS ACHIEVEMENT AND RETENTION IN SELECTED JUNIOR SECONDARY SCHOOLS IN MINNA, NIGER STATE.

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ABSTRACT

This study examined the effects of geometrical instructional models on mathematics students achievement and retention in selected junior secondary school in Minna, Niger State. The study adopted a quasi-experimental design. Two Junior Secondary Schools were randomly selected for the study in Bosso Local government Area of Niger State. The population of the study consisted of JSSII students in the two secondary schools randomly selected from the local government area. A total of 60 students composed the sample of the study. Two research instruments namely Mathematics Geometrical Instructional model (MGIM) and Geometrical Instructional Video (GIV) on Mathematics. The MAT was used for the study. The data generated from the study were analyzed using mean and standard deviation for answering the three research questions, while analysis of covariance (ANCOVA) was used to test all the three hypotheses at 0.05 significant levels. The result from the data analyzed showed that the use of geometrical instructional video as an instruction method was a significant factor in students' overall achievement, as those exposed to the use of GIV performed better than their counterparts who were taught using conventional instruction method.

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CHAPTER ONE

1.0 INTRODUCTION

1.1 Background of Study

Mathematics is the science that deals with the logic of shape, quantity and arrangement. Mathematics is all around us, in everything we do. It is the building block for everything in our daily lives, including mobile devices, computers, software, architecture (ancient and modern), art, money, engineering and even sports.

Since the beginning of recorded history, mathematical discovery has been at the forefront of every civilized society, and math has been used by even the most primitive and earliest cultures. The need for math arose because of the increasingly complex demands from societies around the world, which requires more advanced mathematical solutions, as outlined by mathematician Raymond L. Wilder in his book "Evolution of Mathematical Concept" *(Dover Publications, 2013)*. It has become the central intellectual discipline of all technological societies and it is Indispensable in helping the individual to think more clearly about the values involved in this fast changing world *(Abimbade & Udousor 1997).*

In spite of the importance and popularity of mathematics among Nigerian students, performance at junior secondary school level had been poor *(Iwendi, 2012; NECO, 2012).* Correspondingly, the observed poor performance in mathematics has been a serious concern to all well-being educators. Student poor performance in mathematics over the years has been attributed to the fact that the subject is difficult. In the same view students' performance in mathematics tests has been observed to vary from person to person and from school to school. Nigerian students' achievement in junior secondary school mathematics has been relatively low over the years *(Agwagah, 2000; Obodo, 2004; Osemwinyen, 2008; WAEC, 2011; & Gimba, 2013).*

However, the performance of student in mathematics at junior secondary schools has become a great source of concern to the society. *(Awokoya (1975), Funfunwa (1980))* agreed in different researches that we live in a world where science and technology has become an integral part of the world culture, therefore for any nation to be relevant, it must not overlook the importance of mathematics in her educational system. According to *(Ajagun 2000)* the performance of students in junior secondary science in Nigeria has remain an issue of concern to all stakeholders.

There are different branches of mathematics namely (algebra, analysis, arithmetic, combinatorics, Euclidean and non-Euclidean geometries, game theory, number theory, numerical analysis, optimization, probability, set theory, statistics, topology, and trigonometry) and some of these branches are more difficult for teachers to teach and students to learn than others. The basic geometry at junior secondary level serves as a background for understanding all branches of geometry at higher level. Research findings have confirmed that geometry is one of the topics among the abstract and complex aspects of mathematics, which students find difficult to learn, and some teachers find difficult to teach without the use of instructional materials *(Akinlade, 2004 & WAEC, 2011).*

Teaching and learning materials (instructional material) such as mathematical models have potentials in the concepts such as geometry *(Gambari & Gana, 2005). Abimbade (1997)* concluded that instructional models enhance visual imagery, stimulates learning and assists the teacher to properly convey the topic content to the learner, in order to achieve better understanding and performance.

With the analysis of empirical studies on instructional models, *(Shih, Kuo and Liu 2012)* developed and evaluated the instructional model and learning system and found that the model enhanced mathematical achievement. *(Aboderin 1997)* found that the use of

Pythagoras model for mathematics instruction had positive effect on students' achievement. *(Joshua 2007)* reported that using geometrical globe model for teaching mathematics at junior secondary schools enhanced students' performance and retention.

Retention is the ability to remember fundamental concepts rather than "just" facts. It is on the basis of the above results that it was indicated by *(Kurumeh, Onah, and Mohammed 2012)* that incorrect, insufficient and restricted teaching strategy employed by mathematics teachers is responsible for learners' inability to comprehend and recollect the rudimentary mathematical principles and logical facts. In view of this, *(Iji, 2005)* added that man is gifted with restricted ability for memorizing, therefore, to properly and efficiently apply all that was learnt, retention must have to play an important role. However, *(Osemmwinyen, 2009)* found that students' interests and retention could be aroused and retained through the use of an appropriate instructional media like e-learning. *(Bottge, Rueda, Serlin, Hung, Kwon 2007)* found that students with learning disabilities retained what they had learned in mathematics several weeks after instruction, when exposed to Enhanced Anchored Instruction (EAI).

Typically, the pertinence of geometry and subsequent difficulties experienced by students at junior secondary schools in Nigeria made a study on it very relevant. On these bases, this study examined the effectiveness of geometrical instructional model on mathematical student's achievement and retention in selected junior secondary school in Minna.

Several research have linked gender difficulties with student performance in academic tasks, but no definitive conclusion has been reached. Male students outperformed female students in science in some studies (Njoku, 2000), while female students outperformed male students in others (Anagbogu & Ezeliora, 2007). Bello (1990), Nsofor (2006), Yaki (2006), and Olowe (2010) did not find any form of influence being exerted by gender on students' academic performance in the sciences. Spencer (2004) showed no significant impact of gender on college students' mathematics achievement when they were exposed to online and traditional mathematics courseware. Iwendi, (2009) discovered no disparities in male and female performance in senior positions. Contrary to these reports, Kuruma (2004) and Gimba (2006) found that female students outperformed male students while exposed to geometry, mensuration and 3-dimensional mathematics instructional materials respectively.

1.2 Statement of the Research Problem

To bring about improvement in the teaching of geometry in mathematics, research is needed which will provide classroom teachers with more information as to how children learn geometry every day. The problem under consideration in this study is to investigate a particular spatial ability that of teaching basic solid figures, by the use of models, and to determine what relationship exists between this ability and achievement.

Since the implementation of the Junior Secondary School Certificate Examination (JSCE) by the National Policy on Education which was intended to improve achievement of learners, especially in sciences, such as Mathematics, our recent experiences from JSCE results so far have shown that, we have failed to achieve this goal. And this is due to many factors; such as students negative attitudes due to fear of the subject, which can be attributed to the negative attitude of teachers, due to inappropriate teaching methods, especially while dealing with some complex topics or concepts.

Basic Solids in learning complex topics in mathematics. It is against this backdrop that the researcher intends to find out the effectiveness of one of the methods of using Models, as instructional materials in teaching Basic Solids shapes, in mathematics.

1.3 Aim and Objective of Study

The aim and objective of this study is to investigate the effectiveness of geometrical instructional model on mathematical student achievement and retention of selected junior secondary schools in minna. Specifically, the study examined the:

i. Effectiveness of geometrical instructional models (GIM) and traditional teaching method (TTM) on students' post-test and retention test.
ii. To determine the effect of gender difference when taught with geometrical model.

1.4 Research Questions

i. What is the mean achievement scores of students taught geometrical instructional models (GIM) and those taught with traditional method (TM).
ii. What is the mean retention scores of students taught geometrical models and those taught with traditional method.
iii. What is the difference between boys and girls achievement when taught with geometrical models?

1.5 Research Hypotheses

In order to carry out these research, the following null hypotheses will be tested at 0.05 level of significance.

i. There is no significant difference in the mean achievement scores of students exposed to geometrical models and traditional method.
ii. There is no significant difference in the mean retention scores of geometry students taught with geometrical models and traditional method
iii. There is no significant difference in the mean achievement scores of male and female students taught with geometrical models.

1.6 Significance of Study

This research will provide an insight to the effectiveness of geometrical instructional model on mathematical student achievement and retention in selected junior secondary school in Minna Niger state. This research outcome will be of benefit to the following :-

Student :- It will broaden their knowledge and easy understanding in construction process that is, houses and buildings are built in different geometric shapes to give a new look as well as to provide proper ventilation inside the house. It makes learning more real, practical and gives it more meaning, it also improves their achievement and retention of the information or instruction given to them by the teacher.

Teacher :- The research will be of great importance because it will help in making teaching more efficient and effective. It will help to understand the need of the use of instructional material or model in teaching various geometry concept in mathematics. It makes teaching more real and practical. It also save time and energy to properly teach the concept through discussion, demonstration and even lecture method.

Course Developer :- This study will help course developer to see the effect of improvisation on students since information and instruction bare physical and practical to learners. It will also create the knowledge of usefulness and the use of improvisation as an effective and efficient instructional tools.

Ministry of Education :- This study will help ministry of education to understand how important in the distribution of resources to schools

Government :- This study will help government to give good attention in providing funds to schools to procure the needed infrastructure and facilities, and also makes money available to fund education.

Researcher :- The researcher hopes that results of this study will be useful to future researchers with interest in examining further on this topic. This should lead to the generation of new ideas for the better implementation of geometry and learning process.

1.7 Scope and limitation of study

This study was limited to selected junior secondary school in Minna. It is limited to the effect of geometrical instructional model on mathematical student's achievement and retention. The study was specifically sought to determine the geometrical competencies in selected junior secondary school in Minna, Niger State, Nigeria.

1.8 Definition of terms

i. **Instructional materials**: also known as teaching/learning materials (TLM), are any collection of materials including animate and inanimate objects and human and non-human resources that a teacher may use in teaching and learning situations to help achieve desired learning objectives.

ii. **Geometry**: the branch of mathematics concerned with the properties and relations of points, lines, surfaces, solids, and higher dimensional analogues.

iii. **Instructional Model**: Instructional Models are guidelines or sets of strategies on which the approaches to teaching by instructors are based

iv. **Retention:** this is the process of transferring new information into long-term memory. This means you've effectively taken in the information and are able to recall it in the future.

CHAPTER TWO

2.0 RELATED LITERATURE REVIEWED

2.1 Conceptual framework

2.1.1 Concept of Geometry Modeling

Geometry is the mathematical study of shapes and patterns. Geometry is a branch of mathematics that deals with shapes, sizes, positions, angles, and dimensions. It helps you understand how objects stay upright you need to understand the height, length, area, depth, and volume and visualize its respective features. Introducing basic geometry to students, it means you are introducing shapes, patterns, and analysis to very young minds, as well as setting the foundation for many years of growth and development in junior and senior secondary schools. Imaging teaching geometry using animation, models, and displacing some of the cut-out shapes, it increase motivation and built instant development in retention.

According to Chinese proverb that say; what you hear, you forget, but what you see you remember. At the basic level either in primary or junior secondary school, students need to be taught shapes at the visual level, which means they should be able to visualize a shape in their mind, recognize it when they see it, draw a reasonable representation, and know their names such as circle, rectangle, square, cone, cylinder and many more. Furthermore, as an instructor trying to introduce relational analysis in which students are beginning to understand how shapes can be related to and compared to one another and you really want them to understand that shapes can be above, below, behind, in front and how groups of them might look like in relation to each other. In other words, you want to introduce patterns, or the ways that shapes, numbers, and other symbols can be meaningfully arranged, and the fundamental reasoning, which means if one thing is true, what else must be true and one thing is true or will not be true. Apart from these, you want the student to begin to solve problem, as it relates to shapes and patterns. All these strategies for meeting these objectives should involve several areas of student's minds (prior Knowledge or learner experience) because this reinforces their memory connections as they are learning. As a rule of reinforcement, impressions are formed in the human mind, especially the young ones, through the use of reinforcing sensory impressions. Teaching and learning geometry will means appealing to different learning styles, such as visual, auditory, or kinesthetic, and intelligence types, such as language, music, art or mechanical knowledge, as possible. Using modelling, instructional materials such as chart, pictures, graphs, and animation has increasingly improved students' academic achievement and retention in mathematics and not only in mathematics but wide range in social and physical science subject (an interview with Kabiru Waziri, 2022 a teacher in Bilal secondary school). Inability of students to retain what they have learnt, has been pointed out as one of the contributing factors to students' poor achievement in mathematics.

Retention is the ability to remember things. Retention also describe as the ability to remember or keep the mathematics knowledge that has been learned and to recall it when needed cited (Rilwan, 2021). Among the attributes of retention that are closely related to success, are the power to recall (i.e., memory) and to recognize (Ogbonna, 2007). Memory is the capacity to retain an impression of the past experiences. Memory, according to Ogbonna (2007), is classified based on duration, nature and retrieval of perceived items. Iji (2003), asserted that man is endowed with limited capacity for memorization and to correctly and effectively use or apply whatever one has learnt, retention must come to play an important role. However, Osemmwinyen (2009) found that students' interests could be aroused and retained through the use of an appropriate instructional media like e-learning. Bottge, Rueda, Serlin, Hung, Kwon (2007) found that students with learning disabilities retained what they had learned in mathematics several weeks after instruction, when exposed to Enhanced Anchored Instruction (EAI). Agwagah (1994) investigated the effect of instruction in mathematics reading on pupil's achievement and retention in mathematics. The result of the study indicated that students who were taught mathematics achieved higher and retained more of the content taught. Iji (2003) explored the effects of logo and basic programs on achievement and retention in geometry of junior secondary school students and it was revealed that students achieved higher score when taught with geometry test than other. Ogbonna (2007) explored the effects of two constructivist instructional models on students' achievement and retention in number and numeration. The result revealed that the use of constructivist instructional models enhanced significantly students' achievement and retention in mathematics

2.1.2 Genesis of Geometry Modelling

Since old times, geometry has been a part and parcel of human civilization. The advent of a wheel is also the experiments carried out by the early men with instruments to find something that will reduce friction. It was established as a subject by Euclid, the Father of Geometry. He derived from two words, 'geo' means earth and 'metron' means measurement. Geometry is a domain where the features and traits of different shapes, sizes, diagrams, angles, positions, and so on are studied and defined for the understanding of the academicians and students. It is an important part of mathematics that has been used in other subjects as well. Its existence can be tracked down to thousands of years back during the Egyptian civilization. The Indus Valley Civilization also showed the existence and use of geometry. They were the first to find and use the properties of obtuse triangles. Since the 6th Century BCE, the Greeks refined the concepts of geometry exponentially. The natives of this civilization redefined and found the existence of different types of shapes in nature. They also invented a few and found that the four-sided pyramid is extremely stable. A pyramid took decades to complete but is standing the test of time amidst an arid desert for thousands of years. If you observe very carefully, you will find the best examples of geometry in our daily life.

The existence of geometry can be traced back to the era of early men. At that time, this subject did not have any existence but the use of geometrical concepts can be witnessed from the fossils, ruins, and artifacts. The invention of the wheel is nothing but the application of the concept of a round object minimizing friction. This is one of the best five uses of geometry in our daily life. Even at this date, we find driving vehicles on a circular tire quite convenient. This is how geometry evolved and was recognized as a subject during the time of the Greek civilization. The prime expansion of the geometrical segment of mathematics took place during the Greek civilization. Renowned mathematicians and philosophers such as Euclid, Thales, Archimedes, and Pythagoras explained the different aspects of geometry and established a platform for further innovations. The concepts we study relate to the application of geometry in daily life and the foundation has been developed over the years by these civilizations. Thales proved many mathematical functions and relationships and constructed the base of geometry. Pythagoras established the fact that the sum of all the angles of a triangle will always result in 180 degrees. The name of the theorem that explains the relationship between a perpendicular, a base, and the hypotenuse of a right-angled triangle is named after him. In the 3rd Century BCE, Euclid gave geometry a constructive base when he wrote books on different concepts. His book 'The Elements of Geometry' depicts how he laid out the exceptional foundation of different aspects of geometry that are being used to date. His concepts such as two points can be joined to give a straight line and the quality of all right angles is still

2.1.3 Challenges of Geometry in teaching and learning

1. Findings from the study revealed that students had greater difficulties in learning geometry such as drawing diagrams for a given geometric problem and applying more than one theorem to solve a given geometry problem.

2. Proofs are hard topics to get into, and everyone struggles with it. Students need to understand that everyone suffers from this proofs, even the most mathematically gifted ones. But as long as you change your approach, think creatively and never stop practicing, you can eventually get over your fear of geometry.
3. Many students enter junior secondary school with an understanding of shapes: the names of each and formulas for calculating their areas. But it can be hard to remember these things since they're so abstract and have minimal relation to anything in real life. So geometry is hard because it's very abstract.
4. Additionally, students sometimes struggle with geometry because they have difficulty visualizing how shapes work at different angles. Even math experts can stumble in geometry because it does not follow a straightforward procedure like most of the other topics they study at school.

2.1.4 Factors of Geometry Modelling in Education

Several factors have been attributed to the poor performance in secondary school mathematics, among which are: poor methods of teaching (Harbour-Peters, 2001), poor interest in mathematics (Badmus, 2002 & Obodo, 2004), gender difference (Agwagah, 2000) and lack of appropriate instructional materials for teaching mathematics at all levels of education in Nigeria (Gambari, 2010). Some studies revealed that male students performed better than females in science (Njoku, 2000). In a report, WAEC (1996-2011) chief examiners' reports confirmed that boys performed better than girls in mathematics. Spencer (2004), Osemmwinyen (2009) and Iwendi, (2012) found no gender difference in the performance of male and female students in school mathematics. Contrary to these reports, Kuruma (2004) and Gimba (2006) found that female students performed better than male students while exposed to geometry, mensuration and 3-dimensional mathematics instructional materials respectively. Bergman and Carroll (2010) reported that computer animations accompanied with traditional teaching increases the performance of high school biology students. In another study, Karacop and Doymus (2013) found that the teaching of chemical bonding via the animation and jigsaw techniques was more effective than the traditional teaching method in increasing academic achievement. In mathematics, Aktas, Bulut and Yuksel (2011) reported that academic performance of the students increased by using computer animations and activities about patterns. Similarly, Wang, Vaughn, and Liu (2011) found that animation interactivity improved students′ performance in statistics.

However, Palmiter and Elkerton (1993) studied the use of animation to aid computer authoring tasks, in their findings, Animation initially assisted both accuracy and speed, but after one week had elapsed, the subjects exposed to animations actually had regressed behind the non-animation subjects.

2.1.5 Strategies for Integrating Geometry modeling

In other to achieve effective teaching and learning of geometry in the junior classes, one need to know the different styles of learner in the classroom setting. There are eight (8) different learning styles depending on the situation:

1. Visual learners
2. Aural learners
3. Verbal learners
4. Social learners
5. Logical learners
6. Physical and tactile learners
7. Solitary learners
8. Naturalist learners

Teaching geometry involves various application of strategies that use associations and connections. To achieve efficiency in geometry is to create a reasonable and friendly environment where the student experiences the learning process. This simulate relationships and memories for the student to recall the geometry concept. The teacher need to devise a means to mold this experience into the student. This will only be possible if the students experience is incorporated with different learning styles. The following are strategies for teaching geometry:

- **Relational Analysis**

Relational analysis gives students perspective when comparing shapes with each other. This may be used to describe their positions and how each relates to the others.

- **Fundamental Reasoning**

There are two types of reasoning which are deductive and inductive. It is used in geometry when students explore and create hypotheses, followed by finding proofs and facts to formulate conclusions. Deductive reasoning is used in proofs and reaching conclusions based on facts such as postulates and proven theorems in geometry. Inductive reasoning is used in activities by allowing students to make observations and articulate the associations and relations of shapes and patterns.

Other strategies include Recognition of shapes and names, Recognition of patterns and sequence, problem solving and analysis, memory and recognition support.

2.1.6 Effectiveness of Using of Geometry Modeling

Geometry has several benefits in day-to day activities and hence, it is necessary to learn for the students. Here are some following benefits:

1. Students studying geometry provides for them many foundational skills and helps them to build their logical thinking skills, deductive reasoning, analytical reasoning, and problem solving skills. Hence, contributing to their holistic development.

2. Geometry as a concept contribute to students to allow them to connect mapping objects in the classroom to the real world contexts in respect to their direction and place developing their practical thinking
3. It also find huge applications in the real world as it helps us in deciding which materials to use, which design to make, and even plays a vital role in the construction process itself.
4. It also help to provide a better understanding of spatial relationships which are important in the role of problem solving and higher order thinking skills which geometry extensively provide students to acquire.
5. It also serve as basic to architectural design of structures such as roads, houses, complexes, bridge and many more.

2.2 Theoretical Framework

2.2.1 Social Constructivist Theory

The concept of learning through peer mentorship is based on a social constructivist approach to learning that emphasizes the role of understudies in producing understanding through amicable contact within their zones of proximal turn of events (Vygotsky, 1978 as referred to Abdullahi 2016). Than applying a boost/reaction measure, clients are effectively occupied with making importance through intellectual convenience and additionally osmosis. (Piaget, 1969, as referred to Abdullahi 2016). Holt and Willard-Holt (2000) accentuate the idea of dynamic evaluation, which is a method of surveying the genuine capability of students that varies altogether from ordinary tests. Here the basically intelligent nature of learning is stretched out to the course of appraisal. Maybe than survey appraisal as a cycle completed by one individual, like an educator, it is viewed as a two-way measure including collaboration between both teacher and student. The job of the assessor becomes one of going into discourse with the people being evaluated to discover their present degree of execution on any assignment and offering to them conceivable manners by which that exhibition may be enhanced an ensuing event. Consequently, appraisal and learning are viewed as inseparably connected and not independent cycles (Holt and Willard-Holt 2000). Equal education, peer-coordinated effort, intellectual apprenticeships, issue-based guidance, web-missions, secure guidance, and other tactics that include learning with others are examples of social constructivist approaches (Kim, 2001).

(Vygotsky, 1978) contended that learning occurs through friendly exchange inside a social setting, with language as the essential empowering apparatus. This social constructivist reasoning has been developed as of late, presenting the idea of intellectual apprenticeship (Brown, Collins, and Duguid, 1989 as refered to Abdullahi 2016) through which understudies learns in a way like conventional apprenticeships. The understudies access aptitude through tutors, whose job is to work with as opposed to instruct, and the point of learning is to tackle sensible and pragmatic issues in a legitimate setting. For a companion mentor, this setting is an extremely practical human setting. Similarly as in customary apprenticeships, students participate in exercises 'at work' as opposed to through the pedantic instructing of conceptual ideas. The contention is that understudies are better prepared to move toward non-natural issues and produce arrangements that are suitable to a given culture.

2.2.1 Piaget's Constructivist Theory

Constructivism, is a theory which posits that individual or learners do not acquire knowledge and understanding by passively perceiving it within a direct process knowledge transmission but rather construct new understanding and knowledge through experience and social discourse, integrating those new acquired information with their previous knowledge. This theoretical frame upon which this research is based, defined the constructivist theory as an environment where student is actively engaged in the learning process rather than attempting to receive knowledge in a continuously passive instruction (Taber G.M 2011 referred to Kabiru 2018). The theory is referred to as learner-centered instruction, learners are makers of meaning and knowledge. Whenever a student encounter new problems, they tend to reconcile it with their prior knowledge, ideas and experience, probably changing their methods, accept or disregard the new information as irrelevant. Constructivist theory have guided teachers, tutors, instructor to involves form of guided discovery method where instructors avoid giving specific instruction and attempts to students through questions and activities using relevant instructional materials to discover, appreciate and verbalize new knowledge. This has resulted into many teaching and learning strategies, tools and resources involving the use of computers, simulations, multimedia projectors, animations, and the World Wide Web (Internet connectivity).

Van Hiele Theory (1957)

Van Hiele Model suggests that geometrical thinking has five closely related stages. Most of the geometrical thinking studies have been carried out by taking this model as the basis. Van Hiele model was formed to improve geometrical comprehension and this model was developed in classroom settings. In this model, students should join the activities and find out the characteristics of geometrical concepts. The most important characteristics of Van Hiele Model is that it explains the development of geometrical thinking process with five related stages. Each of these stages determines the thinking processes that are necessary for finding geometrical relations out. These stages define the process of thinking and the types of geometrical ideas rather than the amount of the data. Geometrical thinking stages proposed by Van Hiele Model are (Olkun ve Toluk; 2003; Van de Walle, 2004): Visual period (Level 0), analytic (Level 1), informal deduction (Level 2), formal deduction (Level 3) and rigor (Level 4). These stages determined by Van Hiele Model explain the geometrical thinking skills of students and they are useful for classroom applications.

2.3 Empirical studies

Abari, Gimba, Hassan, Jiya, (2019) investigated the effects of Geogebra Instructional Package on secondary school students retention in Geometry in Minna Metropolis of Niger State, Nigeria. Two research questions were asked and answered while two hypotheses were formulated and tested at 0.05 level of significance. The design of the study was quasi-experimental design of pretest-posttest non-equivalent control group. The sample of the study was 205 students. The experimental group was taught using Geogebra Instructional package while the control group was taught using the expository method. The instrument for data collection was Geometry Retention Test(GRT) and Geometry achievement Test(GAT).The data collected at the end of the research was analyzed using descriptive statistics of mean and standard deviation to answer research questions while the hypotheses were tested using analysis of covariance. The result of the study revealed that students taught geometry using Geogebra Instructional Package retained higher mean scores than those taught using Expository method. The result also revealed no significant difference in the mean retention scores of male and female students taught geometry using Geogebra Instructional Package. The current work looks to discover the Effect of Geometrical Instruction Model on Mathematics Students Achievement and Retention of Junior Secondary School in Minna, Niger State.

Gambari, (2010) investigated the effect of instructional models on the performance of Junior Secondary Students in Geometry at Junior Secondary School in Minna, Niger State, Nigeria. It examined the significance of the post-test achievement scores of students taught using instructional models and the conventional method. The research was a pre-test post-test quasi-experimental control group design. The sample consisted of forty junior secondary school students drawn from two secondary schools within Minna metropolis. Stratified random sampling technique was used to select 40 students (20 males and 20 females). The

Geometry Achievement Test (GAT) was pilot tested using test-retest method and the reliability score was 0.87. GAT was administered to students as pre-test and post-test before and after the treatment. The students' pre-test and post-test scores were analyzed using t-test statistics. The results indicated that the students taught using instructional model performed significantly better than their counterparts taught using the conventional method. However, there was no significant difference reported in the post-test performance scores of male and female students taught using instructional model and those taught with normal instruction. These findings indicated that geometry concept in mathematics could be taught and learnt better through the use of instructional models. The current work looks to discover the Effect of Geometrical Instructional Model on Mathematics Students Achievement and Retention of Junior Secondary School in Minna, Niger State.

Tolga erdoöan and Soner durmuù (2009) determine the effects of the instruction based on Van Hiele Model on preservice teachers' the geometrical thinking levels. This study has been carried out with junior students attending to the Elementary School Teaching Program. There were eight classes of junior preservice teachers, two of them were randomly assigned as experimental groups which were instructed with Van Hiele Model and the other two were randomly assigned as control groups which were instructed with traditional instruction. Based on the analysis of the data, findings will be discussed and some recommendations will be presented.

Gambari, Falode, and Adegbenro, (2014) investigated the effectiveness of computer animation and geometry instructional model on mathematics achievement and retention on Junior Secondary School Students in Minna, Nigeria. It also examined the influence of gender on students' achievement and retention. The research was a pre-test post-test experimental and control group design. 40 junior secondary school students were drawn from two secondary schools within Minna metropolis. Stratified random sampling technique was used to select 40 students (20 males and 20 females). The Geometry Achievement Test (GAT) was used for data collection. The reliability coefficient of 0.87 was obtained using Kuder-Richardson (KR-20). GAT was administered to students as pre-test and post-test. The students' pretest and post-test scores were analyzed using t-test statistics. The results indicated that the students taught geometry using computer animation performed significantly better in posttest and retention test than their counterparts taught geometry using instructional model and conventional method respectively. However, there was no significant difference reported in the post-test performance scores of male and female students taught geometry using computer animation and instructional model respectively. These findings indicated that geometry concept in mathematics could be taught and learnt meaningfully through the use of computer animation. The current work looks to discover the Effect of Geometrical Instruction Model on Mathematics Students Achievement and Retention of Junior Secondary School in Minna, Niger State.

Okey, Ordu Kelechi and Doris Omeodu (2018) investigated the effects of Instructional model on students' performance in chemistry in Obio/Akpor Local Government Area, Rivers State. The study was carried out to determine the effect of teaching students organic chemistry using physical model as instructional aid against teaching students organic chemistry using diagrams as instructional aid. Two research questions and two hypotheses guided the study. A pre-test posttest non-randomized control quasi-experimental design was adopted in the study. A cluster sampling technique was used to obtain a sample of two intact classes which consisted of 50 students in the control group and 50 students in the experimental group. Students in the control group comprised 28 male and 22 female while the experimental group comprised of 30 male and 20 female students. Two instruments were developed and used for data collection. To obtain reliability coefficient Using test-retest, Pearson Product Moment

Correlation was used to calculate the reliability coefficient. A reliability coefficient of 0.98 was obtained for the Chemistry Achievement. Treatment for both control and experimental groups lasted for a period of 2 weeks. The research questions were answered using mean while the hypotheses were tested at 0.05 alpha level of significance using analysis of covariance. The results of the study showed that there was a significant statistical difference in the mean achievement of students taught organic chemistry using physical model as instructional aid and students taught organic chemistry using diagram as instructional aid with the students taught using physical model performing better. It was also found that students exposed to instruction using physical model as instructional aid agreed that the exposure enhanced their interest in chemistry. Based on the findings of the study, it was therefore recommended that physical model should be made available in schools by government and teachers should also utilize this models in teaching the students because it enhancing their performance. The current work looks to discover the Effect of Geometrical Instruction Model on Mathematics Students Achievement and Retention of Junior Secondary School in Minna, Niger State.

Obi, Agwagah and Agah. (2014) determined the effects of Origami instructional approach on JS I students' retention in geometry. Two research questions and three hypotheses were formulated to guide the study. The study adopted a quasi-experimental non-equivalent pretest posttest control group design and was restricted to Nsukka local Government Area of Enugu State. Two Co-educational Secondary Schools were drawn for the study, using simple random sampling technique. Out of the two drawn schools, one was randomly assigned to Origami Group (OG) while the other one to the Control Group (CG). A sample of 101 JS one students was involved (65 female and 36 male). The instrument for data collection was geometry retention test (GRT). Data collected were analyzed using mean, standard deviation and analysis of covariance (ANCOVA). The result of the study revealed that use of Origami in teaching geometry to junior secondary school students enhanced their retention in geometry. The study also revealed that the use of Origami had no statistically differential effect on male and female students' retention. The study also revealed that there was a significant interaction effect between gender and instructional material, on retention of the concepts taught during the study. Based on the findings, the researchers recommended that use of Origami should be adopted in the teaching of geometry (mathematics) in primary, secondary, and tertiary levels of education system. It was also recommended that seminars, workshops and conferences should be mounted by professional bodies, federal and state minis tries of education on the use of Origami for mathematics teachers, students and others. This will enable the mathematics educators, serving teachers, students and all to benefit from such an approach. The current work looks to discover the Effect of Geometrical Instruction Model on Mathematics Students Achievement and Retention of Junior Secondary School in Minna, Niger State.

2.4 Summary Literature Reviewed

From the literature reviewed, the researcher discovered that instructional model plays a vital role in effective teaching and learning of mathematics. From the empirical studies, it was revealed that there was a significant interaction effect between gender and instructional material, on retention and academic achievement. It was recommended that instructional models should be adopted in the teaching of geometry (mathematics) in primary, secondary, and tertiary levels of education system. It was also proven that instructional model has been on the edge of positively increasing student's achievement, motivation and retention. The use of social constructivist, Piagets constructivist theory and Van Heile theory were the theories/models that supported the study as they advocated for the use of instructional models for effective teaching and learning. The current work set out to discover the Effects of

Geometrical Instructional Model on Mathematics Students Achievement and Retention of Junior Secondary Schools in Minna, Niger State.

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1 Research Design

This research design adopted a pre-test, post-test control non randomized group quasi-experimental design. This means that, the researcher couldn't randomly pick and assign subjects because intact classes were used to give two levels of treatments that were involved. Intact classes were used instead of randomly composed samples, the design was deemed appropriate for this study. The following is the format for the research design:

Table 3.1 Research Design Layout

Group	Pretest	Treatment	Posttest
E:	O_1	**T**	O_2
C:	O_3	**-**	O_4

E = Experimental Group

O_1 = is the first observation (pretesting) of experimental group before treatment

T = Treatment for experimental group

O_2 = is the second observation (post-testing) of experimental group after treatment by administering posttest.

C = Represent the control group exposed to the routine teaching

O_3 = is the first observation of the control group by administering pretest.

O_4 = is the second observation (post testing) of the control group.

3.2 Population of the Study

The population of the study is all the JSS II students in two junior secondary schools in Minna, Niger State. The two schools are Bosso Day Secondary School and Abdullahi Dada

Day Secondary School Maikunkele all in Minna Metropolis. The total number of the population was 224. However, in most research studies, it is not always possible to meet all members of target population, which are all JSS II students in both schools.

3.3 Sample and Sampling Techniques

Purposive sampling procedure is used for the study to obtain 60 sample sizes. The use of hat and draw method of selection was used to avoid bias among the students. Therefore, each group consists of thirty participants from each junior secondary school (JSSII). The research integrate Guilford (1965) Central Limit Theory reported in Hassan (2011) supported by Salaudeen (2012) and Nma (2017) asserted that the sample Size of $n \geq 30$ will suffice for the normal approximation to be reasonable.

3.3.1 Names of schools with their corresponding number of (SS1I) students

NAMES OF SCHOOLS	NO OF STUDENTS IN JSS II
1. Bosso Day Secondary School	109
2. Abdullahi Dada Day Secondary School Maikunkele	115

3.4.2 Distribution of Students from the sampled class (JSS 1I)

Name of Schools	Number of Students		Groups		Total
	Male	Female	E	C	
Bosso Day Secondary School	15	15	15	15	30
Abdullahi Dada Day Secondary School Maikunkele	15	15	15	15	30
Total	30	30	30	30	60

3.4 Research Instrument

Three instruments will be used for this study, they include:

I. Mathematics Geometrical Instructional Model (MGIM)

II. Mathematics Achievement Test (MAT).

III. Geometrical Instructional Video (GIV)

These instruments were developed by the researcher and are based on the contents taught while the MGIM is on the feelings of students about the method been used.

3.5 Validity of the Research Instruments

One specialist from the Federal University of Technology Minna Niger State's Department of Science Education and another specialist from College of Education Minna Department of Sciences as well as some instructors from the sampled schools, all verified the instrument utilized in this study. They all provided helpful suggestions to help the researcher gather the necessary information and data for the study. Their ideas and corrections were taken into account.

3.6 Reliability of the Research Instrument

The experimental and control groups were given a test retest at two-week intervals, two schools that are not part of the experimental schools {Zarumai model school and Government Day Secondary School} are used to determine the instrument's dependability. The Pearson Product Moment Correlation Coefficient statistics were used to examine the test results. The correlation coefficient was found to be r= 0.98, indicating that the instrument is reliable.

3.7 Method of Data Collection

Bosso Day Secondary School was used as the experimental group while Abdullahi Dada Day Secondary School Maikunkele was chosen to be the control group. The researcher visits the sampled schools for an introduction and to obtain permission to utilize the schools, as well as to sample the classes and students who will be involved in the study during the first week.

On the first day of the second week, the researcher visits the school for the control group which is Abdullahi Dada Day Secondary School Maikunkele and Pretest was then administered to all the students involved. On the second day the researcher personally taught the control group using his first lesson plan, the third day with the second lesson plan and the fourth day with the third lesson plan. At the end of the second week, three (3) lessons were taught altogether. On the first day of the third week, the researcher visits the school he uses for experimental group which is Bosso Day Secondary School and then pretest was then administered to all the students involved. On the second day the researcher personally teaches the experimental groups using his first lesson plan, the third day with the second lesson plan and the fourth day with the third lesson plan. Three (3) lessons were taught in total by the end of the second week. For the control and experimental groups, both schools used the same pretest and lesson plans. After a week, a Posttest was given to all of the Students in the two schools who were involved in the study, both experimental and control groups, to measure their academic performance. The scores from the tests were combined together to generate the study's data, and the average was calculated.

3.8 Method of Data Analysis

Descriptive statistics of mean and standard deviation (SD) was used to answer the research questions and the influential statistics of the t-test was used to test the hypothesis at 0.05 level of significance using Statistical Package for Social Science (SPSS) version 23.

CHAPTER FOUR

4.0 RESULT AND DISCUSSION

4.1 Introduction

This chapter presents the analysis and interpretation of the data collected. The data collected was through the use of geometrical instructional video (GIV) and mathematics achievement test (MAT) as follows:

i. Pretest data, to determine group equivalence if experimental and control groups

ii. Post test data to determine achievement after four weeks of treatment

These forms of data are analysis in the following paragraphs and use to answer three research question and their corresponding null hypothesis.

4.2 Answers to Research Questions

What is the mean achievement scores of students taught geometrical instructional models (GIM) and those taught with traditional method (TM).

Table 4.1 Mean and Standard Deviation of pretest and post-test Achievement scores of Experimental and Control Group

			Pretest		**Post Test**	
Groups	**N**	**Df**	$\bar{X}$	**SD**	$\bar{X}$	**SD**
Exp Group	30		7.93	1.99	14	2.03
		58				
Control Group	30		7.13	1.67	13.1	1.47

The data presented in Table 4.1 shows the mean and standard deviation of the pre-test and posttest of both experimental and control groups. Mean score of pre-tests of experimental group is 7.93 and SD= 1.99, for the control group means= 7.13 and SD=1.67, while the post test, the means score for the experimental group is 14 SD =2.03, while the control group is Mean = 13.1 SD=1.47. With this result, student in experimental group performed better in the achievement test than the control group.

Research Question Two

What is the mean retention scores of students taught geometrical models and those taught with traditional method

Table 4.2 Mean and Standard Deviation of pretest and post-test Achievement scores of male and female students taught geography concept using web application

			Pretest		**Post Test**	
Groups	**N**	**Df**	$\bar{X}$	**SD**	$\bar{X}$	**SD**
Exp	30		14	2.03	15.5	2.28
		58				
Control	30		13.1	1.47	13.43	1.52

The data presented in Table 4.2 shows the mean and standard deviation of the experimental and control groups. Mean score of experimental groups is 14 and SD= 2.03, for the control group means= 13.1 and SD=1.47. With this result, student in experimental group performed better in the achievement test than the control group.

Research Question Three

What is the difference between boys and girls achievement when taught with geometrical models?

Table 4.3 Mean and Standard Deviation achievement score of the student taught with web application

Groups	N	Df	$\bar{X}$	SD
Male	15		14.8	2.4
		28		
Female	15		13.2	1.65

The data presented in Table 4.3 shows the mean and standard deviation of the pre-test and posttest of both male and female. Mean score of pre-tests for male is 14.8 and SD= 2.4, while the pretest the means score for the female is 13.2 SD =1.65, from the result, male students performed better than the female student with a 14.8 and S.D = 2.4 and female 13.2 and S.D = 1.65 from posttest scores.

4.3 Testing of Research Hypothesis

Null Hypothesis One:

HO_1: There is no significant difference in the mean achievement scores of students exposed to geometrical models and traditional method.

Table 4.4: Summary of t-test Analysis Comparing Students' Academic Achievement using geometrical instructional model and conventional method.

Groups	N	Df	$\bar{X}$	SD	t-cal	p-val	Remark
Exp Group	30		14	2.03			
		58			-1.96	0.05	S
Control Group	30		13.1	1.47			

S=significant P<0.05

From table 4.4 shows the t-test analysis of the experimental and control groups. The mean score of the experimental group is 14 SD = 2.03 and df = 58. The control group has a mean score of 13.1, SD = 1.47 the t-value = -1.96 and p-value = 0.05 which is significant. On the basis of this, hypothesis one of which states that, there is no significant different between the experimental and control groups is rejected. Hence there is a significant different in the two groups.

Null Hypothesis Two

HO_2: There is no significant difference in the mean retention scores of students exposed to geometrical models and traditional method.

Table 4.5: T-test Analysis of Retention Scores of Experimental and Control Groups

Group	*N*	*Mean*	*SD*	*Df*	*t-value*	*p-value*
Experimental	30	15.5	2.28	58	4.12	0.00
Control	30	13.43	1.52			

The result in table 4.5 above shows that the t-value (4.12) at 0.00 level of significance. Also, the mean score of the experimental group (15.5) is greater than that of the control group (13.45). The null hypothesis was therefore rejected. The null hypothesis states that there is no significant difference between the mean retention scores of students taught geometrical instructional models and those taught using conventional teaching method. The significant difference is in favor of experimental group as shown in their mean scores.

HO_3: There is no significant difference on gender achievement when students are taught geography using Technology-Mediated Instruction.

Table 4.5: Summary of t-test Analysis Comparing Male and Female Student

Groups	N	Df	$\bar{X}$	SD	t-val	p-val	Remark
Male	15		14.8	2.11			
		28			2.25	00.034	R
Female	15		13.2	1.65			

S= significant P<0.05

Table 4.6 shows the t-test pretest score of male and female. The mean score of the male is 14.8, SD = 2.11 and df = 28. The mean score of the female 13.2, SD = 1.65. The t-value = 2.25 and p-value = 00.034. The null hypothesis state that there is no significant difference in the mean score of male and female students taught geometrical models. From the result, the p-value is greater than the significant value of 0.5%. Hence this did not reveal significant difference in the academic achievements of the male and female students in the experiment. The Null hypothesis was therefore retained.

4.4 Discussion of Result

The findings of the research as seen in Table 4.1 and 4.2, shows that the experimental group recorded the highest mean score than the control group, which shows that geometrical instructional video has positive effect on the academic achievement and retention in mathematics among students of junior secondary schools in Minna, Niger state. Also, the findings of the research as regards to the effects of geometrical instructional model on student achievement and retention in the study of mathematics as can be seen in table 4.3 and 4.4 reveals that the experimental approach has positive effects on male students than their female counterpart. Table 4.5 and 4.6 indicates that there is a significant difference in the academic achievement and retention of the students in experimental group and control group. A significant difference implies that null hypothesis was rejected and the alternate hypothesis was retained. Therefore, null hypothesis that states that there is no significant difference between students taught using conventional method and geometrical instructional model for junior secondary school in Minna, Niger State is rejected. The significant difference indicates that geometrical instructional video strategy recorded the highest mean score than the conventional method.

4.4 Summary of Findings

Major findings of the study are summarized as follows: -

1. It was revealed that students exposed to geometrical instructional video (i.e. experimental group) performed significantly higher than the students who were taught without geometrical instructional video (control group). The null hypothesis HO_1 was therefore rejected.
2. It was established that there is no significant difference in the achievements of male and female taught mathematics in the experimental group.

CHAPTER FIVE

5.0 SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 Introduction

This chapter presents the summary of the entire work, conclusion drawn from the study and offer recommendation for further research.

5.2 Summary of the Work

Chapter one provided the background to the study. The central objective is to investigate the effects of geometrical instructional models on mathematics student achievement and retention in selected junior secondary schools in Minna, Niger State.

In chapter two, review of related literature was made. Chapter three presented the methodology that was used in collecting data for the study. Design of study, population of the study, sample and sampling techniques, and method of data collection and analysis were made in the study.

Chapter four presented and analyzed the data that was generated for the study. This study found that the geometrical instructional model approach of teaching mathematics has significant effects on the academic achievement and retention of students in junior secondary schools in Minna, Niger state.

5.3 Conclusion

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

i. Students taught mathematics using geometrical instructional model achieved better academically than using the conventional method.

ii. Students taught using geometrical instructional model approach exhibit high level of retention in mathematics than using the conventional method.

iii. Male students taught mathematics using geometrical Instructional model differs significantly in achievement and retention from their female counterpart.

iv. The usage of geometrical instructional model approach in teaching mathematic and by extension other subjects has the potentiality of enhancing junior secondary mathematics students' academic achievement, retention, and interest.

5.4 Recommendations

Based on the findings of this study, the following recommendation were drawn by the researcher:

i. The use of geometrical instructional model approach in teaching mathematic in school should be encouraged by critical stakeholders in the education sector. This can be achieved by training and retraining teachers on the use of the various medium of technology that will be adopt.

ii. Government should make adequate provision for computers in government own secondary schools and as well encourage private schools to key into the approach.

iii. Curriculum planners and curriculum development bodies in Nigeria like NERDC should design programs and policies that will incorporate the use of technological devices such as projector in teaching and learning mathematics at junior Secondary School level.

iv. Promotion of awareness/enlightenment to teachers and students through seminars and workshops and training of mathematics teachers for the teaching, guidance and counseling of students.

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APPENDIX A

MATHEMATICS ACHIVEMENT TEST

Time allowed 45 Minutes

School Name______________

Sex: Male _______ Female ___________

Age _______

Instructions:

There are twenty questions in this section. Each question has four alternatives. From the four alternatives pick the correct answer for each question. Attempt all the questions.

1. A triangle has ________ sides.

   A. 2

   B. 3

   C. 4

   D .5

2. A triangle has_______ corners

   A. 3

   B. 1

   C. 6

   D. 7

3. A_______ is made up of only straight line

   A. Kite

   B. Parallelogram

   C. Rhombus

   D. Square

4. A ______ has 6 flat surfaces.

A. Kite

B. Cube

C. Rectangle

D. Square

5. A _____is made up of only straight line.

A. Rectangle

B. kite

C. Trapezium

D. Rhombus

6. A _____is a shape with all four sides equal in length.

A. Rectangle

B. Trapezium

C. Rhombus

D. Square

7. How many sides and corners does a square have?

A. 2

B. 4

C. 3

D. 7

8. How many corners does a triangle have?

A. 3

B. 2

C. 6

D. 4

9. How many sides and corners does a rectangle have?

A. 4

B. 3

C. 5

D. 8

10. A cube has how many corners?

A. 5

B. 4

C. 8

D. 7

11. A ________is a shape that does not have any sides or any corners

A. Cone

B. Triangle

C. Circle

D. Kite

12. A ______ is a shape that all the sides are all equal in length.

A. Regular polygon

B. Rectangle

C. Square

D. Circle

13. A cuboid has _______ flat surface

A. Three

B. Four

C. Five

D. Six

14. A cuboid has______ corners

A. Five

B. Eight

C. Four

D. Two

15. A ________ is made up of only curve line

A. Circle

B. Cuboid

C. Rectangle

D. Cube

16. Each face of the cuboid is a_____

A. Curve

B. Bend

C. Rectangle

D. Sphere

17. The sum of angles of triangles is _________

A. 180^0

B. 360^0

C. 270^0

D. 140^0

18. A cylinder has one curved face and _________ flat faces?

A. 1

B. 9

C. 3

D. 2

19. A sphere has _______ curved face and does not have _______ corners

A. One and Four

B. One and Two

C. Two and One

D. One and Any

20. A ________ has one curved face and one flat surface.

A. Cylinder

B. Circle

C. Cone

D. Sphere

THE ANSWERS TO THE QUESTIONS

1. B

2. A

3. D

4. B

5. A

6. D

7. B

8. A

9. A

10. C

11. C

12. C

13. D

14. B

15. A

16. C

17. A

18. D

19. D

20. C