ENHANCING JUNIOR SECONDARY SCHOOL MATHEMATICS STUDENTS' ACHIEVEMENT AND RETENTION USING NON-PROJECTED MEDIA IN BOSSO LOCAL GOVERNMENT MINNA, NIGER STATE

BY

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Abstract

This study investigated the impact of the enhancement of Junior Secondary School Mathematics Students Achievement and Retention Using Non-Projected Media in Bosso Local Government Minna, Niger State. Geometry was selected as the specific topic to be taught. Four objectives, research questions and hypotheses were raised to guide the study. Related literatures were reviewed based on the research topic, and all the authors cited in the literatures were duly acknowledged in the reference. The study adapted quasi- experimental design using pre-test, post-test, non-equivalent control group. Experimental group received experimental treatment using non-projected media while controls were taught using conventional method. A random sampling of 160 Junior secondary school students in selected private schools in Bosso local government was carried out. Mathematics Achievement Test developed by the researcher and validated by expert guide in data collection, Research questions were answered using Mean and Standard Deviation while t-test statistic at 0.05 confidence levels was used in testing null hypotheses raised. From the result of findings, it was confirmed that, there is significant difference in the achievement scores of Mathematics Students taught using non-projected media and those taught the same concept just using conventional method. Subjects in the experimental group perform better than control group. The result obtained further revealed that there is no significant difference in the achievement of the male and female students exposed to non-projected media. Based on the findings of this study, it was recommended that the use of non-projected visual resources in teaching Mathematics in school should be encouraged by relevant bodies, and State Ministries of Education, through organizing seminars and workshops to teachers on utilization of non-projected visual resources in teaching and to provide non-projected media materials for teaching Mathematics particularly in junior Secondary Schools of the Federation.

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CHAPTER ONE

INTRODUCTION

1.1 Background of Study

The crucial role science plays in the development of any nation has long been recognized. Nigeria was not left out in raising of the standard of science teaching through curriculum development. Science education research has shown that the learning of science is a hard task for most students and the abstract nature of science makes learning scientific concepts difficult for most students. Today mathematics is one if the compulsory subject that is being offered by both arts and science oriented students. Mathematics as a subject is the study of quantity, structure, space, relation, change and various topics of pattern, form and entity (Cogan *et al*., 2019). It promotes the training of the mind. It is an indispensable subject and the Queen of sciences (Ernest, 2018). Turşucu*et al*. (2017) stated that Mathematics is the queen of Sciences, a servant of Science subjects while others viewed Mathematics as King of Arts, Queen of Science. It is also a science of number and shapes (Howard, 2019).

Mathematics is used every day by everyone especially in this present scientific and technological world. Emphasis in Nigeria today is on technological development and mathematics is needed for this technological development. Linking Mathematics to development and progress through Science and Technology, (Anaekwe&Ofordum, 2021) stated that the arrows connecting mathematics with development and progress of any nation are as shown below: Mathematics ➔ Science ➔ Technology ➔ Development ➔ and Progress.

In line with this relationship that exists between Mathematics, Science and technology, Kátai (2021) remarked that mathematics remains the pivot on which any true science can rest and no true science can succeed without going through mathematical demonstration; any nation that wants to develop technologically begins by developing her mathematical arts right from the classroom; in other words, mathematics and science are important in our daily lives. It is this importance of mathematics that has made Timms *et al*., (2018) to stress that without mathematics, there is no science; without science, there is no modern technology, and without modern technology, there is no modern society. The implication of this statement is that there could be no real development, technologically without a corresponding development in mathematics.

Teaching method is one of the important elements of teaching and learning process. A good teaching sometime fails due to non-suitable method of teaching. In this era not only the new methods of teaching have been developed but also the methods of teaching are greatly affected by the development of new technologies that is, computers, computer assisted instructions, projector slides and non-projected media.

The use of non-projected media in teaching and learning presents impact to institutions of higher education. Non-projected media is a multi-sensory that stimulates multiple senses of audiences at a time. Its interactive nature enables teachers to control the flow of information (Anderson, 2019).

Non-projected media technology affects both aspects of teaching and learning. It does this in three ways: firstly, how it presents information; secondly, how students interact both with the medium and through the medium with the teacher and other learners; and lastly, how knowledge is structured within non-projected media.

Despite the acceptance that non-projected media has an important role to play in changing and modernizing educational systems and ways of learning, scientific evidence of the concrete contributions of non-projected media to the learning domain, is less evident. In addition to this, publications in this domain have generally focused on Western countries.

Sasidhar (2020) defines non-projected media as those teaching aids which are used without any projection. Moore *et al*., (2020) viewed them as those media that translate abstract ideas into a more realistic format and allows instruction to move from verbal representation to a more concrete level. He noted that non-projected media mainly comes under three categories that are graphic aids; three dimensional aids and display boards. In other words, these media include those physical items that student can see or touch directly and does not involve projection They include still pictures ‘drawings, charts, graphs, cartoon, real objects, models, dioramas, and display surfaces among others. Non-projected media are not only locally available, they are also not expensive. They are not only readily available, resourceful but committed teachers and students can improvise the materials. They elicit the creativity and resourcefulness of both teachers and the students.

They do not depend so much on electricity for their operation and utilization by the teachers and students. They make the learner to participate actively in the teaching-learning process. They give greater meaning or visual illustration to abstract and complex concepts. Non-projected visual resources are therefore, used in the teaching and learning process for the following reasons;

1. To concretize the context or what is being taught to the understanding level of the learner.

2. To make what is being taught very real to the learner, and to arouse their curiosity and interest.
3. They make teaching easier and more effective for the learner.
4. They enhance remembrance and reaction on the part of the learner.
5. They enable students acquire experience and knowledge that they would otherwise not have appreciated and understood by mere teachers' explanations.
6. They save teachers time which may be employed usefully in other activities.
7. The resources pleasantly accommodate the different learning behaviors of the learners or their individual differences.

Non-projected visual displays are the backbone of the whole range of the classroom visual materials. Remember the adage that says "no impression without expression". The inexperienced teachers often regard non-projected media as second rate visual materials in view of the glamour attached to films radio, computer and television. These visual materials serve a lot in the classroom settings. They require no electrical power or light source. They are in various shapes, size and colors. Also, they can be easily produced or made by the teacher, and can be easily adapted to the requirement of any subject in order to make students to understand a particular concept. The effectiveness of this non-projected media which is the independent variable can only be seen in student's achievement and retention. Achievement is the product of a students results taken at a particular condition.

Gender issues are inconclusive and methods that promote both male and female achievements need to be adopted. It has been reported that the use of non-projected media, like the Non-projected media in teaching enhances teaching and learning. Enhanced achievement may also lead to students ability to retain concepts better. This is because non-projected media is an innovative way to enhance teaching and learning process. The learners ability to retain concepts taught is also associated with their gender signifies categorization of students into male and females.

1.2 Statement of Problem

In spite of the desire for technological development, couple with the fact that Mathematics is a very vital subject for technological development and as such, its teaching and learning as well as students' poor academic achievement have become a source of concerns to all stakeholders. The act of teaching is fundamentally concerned with passing ideas, skills and attitudes from the teacher to the learner.

In Nigeria for example, experience has shown that spoken words alone in the communication of ideas are grossly ineffective and inefficient in producing desired learning outcomes. Every year, when the results of public examination are released, chief examiners report that there has always been mass failure in Mathematics. The reason for this could be ascribed to the fact that there are topics in Mathematics that pose serious problem of comprehension to students. These topics cannot be taught affectively without the use of relevant non-projected media materials to make the learning practical. Another problem is the unavailability of these materials in schools, therefore there is the need for improvisation. If all the concepts in Mathematics are taught with understanding, students are likely going to perform highly, thereby becoming high achievers in the subject.

However, many strategies have been used by other researchers such as use of CAI, power-point but yet the poor achievement of students has persisted. Therefore, the strategy considered b y the researcher to salvage the persistent poor achievement in mathematics might be the use of non-projected media. Therefore, the study intends to investigate the impacts of junior secondary school mathematics student's achievement and retention using non-projected media in schools in Bosso Local Government Area, Niger state.

1.3 Aim and Objective of the Study

The aim of this study is to investigate the impacts of junior secondary school mathematics student's achievement and retention using non-projected media in Junior Secondary schools in Bosso Local Government Area, Minna, Niger state.

The objectives of the research are to:

1. Determine the effects of non-projected media on mathematics student's achievement in Geometry.
2. Examine the effects of non-projected media on mathematics student's retention in Geometry.
3. Determine the influence of non-projected media on male and female students' achievements in Geometry.
4. Determine the influence of non-projected media on male and female students' retention in Geometry.

1.4 Research Questions

1. Is there any difference in the mean achievement scores of those students taught using Geometry with non-projected media and conventional methods?

2. Is there any difference in the mean retention scores of those students taught using Geometry with non-projected media and conventional methods?
3. Is there any difference in the mean achievement scores of male and female students taught Geometry using non-projected media?
4. Is there any difference in the mean retention of male and female students taught Geometry using non-projected media?

1.5 Research Hypothesis

Ho_1: There is no significant difference between the mean achievement scores of those students taught Geometry using non-projected media and conventional methods.

Ho_2: There is no significant difference between the mean retention scores of those students taught Geometry using non-projected media and conventional methods.

Ho_3: There is no significant difference between the mean achievement scores of male and female students taught Geometry using non-projected media.

Ho_4: There is no significant difference between the retention of male and female students taught Geometry using non-projected media

1.6 Significance of the Study

This study will be useful to students, teachers, parents, researchers, professional development bodies in education and curriculum planners in the following ways;

The study will benefit the teachers on how to make effective use of non-projected media resources in their teaching activity. The study will expose the teachers to the use of Non-projected media in such a manner that would awaken their interest and enthusiasm.

Students will hopefully benefit from this study in improving their academic performance when instructional materials like non-projected media are adopted in teaching and learning of Mathematics. The study will expose them to the benefits of the use of Non-projected media resources in the learning of Mathematics.

The study may also provide very useful information to the Ministry of Education, government, and other educational authorities and agencies to provide interventions so as to promote the use of non-projected media when teaching Mathematics and others subjects in general. It will facilitate their decision making process in terms allocation and procurement of Non-projected media resources for effective teaching and learning in Mathematics.

The study will also serve as resource materials for those who may wish to embark on similar research work. It will provide them with information which will widen their understanding when the use of Non-projected visual resources is concerned.

1.7 Scope of the Study

This study seeks to assess the effect of non-projected media on the teaching and learning of mathematics in Junior Secondary Schools in Bosso Local Government, Niger state. The study will be limited to junior secondary schools within Bosso Local government of Niger state, reason being that there is limited time and finance to carry out this research on a much broader scale. Also, due to the time constraints, JSS two students are used for the study because the concept falls under the scheme of work, Geometry would be covered, to assess the student's achievements and retention. The Non-projected Media to be used would be designed using flip charts.

1.8 Operational Definition of Terms

Non-projected Media: Non-projected materials are those materials that do not require any form of projection before they can be utilized.

Gender: This is refers to either male or female.

Achievement: Student achievement is the measurement of the amount of academic content a student learns in a given time frame (Gess-Newsome *et al*., 2019).

Retention: It indicates how well a school ensures academic success or completion. Stakeholders use it to measure a school's performance (Walker *et al*., 2018).

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

In developing nations, secondary education has been shown to bring critical gains to children's social, physical, emotional and cognitive development (Pace *et al*., 2019). The Federal Ministry of Education officials in Nigeria revealed that most teachers do not have the expertise in their subjects and learners fail examinations and few of them pursue mathematics courses at tertiary level leading to even greater shortage of mathematics teachers (Fatade *et al*., 2013).

Mathematics is considered a core subject throughout the school years of each child but most Nigerian secondary school teachers are not trained hence they do not have the knowledge of the types of instructional resources to be used in mathematics lessons. As a result, there is a poor foundation for secondary school students in mathematics which leads to low performance from secondary to higher levels of learning (Mazana *et al*., 2019). Olumuyiwa and Akinsola (2021) reported that early intervention program like provision of learning resources had a positive influence on children's mathematics achievement. Children enrolled in pre-school with adequate instructional resources and trained teachers have an advantage of acquiring mathematics concepts and skills (Olumuyiwa & Akinsola, 2021).

2.2 Conceptual Framework

2.2.1 Meaning of Instructional Materials

Instructional materials have been defined by various authors. For example, Kalthoff *et al*. (2020) viewed them as didactic materials thing which are supposed to make learning and teaching possible. According to Bawa (2016), instructional materials are materials or tools locally made or imported that could made tremendous enhancement of lesson impact if intelligently used.

Rapanta *et al*. (2020) referred to them as objects or devices, which help the teacher to make a lesson much clearer to the learner. Instructional materials are also described as concrete or physical objects which provide sound, visual or both to the sense organs during teaching (Sephania *et al*., 2017).

Instructional materials are in various classes, such as audio or aural, visual or audiovisual. Thus, audio instructional materials refer to those devices that make use of the sense of hearing only, like radio, audio tape recording, and television. Visual instructional materials on the other hand, are those devices that appeal to the sense of sight only such as the chalkboard, chart, slide, and filmstrip.

An audio-visual instructional material however, is a combination of devices which appeal to the sense of both hearing and seeing such as television, motion picture and the computer. Among the instructional materials the classroom teacher uses, the visuals outnumbered the combination of the audio and audio-visual. Instructional material is the school resource inputs (SRIs) that is used within the classroom to facilitate the teaching learning process.

However, the instructional material provided to the classrooms in Nigeria is substandard in quality and lesser in quantity as compared to the advanced countries. The availability of textbooks, appropriate chalkboard, math kit, science kit, teaching guide, science guide, audio-visual aids overhead projector, maps, models and charts) are the important instructional material.

However, many facilities are missing in approximately all the secondary Schools. First instructional material is the textbook. Various definitions of textbook emphasize the role of textbook as a tool for learning.

Textbook is the nucleus of all the learning activities related to a particular curriculum. Certainly, teacher is not a sufficient source of knowledge for a number of reasons such as the large class size and the time factor and so on. Besides, student has to improve the knowledge received from teacher by reading the textbook.

Textbook plays a vital role in imparting knowledge to the students in the third world countries. Furthermore, there is no choice other than textbook in many developing countries. Therefore, it is one and the only source of knowledge. In Nigeria, there are numerous numbers of textbook available for a particular subject in a particular class.

Students are asked to depend on these variety source of information. The second instructional material is chalkboard/blackboard. Chalkboards/blackboards are the teaching aids that teachers frequently use, particularly during the lectures and discussions. These are of different kinds such as chalkboard, blackboard, marker board, felt board and magnetic board.

However, only blackboard or chalkboard is provided in public schools. Teachers use it in classrooms to write the important words, to draw diagrams, figures and maps. The third instructional material is math kit. Math kit is a study kit for the subject of Mathematics. Usually, study kit is a box containing a variety of visual aids, artistically assembled and displayed pertaining to a single topic.

It includes different types of visual aids that are useful for the subject of Mathematics. The fourth instructional material is science kit. Science kit is a study kit for science subjects for example.

Physics, Chemistry and Biology. It includes the necessary aids that are useful for the teaching of these subjects. These aids may be models, charts, maps, apparatus and some other types. The fifth instructional material is teaching guide.

Teaching guide is a booklet provided to teachers. It provides guidance to teachers about the matters regarding teaching, from lesson planning to the teaching learning process completely. Furthermore, it guides them to adopt a suitable teaching methodology and a suitable instructional material for a topic.

The sixth instructional material is science guide. Science guide is a booklet for the guidance of science teachers only. It guides them in the teaching of theory and experiments of science subjects. It guides them how to use apparatus and chemicals in the practical laboratories (PL).

The seventh instructional material is audio-visual aids. Audio-visual aids are the teaching aids that are used in the teaching learning process. These aids play a very significant role in the teaching learning process. These aids make the teaching learning process not only realistic but also very pleasant. The use of audio-visual aids can revolutionize teaching and can help decrease forgetting and increase the permanence of what is taught (Whitebread & Adams, 2019).

Sasidhar (2020) described that the important audio-visual aids are pictures, charts, models, maps, diagrams, filmstrips, television, tape recorders, radio and motion pictures. All these audio-visual aids are used in the classrooms of the advanced countries and many developing countries. Computer is regarded as a necessary tool for learning. It is used as an instructional material in the western countries.

Contrary to it, computer is not used as an instructional material at some public schools' level in Nigeria. Maps, models, charts and overhead projector are the four types of audio-visual aids provided to the secondary schools. Map is a non-projected and two-dimensional aid. It is an accurate representation in a diagrammatic form of the geographical features of the earth or some part of it.

There are varieties of maps like geographical maps, picture maps, political maps and navigation maps, and so on. However, an outline map should be used if a particular view is required. Likewise, the individual atlases are used for the detailed study of a problem. Furthermore, teacher use blackboard for clarification of points derived from map.

Model is a non-projected but three-dimensional visual aid. It has not only length and width but also has depth. Teacher show models to students instead of the real object. Model is used when there is impossible to show the real object to the class owing to its size or their inaccessibility.

Models also provide the interior views of objects that are normally covered or otherwise invisible. It conveys the exact shape of the object whether its size would be smaller or larger. Furthermore, it may have almost the same appearance and color except its size. The model in one piece with its parts not moving is called the static model.

However, if the parts of a model are detachable, the model is called sectional. A sectional model is helpful in explaining the function of each part and its relation to the whole object, for example human eye, steam engine. However, teacher explains and demonstrates its working in the classroom.

A chart is a pictorial way of representing relationships between the several variables or objects and ideas or things. Elleström(2020) described that charts are generally used during lecture and discussion about the relationships of the things. The author, then, counted some characteristics of chart. According to him, words are written neatly and perfectly in block letters in Charts.

Likewise, each item may be written inside a box, lines are drawn, and if necessary, arrows are placed to indicate relationships and directions of flow. Colors may be used to make the chart attractive. The author also described that different items of food and their proper proportion to constitute a balanced diet can be shown in a chart.

Similarly, a chart may also be prepared to compare and contrast two things. In the same way, a flow chart may be prepared to show how a particular thing or products flows or moves through different steps or departments in an organization. Furthermore, the device that projects the small transparencies in to larger views on the board is called overhead projector.

Through overhead projector, students are able to read, look and understand the text, graph, picture or anything other written or drawn on the transparencies. Overhead projectors are becoming common and popular, and are widely used in normal teaching, especially in the seminars and workshops. An overhead projector is provided only to the urban public secondary schools. However, it is rarely used as an instructional material in the classrooms of public schools in Nigeria.

2.2.2 Advantages of instructional media in teaching and learning.

There are many advantages of using instructional media in teaching and learning. There are two experts discussed advantages of instructional media. Those experts are (Oweis,2018) and (Sasidhar,2020). The first expert, Oweis (2018), stated that there are seven advantages of using media. The first is to motivates students to learn English as implementation of new multimedia technology in teaching that includes audio, visual and animation effects encourages students to learn English efficiently. The second one is developing students' communicative competence through employment of media in language classroom that may increase students' activity and students' communicative competence. The third is to widens students' knowledge about the culture of English so that students do not only improve their ability in English but students can also learn the cultural background of the language that can make them motivated to learn. Then, improves teaching efficiency as media in language classroom provide real-life environment for students, could give students more information and improves teaching efficiency.

Enhances interaction among students and between teachers and students since the use of media can attract students to be more active in classroom and it improves communication between teacher and students. Then, creates a conducive teaching environment in the classrooms since using media while teaching will develop dynamic involvement of teacher and students and it can produce positive language classroom. And the last is to provides opportunities for English teaching outside the classrooms so that teacher able to conduct teaching outside classroom since the students can contact the teacher using the internet.

Sasidhar (2020), the second expert, argued that the advantages of using non-projected media are English teaching and learning become more efficient, provide a lot of useful information and saving a lot of time.

2.2.3 Disadvantages of instructional media in teaching and learning.

Apart from the advantages of the use of instructional media in teaching and learning, there is also disadvantages. Statements of three experts who discussed disadvantages of instructional media presented in this study. Those experts are Oweis(2018) and Sasidhar(2020).

Oweis (2018) explained that there are some disadvantages of using non projected media in language classroom. The first disadvantages is that it emphasis on the supplementary of effective teaching because the teacher will lose their key role as facilitator because the teacher perhaps become very dependent to non-projected media in classroom. The second one is that it is easy to damage with the regular use of the media. They many not be suitable for use in a large group of pupils to view it. The last is expensive way of conducting language classes as the use of non-projected media in language classroom can be very expensive because the school need to buy the materials and so on. to support the use of non-projected media in classroom.

Sasidhar (2020), the second expert, stated that the disadvantages of using non-projected media is that students can feel lost and they do not know what to choose because there is so many information provided by non-projected media.

2.2.4 Selection and Use of Media in Teaching and Learning

Models for media selection range from simple procedures or algorithms to complex theoretical schemes. Some are based on the communication ‘channel’ being used (audio, video, and so on.) or the characteristics of the media itself. Others emphasize the learning outcomes being addressed, while still others focus on learner attributes or educational theory or the teaching-learning process.

Carrillo and Flores (2020) have identified nine key factors that should influence media selection as institutional resource constraints, course content appropriateness, learner characteristics, professor attitudes and skill levels, course learning objectives, the learning relationships, learning location, time (synchronous versus asynchronous), and media richness level.

Tesfa michael (2019) have distilled these nine factors down to three major criteria for selecting instructional media: practicality, student appropriateness, and instructional appropriateness. These are explained as follows:

Practicality: Is the intended media practical, in that the media is available, cost efficient, time efficient, and understood by the instructor?

Student Appropriateness: Is the intended media appropriate for the developmental and experiential levels of the students?

Instructional Appropriateness: Is the intended media appropriate for the planned instructional strategy? Will the media allow for the presentation of the proposed lesson in an efficient and effective manner? Will the media facilitate the students' acquisition of the specific learning objectives?

On the other hand, Carrillo and Flores (2020) specify three major constraints that operate on media selection, each of which may impede the selection process. These constraints include the following:

(Un) availability of Materials: Using existing instructional materials can facilitate the creation of instructional units; however, if no appropriate materials exist, then the instructor must create the materials. This usually leads to a production constraint.

Production Constraints: Creating quality instructional media can be a costly, in both time and money, enterprise. A central question to answer is what level of media quality is acceptable, that is, both time and cost efficient as well as instructionally effective.

Instructor Facilitation: Most forms of instructional media involve teacher modeling, demonstration, implementation, or more broadly, facilitation. The amount or difficulty of this process of media facilitation may inhibit a teacher's ability to effectively utilize the particular media.

However efficient and effective management of teaching and learning with regard to the use of instructional media, to a great extent, is due to factors such as availability and utilization of instructional materials, learner characteristics, teacher's personality and institutional support (Kaewsaiha & Chanchalor, 2020). Just as the educational process is influenced by many factors, so is the selection of instructional media. Other factors are the knowledge base of learners, age and ability of learners, and subject to be taught, among others. As suggested by Darling-Hammond *et al*., (2020) in relation to the choice and use of media, any instructional situation must provide for four learner needs: stimulation, order, strategy and meaning. This means that for learning to be achieved, the appropriate stimuli for derived responses can be well facilitated by being able to engage the learner's senses of hearing, seeing, touching, which in no doubt should follow a planned pattern or procedure.

Instructional media are substances that leave marks on the learner and the learning situation. Darling-Hammond *et al*., (2020) makes it clear that instructional media which precede written texts help to express the psychological dimension of life. Many textbooks have more texts than are needed or texts that may not be suitable in or one way or another. When the right instructional media is selected and used skillfully at the right time, in the right place and in the right manner,

Darling-Hammond *et al*., (2020) they can help widen the channels of communication between the teacher and learner. Therefore, before using any instructional media, the teacher should consider the appropriateness of the media in order to select what could satisfy the objectives of the lesson for which they were selected. It is important that during teaching, the teacher matches the lesson and corresponding activities to determine the type of instructional medium to be selected for use.

2.2.5 Mathematics achievement

Mathematics is one of the formal disciplines that help man lay a solid foundation for future survival. Scientific and technological developments are dependent on mathematics. Furman, (2017), defines mathematics as a fundamental human activity-a way of making sense of the world. Gravemeijer *et al*., (2017), sees mathematics as essential tool in the formation of the educated man. Because of its importance, Nigeria has made mathematics compulsory in both primary and secondary School curriculum (Olumuyiwa & Akinsola, 2021) in order to give a sound basis for scientific and reflective thinking, and prepare students for the next level of education.

Its application in other disciplines, mostly in sciences, is appreciative and without it, knowledge of the sciences remains superficial. However, a considerable number of students have inadequate understanding of mathematics and mathematical concepts and skills (Verschaffel *et al*., 2020).

Mathematics is used as a basic entry requirement into any of the prestigious courses such as medicine, architecture and engineering among other degree programs. Despite the important role that mathematics plays in the society, there has been poor performance in Mathematics in Nigerian national examinations (Ogunleye, 2019). Several factors have been attributed to poor performance in mathematics among which are poor methods of teaching (Acharya, 2017), poor interest in mathematics, lack of appropriate instructional materials for teaching mathematics at all levels of education (Abubakar *et al*., 2021).

Several studies have shown other indices that could affect pupils' mathematics achievement. Du (Plessis & Mestry,2019) in their study of rural education in the U.S showed that classes and Schools differ in terms of their learning environment and School resources. Ahluwalia and Preet

(2017) in a comparative study of public and private Schools were better equipped than their private counterparts.

TIMSS report of 2011 on mathematics result analysis showed that Mathematics achievement is improving over the years in some member Countries, Nigeria is not one though. The Governments of many countries are struggling in considering how to provide best mathematics education for their students. According to the report, students' ability in mathematics is deteriorating over their school years, as a student grows older, math competencies decrease. A country such as Chinese Taipei showed bimodal distribution on mathematics achievement with 2 peaks of high performance and high peak of low performance. This signifies that educational opportunities or resources are not equally distributed to all students (Jacobson,2019).

Identifying difficulties at an early age can prevent children from developing inappropriate strategies and misconceptions that can become long term obstacles to learning, (Theimer *et al*., 2020). Early intervention can also combat the development of anxiety which can become a significant factor among older students, (Boullier & Blair, 2018). It can be assumed in most cases that if intervention start early and specific weaknesses are concentrated upon, they might not need to be very long or intensive, (Theimer *et al*., 2020). Jacobson (2019), reported in TIMSS that beginners have much more positive attitude towards mathematics and this plays a crucial role in learning the subject, hence high achievement.

Hagler (2021) asserts that junior years are an important time of transition and growth in student's mathematical thinking. According to the report, during this time, the curriculum is changing in its content, sophistication, abstraction and expectations of student proficiency. There is also move to abstract reasoning. Junior students begin to investigate increasingly complex ideas, building on their capacity to deal with more formal concepts.

2.2.6 Non-Projected Materials

Kiptum (2020) asserts that, non-projected materials are those materials that do not require any form of projection before they can be utilized. Non projected materials are different forms of instructional materials that did not require process of projection before its operation can take place. This could include the following, textual and non-textual, chalkboard, magnetic board/soft board, flip-chart, specimen, model, and so on. Textual materials and non-textual materials refer respectively to all the print and non-print materials that are used by the teachers and learners for instructional process.

The print materials are the textbooks, magazines, periodicals, journals, and newspapers, among others while the non-print materials include charts, chalkboard, radio television, films, video tapes, audio tapes, festivals and games. He further expressed that together they assist the students in acquiring clear concepts of subject matter they are also students' best single academic friends. Moreover, they can provide security for the unprepared teacher and an escape hatch for one who is instructing outside his field of specialization.

Non-projected media resources are teaching aids that facilitate the presentation of message that does not involve the projection on the screen. Non-projected displays can be used in an extremely wide range of instructional situations, covering all class levels.

2.2.6.1 Mass instruction

This is probably where non-projected displays are capable of making their most important contribution. Indeed, many of the displays that fall into the category are specifically designed for use as visual aids during expository teaching of one form or another. In such teaching, their role is, of course, entirely supportive.

2.2.6.2 Individualised learning

Although some types of non-projected displays are of little or no use in individualized learning, others are capable of playing an extremely useful role. Models, for example, can be used in a wide range of self-instructional situations, as in various types of realia (for example. geological and biological specimens). In most cases, such materials play a key role in the instruction process by providing the actual objects of study.

2.2.6.3 Group learning

Many non-projected displays can also play a useful supportive role in group learning situations, for example. by providing visual aids during presentation/discussion-type activities such as seminars and tutorials or providing the subject matter for small-group exercises.

2.2.6.4 Chalkboard and marker-boards displays

The various dark-coloured surfaces on which displays can be written or drawn using chalk are called chalkboards and the various light-coloured surfaces on which similar displays can be produced using suitable markers, pens or crayons are called marker-boards.

Chalkboards

The chalkboard (or blackboard as it was called until it was realised that such boards were often not black) is so much a part of classrooms that it has become a symbol for education itself. Indeed, until the development of the overhead projector during the 1940's and its more recent spread into virtually every classroom and lecture theatre, the chalkboard was probably the most important of all instructional aids (apart from the printed page).

Even today, such boards are still a standard fixture in virtually all teaching arid training environments, although their use is by no means as automatic and universal as was the case in the past.

The different types of chalkboard

Until the 1950's, practically all chalkboards were black, consisting of large sheets of wood covered with matte black paint. Since then, however, most such boards have been replaced by other types of surface, such as cloth, various forms of plastic and other synthetic materials. In addition, many chalkboards are now coloured, the most common colour being green, and other widely-used colours being blue and brown. This is because coloured boards have been found to produce less glare and reflection are less prone to 'ghosting' (marks left when the chalk is rubbed out), and, in general, provide greater legibility than the traditional 'blackboard'.

Another comparatively recent development in the evolution of the chalkboard has been the appearance of the magnetic chalkboard - a surface made of ferromagnetic material covered with a thin layer of dark-coloured vitreous particles. This can be used in the same ways as magnetic marker-boards.

Marker-boards

These boards, which are also known as whiteboards, are sometimes fitted in teaching rooms instead of conventional chalkboards. They consist of large sheets of white or light-coloured plastic material with a surface texture suitable for writing or drawing on using felt pens, markers or crayons, and can be used in much the same way as chalkboards.

They have, however, a number of advantages over the latter. There is, first of all, none of the mess that always results when chalk - even the so-called 'dustless' variety - is used. Second, a much wider range of colours and tone strengths can be used, and the resulting display is invariably sharper, better defined and clearer than is possible using chalk. Third, a marker-board - unlike a chalkboard - can double up as a projection screen if required.

There is, however, one possible problem that can arise with marker-boards, namely, difficulty in cleaning the surface properly so that 'ghost' marks are not left behind. For this reason, it is strongly advisable to use only the types of marker pens or crayons that is recommended by the manufacturer of the particular board you are using, and to make sure that you know how the board should be cleaned.

In some cases, this can be done simply by wiping with a dry cloth, while in others, a special cleaning fluid or solvent is required. If this is the case, always make sure that a supply is readily available - together with a suitable cloth or eraser.

Magnetic boards

Even more useful and more versatile than felt boards and hook-and-loop boards are the various forms of magnetic board. These come in two main forms - the magnetic chalkboards and magnetic marker-boards (sheets of ferromagnetic material with specially-painted light surfaces on which material can be written or drawn using suitable markers or pens).

Both types of board enable display items made of or backed with magnetic material to be stuck to and moved about on their surfaces, and both enable this moveable display to be supplemented by writing or drawing on the board. Thus, magnetic boards can be used to produce highly sophisticated displays that enable movement and change in systems to be clearly demonstrated to a class or small group.

They are, for example, the ideal medium for demonstrating military tactics or carrying out sports coaching. For coaching a basketball or football team, for example, the field of play can be painted permanently on the board, with the individual players being identified by clearly - marked magnetic discs that can be rearranged and moved about as and when required, and the various movements, run patterns and so on. being shown by adding suitable arrows or lines using chalk or marker pens.

2.2.6.5 Charts, posters and similar flat display materials

The various forms of chart, poster and other flat pictorial display materials have always been among the most useful and versatile visual aids at the disposal of teachers and instructors of all types.

Flipcharts

These constitute an extremely simple (and, when used in an appropriate context, highly effective) method of displaying information to a class or small group. Such charts consist of a number of large sheets of paper, fixed to a support bar, easel or display board by clamping or pinning them along their top edges so that they can be flipped backwards or forwards as required.

Such charts can be used in two basic ways. First, they can be used to display a succession of pre-prepared sheets, which can be shown in the required order either by flipping them into view from the back of the suspension system one by one or by revealing each successive sheet by flipping the previous one over the back of the suspension system out of the way. If the former method is to be used, the sheets should be clamped to the display system in reverse order of showing, for example. with the one to be shown last uppermost; with the latter method, the sheets should be clamped to the display system in the correct order of showing for example. with the one to be shown first uppermost.

When preparing such flip chart sequences, it is best to keep the message or information on each sheet fairly simple, since this increases their impact. Also, it is obviously essential to make sure that they can be read or seen clearly by all members of the class or group; again, you should check this for yourself by inspecting them from the back of the class or furthest distance from which they have to be viewed.

The other main way in which flipcharts can be used is by providing an instantly-renewable series of blank surfaces on which material can be jotted down on an impromptu basis in the course of a lesson, group discussion or other activity. They can, for example, be used to list replies from class members to questions or ideas generated by buzz groups.

Charts and Wall charts

The various forms of chart and wallchart have always been popular in all sectors of education and training because of their versatility and ease of use, and, even with the spread of more sophisticated visual aids such as slides, films and videos, are still capable of playing an important role in such work. Although the distinction between charts and wallcharts is sometimes a bit blurred, the former term is generally taken to refer to displays on large sheets of paper or cloth that are designed to be shown to a class or group in the course of a lesson.

The latter term is used to describe similar displays that are pinned to a wall or bulletin board and are mainly intended for casual study out with the context of a formal lesson. Another distinction between the two groups is that the material on charts is usually larger and easier to see or read than that on wall charts, since the former has to be clearly distinguishable or legible at a distance whereas the latter can be studied at close quarters. Apart from this, however, the principles that underlie the design of the two are basically the same.

One of the great advantages of both charts and wallcharts is that they can be made fairly large, and can thus contain far more complicated and more detailed displays that it would be possible to incorporate on (say) an OHP transparency or a 35mm slide. They can, for example, be used to show highly detailed maps (one of their most important and most universal uses) and detailed structural, taxonomic, and organizational diagrams of all types.

Posters

These are similar in many ways to charts, but are usually smaller, simpler and bolder in content and style. Their main uses in the classroom are as a means of providing decoration, atmosphere and motivation, although they can also be used to make or remind learners of key points.

2.2.7 Three-dimensional display materials

2.2.7.1 Mobiles

A mobile is, in essence, a three-dimensional wall chart in which the individual components can move about. Instead of displaying a related system of pictures and words on the flat surface of a wall, they are drawn on card, cut out, and hung independently from the roof (or a suitable beam) using fine threads. The resulting display, which turns and changes shape as it is affected by random air currents, acquires a vitality which can never be produced in a flat display of the same material.

Such mobiles can be suspended in a corner of a classroom, where they will not get in people's way, but will still be clearly visible to the pupils. They are particularly suitable for use with younger pupils, who are generally fascinated by the continuous movements that take place in such displays, thus helping to fix the information that they carry in their minds.

2.2.7.2 Models

Models (this are recognizable three-dimensional representations of real things or abstract systems) can play an extremely useful role in a wide range of instructional situations. They are, however, particularly useful in three specific roles, namely, as visual support materials in mass instruction, as objects for study or manipulation in individualised learning, and as construction projects for individuals, small groups or even entire classes. When using models in the first of these roles, however, it should be remembered that even the best three-dimensional model invariably appears two dimensional except to those who are very close, so it is usually worthwhile getting the learners to gather round the model when its salient features are being demonstrated; unless you do this, you could probably achieve the same objectives in most cases by using a two-dimensional representation such as a slide or OHP transparency.

Some specific applications of models are:

1. They can be used to reduce very large objects and enlarge very small objects to a size that can be conveniently observed and handled.

2. They can be used to demonstrate the interior structures of objects or systems with a clarity that is often not possible with two-dimensional representations.

3. They can be used to demonstrate movement - another feature that it is often difficult to show adequately using two-dimensional display systems.

4. They can be used to represent a highly complex situation or process in a simplified way that can easily be understood by learners; this can be done by concentrating only on essential features, eliminating all the complex and often confusing details that are so often present in real-life systems.

2.2.8 Visualization in the Teaching and Learning of Mathematics

The history of visualization within mathematics education is a long one. Since the beginning of the 1980s mathematics educators are interested in the practical challenges of teaching visualization, in visualization of mathematics as exhibits in school or aligned with educational psychology and are looking for theoretical frameworks.

Nearly all researchers offer a common picture for which a mathematician's success owes a considerable amount to visualization skills (Amevor, 2019). On the other hand, the history of mathematics shows visualization to have been cut back and even avoided to a certain extent. In the time of Leonhard Euler, the visual was also used as a means for proving or establishing the existence of a mathematical object, whereas the mathematicians of the 19th and 20th century reduced the use of visualization for gaining new ideas when solving problems.

Heuristics was the task of visualization. It is suspected that this gap between the two trends was one reason why dealing with visualization became a significant topic for researchers in mathematics education. Beyond the specific domain, for the last two decades there have been a growing interest in the use of images as a general cultural change. It was Thomas Mitchel's dictum that the linguistic turn is followed now by a "pictorial turn" or Gottfried Boehm's "iconic turn".

Their concentration on visualization in cultural sciences is based on their interest in the field of visual arts and it is still increasing (Marshall, 2019). Other technology-enabled visualization developments such as medical imaging, which have introduced sophisticated methods for reconstructing and manipulating images, changed the public and scientific conventions in regard to what formerly was invisible.

As happened with modern telescopes which allow one to see nearly infinite distant objects or microscopes which bring the infinitely small to our eye structures become visible and with this kind of visibility, they become a part of the scientific debate. Visualization technology causes new paradigms to be developed as structures that could only be speculated about are now subjects of scientific debate. It could be said that their ontological status has changed and, in that regard, images became a major epistemological factor.

Such new developments, caused substantial endeavor within cultural science into investigating the use of images from different perspectives. The introduction to “Logik des Bildlichen”, which can be translated as “The Logic of the Pictorial”, focuses on the meaning of visual thinking.

In this chapter, they formulated several relevant questions on visualization which should be answered by science of image. Among these questions were: epistemology and images, the order of demonstrating or how to make thinking visible.

When these short deliberations are considered, two positions are recognized. There is a long tradition of visualization within mathematics education which is based and supported by practical and theoretical practices. At the same time there are several recent developments within cultural science concerning visualization. Hence there is a need to find means of transmission and terms that would support the exchange of ideas and research questions between cultural science and mathematics education.

2.3 Theoretical Framework for Non-projected in Relation to Students Academic Performance

The cognitive theory of multimedia learning is adopted. The theory is based on Perkoski (2017) multimedia principle which basically posits that people learn more deeply from words and pictures than from words alone. It draws knowledge from Paivio’s Dual coding theory, Sweller’s Cognitive load theory and Bruner Constructivist theory and was made popular by Perkoski and other cognitive researchers. The major argument of the cognitive theory of multimedia learning is that multimedia supports the way that human brain learns and process information and, therefore, students would learn, achieve and perform more if multimedia content such as images and objects were used with words to facilitate learning. The theory further posits that for meaningful learning to occur, a learner engages in three cognitive processes namely; selection, organization and integration of received information which consists of text and images.

2.3.1 Selection

In this cognitive process, learners select relevant words and pictures. Perkoski (2017) studies showed that learners' verbal and visual memory is limited. To overcome memory limitation, learners need to select only a portion of the presented words or pictorial material. The relevant words selected by the learner pass through auditory sensory memory while the relevant part of the presented pictorial information selected by the learner pass through visual channel though it is possible to convert part of it to the auditory channel (for example, by mentally narrating an ongoing animation).

2.3.2 Organization

Relevant words and images selected by learner are then organized into a coherent representation. This process involves a learner building connections among pieces of verbal or pictorial knowledge. The process occurs in the auditory and visual channels respectively and is subjected to the same memory limitations that affect the selection process. In organizing, Perkoski (2017) argues that learners do not build all possible connections among words or images, but rather they focus on building simple set of connections or a simple structure that makes sense to the learner such as a cause and effect chain.

Therefore, when a learner is presented with textual and pictorial content which is well organized in advance, it assists him/her to make connection with easy and helps to build one's own simple structure. Perkoski (2017) stated that organization is crucial in learning since the learner increases the likelihood of remembering as he/she repeats well-organized verbal and pictorial information in his memory.

2.3.3 Integration

According to Perkoski (2017), integration is the most significant stage in multimedia learning as it involves making connections between word-based and picture-based information. Studies conducted by Perkoski (2017) have shown that meaningful learning occurs as a result of learner's attempts to combine verbal and visual information. Cognitive multimedia theory upholds that linking the verbal and pictorial model helps the two to complement and assist each other.

Therefore, the learner can understand effectively because the different models are processed simultaneously. Integration happens when a teacher presents the content using both words and visual aids such as images. Hence, textual and pictorial information complement each other in learning.

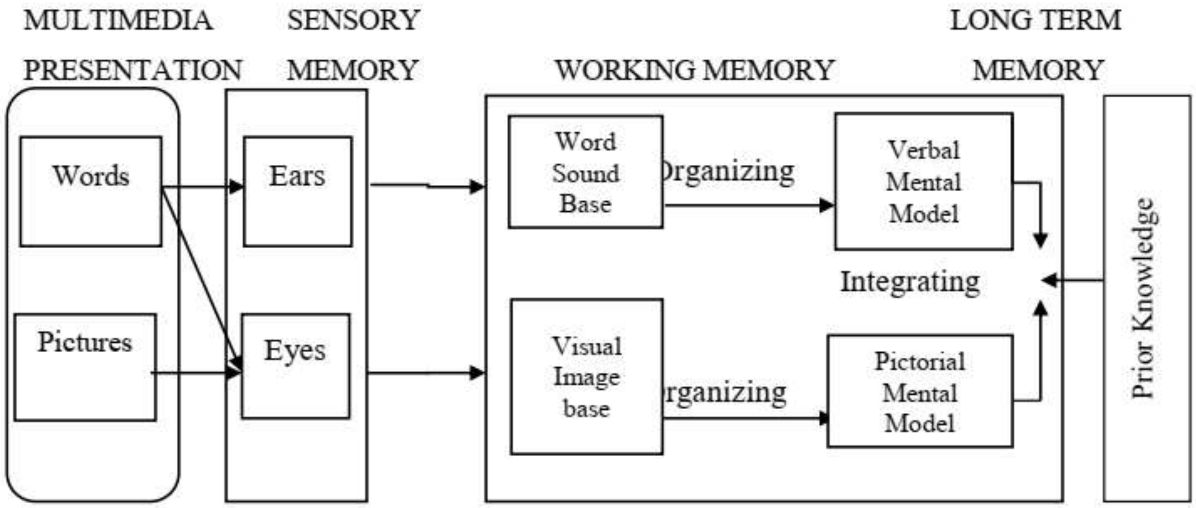


Figure 2.1 Multimedia Theory of Learning

Source: Multimedia theory of learning adapted from Kanellopoulou *et al*., (2019)

2.4 Empirical Studies

Quite a number of studies have been conducted by various researchers in the area of visual aids and student's performance. This speaks of the value of visual aids in education and teaching process in this part of dissertation a few of the findings related to visual aids and its impact to student's achievement and performance are going to be reviewed.

There have being a couple of research carried out on the impact of media (projected and non-projected) on students' achievement and retention in mathematics. Kiptum (2020) evaluated the frequency of use of non-projected media resources in the teaching Geography in public secondary schools in Koibatek Sub-County in Kenya. A sample of 70 Geography teachers, 35 head teachers and 314 students were sampled using purposive and stratified random sampling. Data collection was done by use of questionnaires, observation and content analysis. Data was analyzed using descriptive statistical methods. The results were then presented in pie charts, graphs and tables.

Kiptum (2020) established that most schools had non-projected resources, though a limited supply and were rarely used. However, some schools lacked some important resources such as Geography rooms, facilities for field work, weather station and library services. Constraints emanating from heavy work load, heavy curriculum and inept administration were found to undermine to effective use of these resources in teaching Geography.

Kiptum (2020) In the study, recommended an urgent review of curriculum and increased supervision to ensure that curriculum is highly implemented, and refresher courses be given to teachers on the use of these resources. Geography is one of subjects that can be studied as a physical or social science at high schools' level. In secondary education it is currently an optional subject at upper secondary education.

There have been concerns over declining performance in Geography at national examination, especially areas that test students' knowledge of field work, map work and physical Geography. Coincidentally these are the areas where non-projected media resources are most used.

Nusir, *et al*., (2012) studied the impact of using multimedia interactive programs at children ability to learn basic math skills. The continuous inventions and evolutions in all information technology fields open new channels and opportunities to enhance teaching and educational methods. In one side, those may improve the abilities of educators to present information in an interactive and media enhanced formats relative to traditional methods.

This may help students or learners through offering them the information in channels and methods that can be easier to understand, deal with, and retrieve. On the other hand, offering those alternative methods of teaching can be helpful particularly for children, people with special needs, or students in rural areas where they can have virtual or remote instructors especially for majors that have shortages.

The purpose of their study was to investigate the impact of utilizing multimedia technologies on enhancing, or not, the effectiveness of teaching students at early stages in Jordanian primary schools. A test was developed to assess the students' abilities to understand mathematical basic knowledge and skills. Two groups were selected from a local school based on their own class distribution where one group was taught the subject in basic math using a program developed for the purpose. The second class was taught the same subject using traditional methods of teaching (for example. direct student to child instruction, board, and so on.).

The results of their research showed that in such math skills at this age, using programs or multimedia enhanced methods of teaching can be effective in getting students attention especially when cartoon characters are used. Results also showed that there was no significant difference in learning and knowledge skills and information absorption based on gender distribution where results comparison between little boys and girls showed no significant difference in their learning skills.

Gebre Yohannes *et al*., (2016), examined issues within the new frontier of integrating technology into mathematics education. They presented an approach on how to teach mathematics courses by integrating meaningful multimedia technology to foster the learning process. Their paper focused on how the integration of multimedia-based teaching approach into a Calculus and

Numerical Methods module impacts student's performance and their attitudes toward educational technology.

They collected empirical data from controlled and experimental group students enrolled into this mathematics module which included students' engagement using traditional and multimedia technology teaching and learning process. From the results of the research, it was observed that multimedia-based teaching and learning process changes dramatically the performance of the students on the module calculus and numerical methods. The lesson presented on this way is more organized and comprehended. Multimedia is an effective tool for teaching specially modules like calculus and numerical methods which have complex difficult concepts to understand using the theoretical way of teaching. From the results, it was concluded that multimedia-based teaching and learning process is more effective than the traditional way of teaching.

Okwarai *et al.*, (2017) studied the effect of Projected Instructional Media (PIM) on Senior Secondary School Students' achievement in Biology. The study adopted the pre-test posttest non-equivalent control group design and was carried out in Educational Zone B of Benue State, Nigeria. A total of one hundred and sixty-five senior secondary one student took part in the study. The instrument for the study was Biology Achievement Test (BAT) with the reliability of 0.72 was administered to collect data for the study. Two research questions and three hypotheses were formulated to guide the study; the research questions were answered using descriptive statistics while the hypotheses were tested using Analysis of Covariance (ANCOVA).

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

This chapter consists of the methods that were used in the study such as research design, population of the study, sample and sampling technique, instrumentation, method of data collection and method of data analysis.

3.1 Research Design

The design adopted for this study is the quasi-experimental design. It is being adopted because the sample for the study will be selected in a non-random manner. Intact classes will be used because the school authorities may not allow for the disruption of their school programmes. The research design layout is shown below.

Table 3.1 Research Design Layout

Groups	Pre-test	Research instrument	Post-test	Retention
Experimental	O_1	X_1	O_3	O_5
Control	O_2	X_2	O_4	O_6

Where:

O_1 and O_2 = Pretest Scores of experimental and control group respectively

O_3 and O_4 = Post test Scores for Experimental and Control group respectively

O_5 and O_6 = retention scores of experimental and control group respectively

X_1 = experimental treatment with non-projected media

X_2 = control mode of traditional/conventional learning medium.

3.2 Population of Study

The population of the study was drawn from all Junior Secondary school students from privately owned schools within Bosso Local Government Area, Niger state with a population of two thousand, two hundred and fifteen (2215) students. The target population was focused on Junior Secondary School students II (JSS2) totaling a population of seven hundred and sixty (760) students.

3.3 Sample and Sampling Techniques

The participants that were sampled for the study comprise of 160 mathematics students in the sample schools in Bosso. Two private schools were randomly selected in Bosso local government by a simple random procedure. The two schools selected were assigned to experimental and control group.

Table 3.2 Research Population Distribution

S/N	School	Male	Female	Total
1	FEMA secondary schools	56	30	86
2	Hasha International School	41	33	74
TOTAL		**97**	**63**	**160**

3.4 Research Instrument

The research instrument used for this study is: the mathematic achievement test (MAT). The treatment instrument that were used is non-projected media which was designed by the researcher based on complex topic selected from the Junior Secondary schools' mathematics curriculum, while the test instruments are Mathematics Achievement Test (MAT) and Mathematics Retention Test (MRT).

The MAT and MRT were developed by the researcher based on approved Table of Specifications. 20 multiple choice test items were developed with 5 optional answers and only one correct answer with four other distractors.

Table 3.3 Table of Specification for Mathematics Achievement Test (MAT)

Content	Cognitive Level			Total
	Knowledge	Comprehension	Application	
Lines and Angles	6(30%)	10(50%)	1(5%)	17
Quadrilateral Shapes	-	-	3(15%)	3
Total Items	**6**	**10**	**4**	**20 (100%)**

3.5 Validity of Research Instrument

The instrument was validated by two experts from the Department of Educational Technology and Science Education Department, all in the Federal University of Technology, Minna, and one mathematics teachers for content and validity before pilot test.

3.6 Reliability of Instrument

The pilot test was conducted at Garima Standard Academy in Bosso local government area which was not part of the sampled schools. One intact class of thirty (30) students (J.S.S2) was selected and given Mathematics Achievement test (MAT) questions to read, solve and tick the right answer. The scores were computed and analysed using Pearson Product Moment Correlation (PPMC) and reliability index was 0.87 which shows that the instrument is reliable.

3.7 Method of Data Collection

The experimental and control group were taught using the Non-projected media and conventional method respectively. An achievement and retention test was administered to ascertain their achievement and retention.

Before the administration of the instrument, the researcher visited the schools with a letter from the Head of Department, Department of Educational Technology, seeking for permission to use their school and the subject teachers. The researcher trained the research assistants on how to use non-projected media for one week. Thereafter, pretest was administered to all the classes in the sample schools in Bosso Local Government. The fourth week was the commencement of the teaching using non-projected media.

3.8 Method of Data Analysis

Mean and Standard Deviation will be used to analyze the data that will provide answers to the research questions. Student's t-Test will be used to test the hypothesis of the study and will be tested at 0.05% level of significance.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introductions

This chapter presents the data collected, results and their analyses. This was done in agreement with the formulated null hypotheses stated in chapter one and it deals with the discussion of the findings of the research. The average scores the experimental and control groups were scrutinized using mean, standard deviation and ANOVA statistics as shown in tables below.

4.2 Answering Research Questions

The data collected for the purpose of this study were analyzed based on the research questions and hypotheses formulated.

RQ 1: What is the impact of Non-projected Media on the mean achievement scores of junior secondary school students taught Mathematics and those taught with the conventional method?

Table 4.1 Means and Standard Deviation of the Experimental and Control groups in Achievement Test

Groups	N	Pre-test		Post-test		Mean Difference
		$\bar{x}$	SD	$\bar{x}$	SD	
Experimental	74	44.83	1.372	79.29	9.712	34.43
Control	86	42.31	1.080	64.03	10.099	21.72

The data presented in Table 4.1 shows that the experimental group had a mean score of 44.83 and standard deviation of 1.372 in the pre-test and a mean score of 79.29 and standard deviation of 9.712 in the post-test making a pre-test post-test difference in the experimental group to be 34.43. The control group had a mean score of 42.31 and a standard deviation of 1.080 in the pre-test and a post-test mean of 64.03 and a standard deviation of 10.099 with a pre-test posttest difference of 21.72. With this result, the students in the experimental group performed better in the achievement test than the students in the control group.

RQ 2: What is the impact of Non-projected Media on retention scores of junior secondary school students taught Mathematics and those taught with the conventional method?

Table 4.2 Means and Standard Deviation of the Experimental and Control Groups in Retention Test

Groups	N	Post-test		Retention		Mean Difference
		$\bar{x}$	SD	$\bar{x}$	SD	
Experimental	74	79.29	9.712	72.07	11.651	12.53
Control	86	64.03	10.099	59.54	10.018	4.49

Results in Table 4.2, shows that the experimental group had a mean score of 79.29 and standard deviation of 9.712 in the post-test and a mean score of 72.07 and standard deviation of 11.651 in the retention making a post-test, retention scores difference in the experimental group to be 12.53. The control group had a mean score of 64.03 and a standard deviation of 10.099 in the post-test and a retention mean of 59.54 and a standard deviation of 10.018 with a post-test, retention scores difference of 4.49. With this result, the students in the experimental group were able to retain better in the test than the students in the control group.

RQ 3: What is the impact of Non-projected Media on mean academic achievement scores of male and female students taught Mathematics?

Table 4.3 Means and Standard Deviation of Achievement Mean Score Male and Female Groups of Students Taught Mathematics Using Non-projected Media

Groups	N	Pre-test		Post-test		Mean Difference
		$\bar{x}$	SD	$\bar{x}$	SD	
Male	41	43.90	12.015	79.85	9.281	35.95
Female	33	46.07	10.808	78.53	10.371	32.46

Results in Table 4.2 shows that male group had a mean score of 43.90 and standard deviation of 12.015 in the pre-test and a mean score of 79.85 and standard deviation of 9.281 in the post-test making a pre-test post-test score difference in male group to be 35.95. On the other hand, the female group had a mean score of 46.07 and standard deviation of 10.808 in the pre-test and a mean score of 78.53 and standard deviation of 10.371 in the post-test making a pre-test post-test difference of 32.46 The results show that there is a difference between the mean achievement scores of male and female students when exposed to experimental condition in favour of the male students.

Research Question 4: What is the impact of Non-projected Media on mean retention scores of male and female students taught Geometry?

Table 4.4 Means and Standard Deviation of Retention Mean Score of Male and Female Groups of Students Taught Geography Using Digital Map Software

Groups	N	Post-test		Retention		Mean Difference
		$\bar{x}$	SD	$\bar{x}$	SD	
Male	41	79.85	9.281	71.53	11.910	8.32
Female	33	78.53	10.371	72.80	11.457	5.73

Results in Table 4.4. shows that male group had a mean score of 79.85 and standard deviation of 9.281 in the post-test and a mean score of 71.53 and standard deviation of 11.910 in the retention making a post-test, retention scores difference in male group to be 8.32. On the other hand, the female group had a mean score of 78.53 and standard deviation of 10.371 in the post-test and a mean score of 72.80 and standard deviation of 11.457 in the post-test making a post-test, retention scores difference of 5.73 The results show that there is a difference between the retention scores of male and female students when exposed to experimental condition the male students were able to retain more.

4.3 Pretest Result

Table 4.5 Analysis of Variance (ANOVA) for Pretest between the Experimental and Control Groups.

Source	Sum of Square	df	Mean Square	F	Sig.
Between Group	273.101	1	273.101		
Within Group	23341.528	158	130.400	2.094	0.150
Total	23614.630	159			

*Significant at P < 0 .05

Table 4.5: The result reveals that there was no significant difference in the mean scores of Experimental and Control Groups with F (1,158) = 2.094, p > 0.05. Hence there was no significant difference between the mean achievement scores of students of Experimental and Control which indicates that both the groups are at the same level of academic achievement before the administration of treatment.

4.4 Testing Null Hypotheses.

Hypothesis One

There is no significant difference in the mean achievement scores of those students taught Geometry using non-projected media and conventional methods.

Table 4.6 Summary of Analysis of Variance (ANOVA) for Posttest between Experimental and Control Groups

Source	Sum of Square	Df	Mean Square	F	Sig.
Between Group	9994.862	1	9994.862	100.923	0.000
Within Group	17727.205	158	99.035		
Total	27722.066	159			

*Significant at P < 0.05

Table 4.6: The result reveals that there was a significant difference in the mean scores of Experimental and Control Groups with $F(1, 158) = 100.923$, $p < 0.05$. Hence the null hypothesis stated was rejected.

Hypothesis Two

There is no significant difference between the mean retention scores of those students taught Geometry using non-projected media and conventional methods.

Table 4.7 Summary of Analysis of Variance (ANOVA) for Retention between Experimental and Control Groups.

Source	Sum of Square	Df	Mean Square	F	Sig.
Between Group	6740.718	1	6740.718		
Within Group	20406.210	158	114.001	59.128	0.000
Total	27146.928	159			

*Significant at $p < 0.05$

Table 4.7: The result reveals that there was a significant difference in the retention mean scores of Experimental and Control Groups with $F (1, 158) = 59.128$, $p < 0.05$). Hence the null hypothesis stated above was rejected.

Hypothesis Three

There is no significant difference between the mean achievement scores of male and female students taught Geometry using non-projected media.

Table 4.8 Summary of Analysis of Variance (ANOVA) for Posttest between Male and Female Students.

Source	Sum of Square	df	Mean Square	F	Sig.
Between Group	29.719	1	29.719		
Within Group	6478.567	72	95.273	0.312	0.578
Total	6508.286	73			

*Significant at P < 0.05

Table 4.8: The result reveals that there was no significant difference in the mean scores of male and female students that were taught geometry with the use of non-projected media F (1, 68) = 0.312, p > 0.05. Hence the null hypothesis stated above was retained.

Hypothesis Four

There is no significant difference between the retention scores of male and female students taught Geometry using non-projected media.

Table 4.9 Summary of Analysis of Variance (ANOVA) for Retention between Male and Female Students

Source	Sum of Square	df	Mean Square	F	Sig.
Between Group	27.868	1	27.868	0.203	0.654
Within Group	9338.775	72	137.335		
Total	9366.643	73			

*Significant at P < 0.05

Table 4.9: The result reveals that there was no significant difference between the mean retention scores of male and female students taught geometry with the use of non-projected media F (1, 68) = 0.203, p > 0.05. Hence the null hypothesis stated above was retained.

4.5 Summary of Findings

The following are summaries of finding in the study:

1. The finding revealed that using non-projected media for teaching geometry, students under the Experimental group learn more than students in the Control group of the study.
2. The finding revealed that using non-projected media for teaching geometry, students under the Experimental group retained more than students in the Control group of the study.

3. The finding revealed that using non-projected media for teaching geometry, Male students learn more than Female students.
4. The finding revealed that using the non-projected media for teaching geometry, Male students learn more than Female students.

HO_1 There was a significant impact on the mean achievement scores of senior secondary school students taught geometry with non-projected media than those taught with the conventional method.

HO_2 There was a significant impact on the retention scores of senior secondary school students taught geometry with non-projected media than those taught with the conventional method.

HO_3 There was no significant impact on the mean achievement scores of Male and Female students taught geometry with the use of non-projected media.

HO_4 There was no significant impact on the retention scores of Male and Female students taught geometry with the use of non-projected media.

4.6 Discussion of Results

Hypothesis One, the summary analysis of the Posttest means scores of Experimental and Control Groups using one-way ANOVA statistics in SPSS. A p-value of 0.00 was reported indicating a difference between experimental and control groups. This reveals that there was a significant difference in the mean scores of Experimental and Control Groups with. Hence the null hypothesis stated above rejected. The differences might be as a result of additional instructional material used for the study or the gain in achievement might be a result of blending conventional teaching method with a proper instructional material for example the non-projected media used for this studies which make the findings in line with the work of Egunjobi, (2014); Lasse, (2014) Sofowora and Egbedokun, (2010) that indicates a higher gain in the achievement scores of an experimental group to that of a contorl groups.

Hypothesis Two, the analysis of the retention scores of Experimental and Control Groups using one-way ANOVA statistics in SPSS. The p-value was significant at 0.05 level. This reveals that there is a significant difference in the retention mean scores of Experimental and Control Groups. Hence the null hypothesis stated above There is no significant difference on the retention scores of junior secondary school students taught geometry with non-projected media and those taught with the conventional method is thereby rejected. This confirmed the study of Yau, (2014); Rebecca, Andrew, Simon, and David, (2012) and Lasse, (2014) their finding recommended that non-projected media should be adopted as the most effective instructional in Mathematics because of its influence on retention, more than their counter part that were strictly taught in the class using conventional teaching method only.

Hypothesis Three, the analysis of the mean scores of male and female students that were taught geometry with the use of non-projected media using one-way ANOVA statistics in SPSS. The p-value was not significant at 0.05 level. This reveals that there was no significant difference in the mean scores of male and female students that were taught geometry with the use of non-projected media. Hence the null hypothesis stated above was retained the outcome might be as a result of both genders having abilities to learning more when taught with instructional materials or that instructional materials burst their knowledge. This confirmed the study of Suwopoleme, Linus, and Jacob, (2016); Rebecca, Andrew, Simon, and David, (2012) and Taner, (2016) their finding recommended that non-projected media should be adopted as the most effective instructional in Mathematics because of its influence on achievement of male and female students that were taught geometry have similar influence on their achievement scores.

Hypothesis Four, the analysis of the retention scores of male and female students that were taught geometry with the use of non-projected media using one-way ANOVA statistics in SPSS. The p-value was not significant at 0.05 level. This reveals that there is no significant difference between the mean retention scores of male and female students taught geometry with the use of non-projected media. Hence the null hypothesis stated above there is no significant difference on the retention scores of male and female students taught geometry with the use non-projected media is thereby accepted. This confirmed the study of Suwopoleme, Linus, and Jacob, (2016); Rebecca, Andrew, Simon, and David, (2012) and Taner, (2016) their finding recommended that non-projected media should be adopted as the most effective instructional in Mathematics because of its influence on retention of male and female students that were taught students taught geometry have similar influence on their retention scores.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

Based on the foremost findings of this study, the researcher hereby draws up a conclusion that the use of Non-projected media in the teaching and learning of Geometry is effective and aids the retention, as well as achievement of students in Geometry. A further conclusion is that gender has no substantial impact on achievement and retention of mathematics student in Geometry. Non-projected Media can as such, be applied in the teaching of Geometry in secondary schools, as a means f aiding their comprehension, proficiency and achievement.

5.2 Implications of the Study

Based on the findings of the study, the following implications to education are outlined:

1. The use of Non-projected media has a significant impact on the achievement of mathematics students in Geometry. It suggests that there is a great need for teachers to apply the Non-projected media as a method in teaching topics as Geometry and other related topics. It suggests that although there have been tremendous advancements in technology and sciences, projected media has proven to be rather expensive, hence the need o apply more cost effective methods like Non-projected media, because they are developed from materials that are readily available and non-expensive.
2. The findings of this study also implies that the use of Non-projected media in teaching ,mathematics students also boosts their comprehension and retention. Teachers should be encouraged to make use of Non-projected media, most especially in rural areas where

there is a challenge of availability of more technologically inclined instructional materials. The use of media in teaching and learning can generally arouse the interest of students in a particular concept and hence enhance their achievement and retention.

5.3 Recommendation based on findings

Based on the findings of this study, the following recommendations are made:

1. Mathematics teachers should use Non-projected media in teaching difficult concepts like Geometry since the use has been found to enhance students' achievement and interest in Geometry.
2. School Principals and owners as representatives of governments in their schools should provide and equip Mathematics teachers for more effective teaching that promote students' understanding, especially by using readily available and easy to create Non-projected instructional media.
3. Niger State Government should provide in-service training/workshops/ conference in all the zones in the State to enable teachers' master the production and use of simple Non-projected Media materials in every concept in Mathematics. Computers are not enough in the state now to reach every student however, the use of Non-projected media would be a reasonable solution to such challenge.
4. Professional bodies like Science Teachers Association of Nigeria (STAN) and Mathematical Association of Nigeria (MAN) in their annual conferences should include Non-projected media to enable teachers use them in teaching the students. These bodies should equally train and encourage more teachers on the production and usage of the Non-projected media, as an alternative to the use of computers.

5.5 Suggestions for further study

The findings of this present study have made the researcher to suggest the following:

1. A study may be carried out to investigate the effect of Non-projected media in other difficult concepts in mathematics.
2. The same method may be applied in other Local governments in the state and its effect on achievement and retention of students in Geometry to be found.
3. Primary school concepts may be used such as natural numbers- prime, even, odd, and multiples of numbers. Non-projected media may be developed and used in teaching the different types of numbers and effect of the Non-projected media be found on achievement and retention of pupils in numbers.

References

Abubakar, H. O., Jemilat, I. A., &Oluranti, S. A. (2021). AVAILABILITY AND USE OF AUDIO-VISUAL MATERIALS FOR TEACHING MATHEMATICS AT THE SENIOR SECONDARY SCHOOL IN IBADAN, SOUTHWEST LOCAL GOVERNMENT, OYO STATE. *Library Philosophy and Practice*, 1-17.

Acharya, B. R. (2017). Factors affecting difficulties in learning mathematics by mathematics learners. *International Journal of Elementary Education*, *6*(2), 8-15.

Ahluwalia, A. K., & Preet, K. (2017). The Influence of Organizational Commitment on Work Motivation: A Comparative Study of State and Private University Teachers. *IUP Journal of Organizational Behavior*, *16*(2).

Amevor, G. (2019). *Analysis of matlab instruction on rural-based pre-service teachers' spatial-visualisation skills and problem solving in vector calculus* (Doctoral dissertation, University of Zululand).

ANAEKWE, U. G., & OFORDUM, C. M. (2021, February). IMPACT OF SCIENCE, TECHNOLOGY, ENGINEERING AND MATHEMATICS (STEM) ON ECONOMIC GROWTH AND DEVELOPMENT IN ANAMBRA STATE, NIGERIA. In *Conference* (Vol. 2, No. 1, pp. 29-37).

Anderson, S. (2019). *Audio Visual Aids in Education*. Scientific e-Resources.

Bal-Taştan, S., Davoudi, S. M. M., Masalimova, A. R., Bersanov, A. S., Kurbanov, R. A., Boiarchuk, A. V., &Pavlushin, A. A. (2018). The impacts of teacher's efficacy and motivation on student's academic achievement in science education among secondary and high school students. *EURASIA Journal of Mathematics, Science and Technology Education*, *14*(6), 2353-2366.

BAWA, N. (2016). Effects of instructional materials (computer) in promoting Secondary Schools students' academic performance in Computer Science in Kebbi State, Nigeria. *Journal of Advance Research in Social Science and Humanities (ISSN: 2208-2387)*, *2*(7), 01-16.

Boullier, M., & Blair, M. (2018). Adverse childhood experiences. *Paediatrics and Child Health*, *28*(3), 132-137.

Carrillo, C., & Flores, M. A. (2020). COVID-19 and teacher education: a literature review of online teaching and learning practices. *European Journal of Teacher Education*, *43*(4), 466-487.

Cogan, L. S., Schmidt, W. H., & Guo, S. (2019). The role that mathematics plays in college-and career-readiness: evidence from PISA. *Journal of Curriculum Studies*, *51*(4), 530-553.

Darling-Hammond, L., Flook, L., Cook-Harvey, C., Barron, B., &Osher, D. (2020). Implications for educational practice of the science of learning and development. *Applied Developmental Science*, *24*(2), 97-140.

Das, K., Mondal, R., Chowdhury, R., Boral, D., & Paul, R. (2019). Applications of mathematical knowledge in history, geography, fine-arts & physical education subjects in two-year B. Ed. program: Indian context. *Journal of Emerging Technology and Innovative Research*, *6*(6), 8-15.

Du Plessis, P., &Mestry, R. (2019). Teachers for rural schools–a challenge for South Africa. *South African Journal of Education*, *39*.

Dunn, T. J., & Kennedy, M. (2019). Technology Enhanced Learning in higher education; motivations, engagement and academic achievement. *Computers & Education*, *137*, 104-113.

Elleström, L. (2020). The Modalities of Media II: An Expanded Model for Understanding Intermedial Relations. In *Beyond Media Borders, Volume 1* (pp. 3-91). Palgrave Macmillan, Cham.

Ernest, P. (2018). The Ethics of Mathematics: Is Mathematics Harmful?. In *The philosophy of mathematics education today* (pp. 187-216). Springer, Cham.

Fatade, A. O., Mogari, D., &Arigbabu, A. A. (2013). Effect of Problem-Based Learning on Senior Secondary School Students' Achievements in Further Mathematics. *Acta DidacticaNapocensia*, *6*(3), 27-44.

Furman, C. E. (2017). Making sense with manipulatives: Developing mathematical experiences for early childhood teachers. *Education and Culture*, *33*(2), 67-86.

GebreYohannes, H. M. , Bhatti, A. H., & Hasan, R. (2016). Impact of multimedia in Teaching Mathematics. *International Journal of Mathematics Trends and Technology (IJMTT) – Volume 39 Number 1- November 2016*

Gess-Newsome, J., Taylor, J. A., Carlson, J., Gardner, A. L., Wilson, C. D., &Stuhlsatz, M. A. (2019). Teacher pedagogical content knowledge, practice, and student achievement. *International Journal of Science Education*, *41*(7), 944-963.

Gravemeijer, K., Stephan, M., Julie, C., Lin, F. L., &Ohtani, M. (2017). What mathematics education may prepare students for the society of the future?. *International Journal of Science and Mathematics Education*, *15*(1), 105-123.

Hagler, M. A. (2021). *A Longitudinal Investigation of First-Generation College Students' Mentoring Relationships during Their Transition to Higher Education* (Doctoral dissertation, University of Massachusetts Boston).

Howard, R. (2019). Faeries, Aliens, and Leviathans: Science and Fantasy in Ian McDonald's King of Morning, Queen of Day. *Irish University Review*, *49*(2), 290-303.

Jacobson, M. T. (2019). *Asian Americans in Educational Research: The Use of Disaggregated Racial and Ethnic Subgroup Data* (Doctoral dissertation, University of Minnesota).

Kaewsaiha, P., &Chanchalor, S. (2020). Factors affecting the usage of learning management systems in higher education. *Education and Information Technologies*, 1-21.

Kalthoff, H., Wiesemann, J., Lange, J., & Roehl, T. (2020). The meaning of things. Didactic objects and the implementation of educational theory. *Pedagogy, Culture & Society*, *28*(2), 281-298.

Kanellopoulou, C., Kermanidis, K. L., &Giannakoulopoulos, A. (2019). The dual-coding and multimedia learning theories: Film subtitles as a vocabulary teaching tool. *Education Sciences*, *9*(3), 210.

Kátai, Z. (2021). Algorythmics. Technologically and artistically enhanced computer science education.

Kiptum, C. K. (2020). Evaluating the Frequency of Use of Non-Projected Media Resources in the Teaching Geography in Public Secondary Schools in Koibatek Sub County. *East African Scholars J Edu Humanit Lit;* Vol-3: Iss- 9 (Sep, 2020): 485-491

Marshall, J. (2019). *Integrating the visual arts across the curriculum: An elementary and middle school guide*. Teachers College Press.

Mazana, Y. M., Suero Montero, C., &Olifage, C. R. (2019). Investigating students' attitude towards learning mathematics.

Moore, T. J., Brophy, S. P., Tank, K. M., Lopez, R. D., Johnston, A. C., Hynes, M. M., &Gajdzik, E. (2020). Multiple representations in computational thinking tasks: a clinical study of second-grade students. *Journal of Science Education and Technology*, *29*(1), 19-34.

Nusir, S., Alsmadi, I., Al-Kabi, M., &Sharadgah, F. (2012). Studying the Impact of using Multimedia Interactive Programs at Children Ability to Learn Basic Math Skills. Acta DidacticaNapocensia, ISSN 2065-1430 Volume 5 Number 2, 2012

Ogunleye, B. O. (2019). Effects of concrete-representational-abstract instructional strategy on chemistry performance of students with mathematics learning difficulties in Ogun State, Nigeria. *KIU Journal of Education*, *14*(2), 135-151.

Okwarai, O. K., Anyaghii, P. I., &Ikyaan G. S. (2017). Effect of Projected Instructional Media on Senior Secondary School Students Achievement in Biology. *International Journal of Scientific Research in Education*, May 2017, Vol. 10(2), 137-147.

Olumuyiwa, S. A., &Akinsola, M. K. (2021). Interactive E-Note and Problem-Solving Strategies Effects on Junior Secondary School Students' Achievements in Mathematics, Kaduna-Nigeria. *Contemporary Mathematics and Science Education*, *2*(1), ep21008.

Oweis, T. I. (2018). Effects of using a blended learning method on students' achievement and motivation to learn English in Jordan: A pilot case study. *Education research international*, *2018*.

Pace, A., Alper, R., Burchinal, M. R., Golinkoff, R. M., & Hirsh-Pasek, K. (2019). Measuring success: Within and cross-domain predictors of academic and social trajectories in elementary school. *Early Childhood Research Quarterly*, *46*, 112-125.

Perkoski, R. (2017). *The impact of multimedia feedback on student perceptions: Video screencast with audio compared to text based email* (Doctoral dissertation, University of Pittsburgh).

Rapanta, C., Botturi, L., Goodyear, P., Guàrdia, L., &Koole, M. (2020). Online university teaching during and after the Covid-19 crisis: Refocusing teacher presence and learning activity. *Postdigital Science and Education*, *2*(3), 923-945.

Roberts, B. R., &Wammes, J. D. (2021). Drawing and memory: Using visual production to alleviate concreteness effects. *Psychonomic Bulletin & Review*, *28*(1), 259-267.

Sasidhar, P. V. K. (2020). Unit-3 Audio-Visual Aids. Indira Gandhi National Open University, New Delhi.

Sephania, N., Too, J. K., &Kipng'etich, K. J. (2017). Perception of teachers on availability of instructional materials and physical facilities in secondary schools of Arusha district. *Tanzania. Journal of Teachers*, *4*(28), 68-102.

Tesfamichael, G. (2019). *Effects of Computer-Mediated Communication (CMC) on EFL Students' Pragmatic Competence* (Doctoral dissertation).

Theimer, K., Mii, A., Sonnen, E., McCoy, K., Meidlinger, K., Biles, B., ... & Hansen, D. J. (2020). Identifying and addressing barriers to treatment for child sexual abuse survivors and their non-offending caregivers. *Aggression and violent behavior*, 101418.

Timms, M. J., Moyle, K., Weldon, P. R., & Mitchell, P. (2018). Challenges in STEM learning in Australian schools: Literature and policy review.

Turşucu, S., Spandaw, J., Flipse, S., & de Vries, M. J. (2017). Teachers' beliefs about improving transfer of algebraic skills from mathematics into physics in senior pre-university education. *International Journal of Science Education*, *39*(5), 587-604.

Verschaffel, L., Schukajlow, S., Star, J., & Van Dooren, W. (2020). Word problems in mathematics education: a survey. *ZDM*, *52*(1), 1-16.

Walker, R. M., Lee, M. J., James, O., & Ho, S. M. (2018). Analyzing the complexity of performance information use: Experiments with stakeholders to disaggregate dimensions of performance, data sources, and data types. *Public Administration Review*, *78*(6), 852-863.

Whitebread, D., & Adams, J. (2019). How Children Learn: Implications for Early Childhood Education. *The SAGE Handbook of Developmental Psychology and Early Childhood Education*, 309.

APPENDIX A

NON-PROJECTED MEDIA METHOD LESSON PLAN ON GEOMETRY

SUBJECT: GEOMETRY

CLASS: JSS2

GENDER: MALE &FEMALE

AGE: 13 &14

DATE: July 2021

INSTRUCTIONAL OBJECTIVE

At the end of the lesson the student should be able to:

1. Define Geometry.
2. Explain the difference between parallel line and perpendicular line.
3. Relate quadrilaterals to objects in the environment
4. Describe the properties of parallelogram, kite, and square

INSTRUCTIONAL MATERIALS: These include Flip Chart, protractor, set square, chalk board or white board, marker.

ENTRY BEHAVIOUR: The students are familiar with Shapes and Angles

INSTRUCTIONAL PROCEDURE

Content Development	Teacher's Activities	Student's Activities	Skills Strategies
Introduction	The teacher asks the students to explain what they understand by geometry. The teacher uses the types of relationships the students have to define and explain the meaning of Geometry	The students answer the teachers questions that further clarifies the terms to them.	Set Induction
Lines and Angles	The teacher uses a Flip chart which is non projected media to explain Lines and Angles	The students pay attention	Questioning
Quadrilateral shapes	Using a Flip chart, the teacher shows step by step identify and show how various quadrilaterals relate to each other.	The students listen to the teacher explains the different shapes and properties of Quadrilateral shapes. The student write down notes and illustrate more on the shapes	Listening Questioning Explaining reinforcement
Evaluation	The teacher ask the following questions to the students; 1. Define Geometry 2. Identify the Quadrilateral shapes and properties 3. Show how the various Quadrilaterals relate to each other	The students respond and write down the answers to the teacher's questions	Closure

APPENDIX B

CONVENTIONAL METHOD LESSON PLAN ON GEOMETRY

SUBJECT: GEOMETRY

CLASS: JSS2

GENDER: MALE &FEMALE

AGE: 13 &14

DATE: July 2021

INSTRUCTIONAL OBJECTIVE

At the end of the lesson the student should be able to:

5. Define Geometry.
6. Explain the difference between parallel line and perpendicular line.
7. Relate quadrilaterals to objects in the environment
8. Describe the properties of parallelogram, kite, and square

INSTRUCTIONAL MATERIALS: These include Flip Chart, protractor, set square, chalk board or white board, marker.

ENTRY BEHAVIOUR: The students are familiar with Shapes and Angles

INSTRUCTIONAL PROCEDURE

Content Development	**Teacher's Activities**	**Student's Activities**	**Skills Strategies**
Introduction	The teacher asks the students to explain what they understand by geometry. The teacher uses the types of relationships the students have to define and explain the meaning of Geometry	The students answer the teachers questions. The student listen carefully as the teacher introduces the lesson. They ask questions that further clarified the term.	Listening and questioning
Lines and Angles	The teacher to explain Lines and Angles. The teacher draws on the board and explains the various Angles in Geometry	The students pay attention and ask questions. The students listen as teacher explains while the students write down notes	Listening Questioning Explaining reinforcement
Quadrilateral shapes	Using a the chalk board, the teacher shows examples and step by step identify and show how various quadrilaterals relate to each other.	The students listen to the teacher explains the different shapes and properties of Quadrilateral shapes. The student write down notes and illustrate more on the shapes	Listening Questioning Explaining reinforcement
Evaluation	The teacher ask the following questions to the students; 1. Define Geometry 2. Identify the Quadrilateral shapes and properties 3. Show how the various Quadrilaterals relate to each other	The students respond and write down the answers to the teacher's questions	Questioning Closure

APPENDIX C

Mathematics Achievement Test (MAT)

1. Geometry is a branch of mathematics that deals with_______________

   (a) shape, size, angles (b) color, height, weight

   (c) volume, length, color (d) line, color, volume

2. In geometry _______________ has two arrows that extends on opposite direction

   (a) line (b) ray

   (c) symmetry (d) dot

3. Angle greater than 90^0 but less than 180^0 is referred to as?

   (a) Acute angle (b) right angle

   (c) Obtuse angle (d) combo angle

4. Angle equal to 90^0 is called?

   (a) right angle (b) acute angle

   (c) ruler angle (c) obtuse angle

5. A straight angle has a measure of __________________

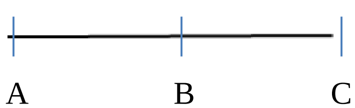
   (a) 150^0 (b) 180^0

   (c) 340^0 (c) 70^0

6. Angle greater than 0^0 but less than 90^0 is __________________

   (a) Acute angle (b) right angle

   (c) Obtuse angle (d) overflow angle

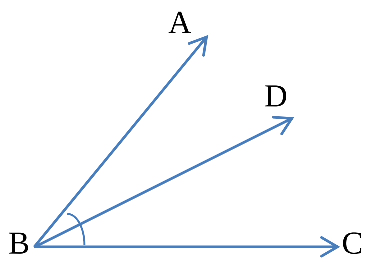
7. 

   From the diagram above B is called?

   (a) midpoint (b) segment

   (c) angle (d) circle

8.



From the diagram above D is called an angle ____________

(a) bisector (b) point

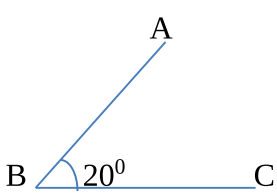
(c) line (d) arrow

9. Lines that are of the same length but never intersect are _____

(a) Straight line (b) Parallel line

(c) Vertical line (d) Perpendicular line

10.



From the diagram above <ABC is a ?

(a) right angle (b) straight angle

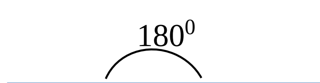
(c) opposite angle (d) acute angle

11. A cell phone has a shape of ____________

(a) Rhombus (b) Circle

(c) Rectangle (d) Triangle

12.

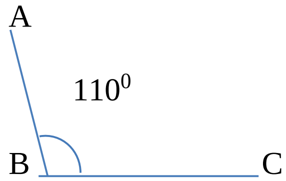


For the diagram is above the angle 180^0 is also called?

(a) right angle (b) obtuse angle

(c) straight angle (d) acute angle

13.

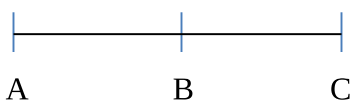


From the above diagram <ABC is an ________________

(a) right angle (b) obtuse angle

(c) straight angle (d) vector

14. Give that AB = 3x + 3, BC = 3x + 7 and AC = 40, find the value of x



From the diagram above B is called?

(a) 5 (b) 7

(c) 40 (d) 75

15. Using the correct answer, find AB

(a) 15 (b) 72

(c) 18 (d) 10

16. Using the correct answer in question 14 above, find BC

(a) 22 (b) 28

(c) 12 (d) 15

17. Angles that are all added up to give 90^0?

(a) Complimentary angles (b) Sub thermal angle

(c) Mid angle (d) Supplementary angle

18. A quadrilateral is any shape with ______________ sides?

(a) 10 (b) 3

(c) 4 (d) 6

19. A square looks like a ________________

(a) Floor tile (b) Kite

(c) Bicycle (d) Shoe

20. A quadrilateral which has all angles as a right angle triangle is _____________

(a) kite (b) rhombus

(c) rectangle (d) circle

MAT ANSWERS

1. **A**
2. **A**
3. **C**
4. **A**
5. **B**
6. **B**
7. **A**
8. **A**
9. **B**
10. **D**
11. **C**
12. **C**
13. **B**
14. **A**
15. **C**
16. **A**
17. **A**
18. **C**
19. **A**
20. **C**

APPENDIX D

Mathematics Retention Test (MRT)

1. Angle equal to 90^0 is called?

   (a) right angle (b) acute angle

   (c) ruler angle (c) obtuse angle

2. In geometry _______________ has two arrows that extends on opposite direction

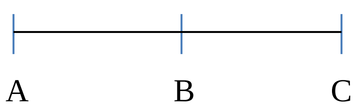
   (a) line (b) ray

   (c) symmetry (d) dot

3. A straight angle has a measure of __________________

   (a) 150^0 (b) 180^0

   (c) 340^0 (c) 70^0

4. 

   From the above diagram B is called?

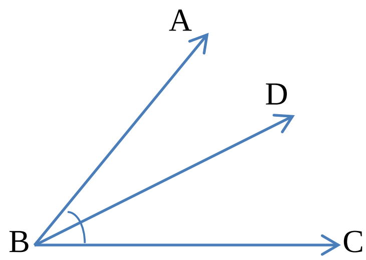
   (a) midpoint (b) segment

   (c) angle (d) circle

5. Angle greater than 90^0 but less than 180^0 is referred to as?

   (a) Acute angle (b) right angle

   (c) Obtuse angle (d) combo angle

6. 

   From the diagram above D is an angle ____________________

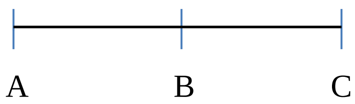
   (a) bisector (b) point

   (c) line (d) arrow

7. A quadrilateral which has all angles as a right angle triangle is _____________

(a) kite (b) rhombus

(c) rectangle (d) circle

8. 

From the diagram above B is called?

(a) midpoint (b) segment

(c) angle (d) circle

9. Geometry is a branch of mathematics that deals with_______________

(a) shape, size, angles (b) color, height, weight

(c) volume, length, color (d) line, color, volume

10. A square looks like a ________________

(a) Floor tile (b) Kite

(c) Bicycle (d) Shoe

11. A quadrilateral is any shape with ______________ sides?

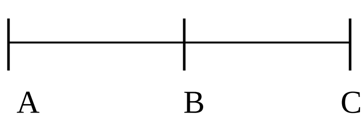
(a) 10 (b) 3

(c) 4 (d) 6

12. Angles that are all added up to give 90^0?

(a) Complimentary angles (b) Sub thermal angle

(c) Mid angle (d) Supplementary angle

13. 

Give that AB = 3x + 3, BC = 3x + 7 and AC = 40, find the value of x

(a) 5 (b) 7

(c) 40 (d) 75

14. Using the correct answer, find AB

(a) 15 (b) 72

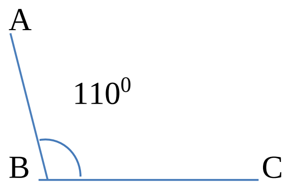
(c) 18 (d) 10

15. Using the correct answer in question 14 above, find BC

(a) 22 (b) 28

(c) 12 (d) 15

16.

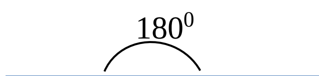


From the above diagram <ABC is an _______________

(a) right angle (b) obtuse angle

(c) straight angle (d) vector

17.



For the diagram is above the angle 180^0 is also called?

(a) right angle (b) obtuse angle

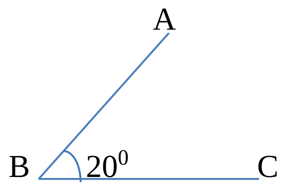
(c) straight angle (d) acute angle

18. A cell phone has a shape of ____________

(a) Rhombus (b) Circle

(c) Rectangle (d) Triangle

19.



From the diagram above <ABC is a ?

(a) right angle (b) straight angle

(c) opposite angle (d) acute angle

20. Lines that are of the same length but never intersect are _____

(a) Straight line (b) Parallel line

(c) Vertical line (d) Perpendicular line

MRT ANSWERS

1. A
2. A
3. B
4. A
5. C
6. A
7. C
8. A
9. A
10. A
11. C
12. A
13. A
14. C
15. A
16. B
17. C
18. C
19. D
20. B

APPENDIX E

FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA
SCHOOL OF SCIENCE AND TECHNOLOGY EDUCATION
DEPARTMENT OF EDUCATIONAL TECHNOLOGY

Dear Sir/Madam,

Instrument Validation Form

The bearer is a student of the above named University and Department. She/he is conducting a research and you have been selected as one of those with requisite expertise to validate his/her instrument. Kindly grant him/her all necessary assistance to make the exercise a success.

Your competency and expertise was considered as factors that will serve to improve the quality of his/her research instrument. We therefore crave for your assistance in validating the instrument. The completion of the form serves as evidence that the student actually validated the instrument

Thanks for your anticipated assistance.

Dr. C.S. Tukura

Dept of Educational Technology, Fed. University of Technology, 15 JUN 2021, P.M.B. 65 Minna, Niger State, Sign....

Head of Department (Signature, Date & Official Stamp)

Student's Surname: UBIMAGO Other Names: KENNEDY-O.

Registration Number: 2016/1/57909BT Programme: B-TECH

Title of the Instrument: MATHEMATICS ACHIEVEMENT TEST

ATTESTATION SECTION

Summary of the Remark on the Instrument: The Instrument is okay for the study if all corrections observed are duly effected

I hereby attest that the above named student brought his instrument for validation

Name of Attester: Dr. A. U. Bashir Fankuzo

Designation: LII

Name and Address of Institution: F.U.T. Minna

Phone Number: 08065542825 E-Mail: bashir.au@futminna.edu.ng

Please comment on the following

1. Appropriateness of the instrument for the purpose it's design for...... Appropriate
2. Clarity and simplicity for the level of the language used...... Satisfactory
3. Suability for the level of the targeted audience ...... Suitable
4. The extent in which the items cover the topic it meant to cover...... Okay
5. The structuring of the Questionnaire...... Satisfactory
6. Others (grammatical errors, spelling errors and others...... Minimal
7. General overview of the Instrument...... Generally the Instrument for the test is Okay

Suggestions for improving the quality of the Instrument

1. Observed correction should be effected
2. ......
3. ......
4. ......
5. ......

Name of Validator...... Dr. A. U. Bashir Yankuzo

Area of Specialization...... Mathematics Edu

Name of Institution...... F.U.T. Minna ...... Designation...... [illegible]

Signature...... [signature] ...... Date...... 27/07/2021

Thank You

FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA
SCHOOL OF SCIENCE AND TECHNOLOGY EDUCATION
DEPARTMENT OF EDUCATIONAL TECHNOLOGY

Dear Sir/Madam,

Instrument Validation Form

The bearer is a student of the above named University and Department. She/he is conducting a research and you have been selected as one of those with requisite expertise to validate his/her instrument. Kindly grant him/her all necessary assistance to make the exercise a success.

Your competency and expertise was considered as factors that will serve to improve the quality of his/her research instrument. We therefore crave for your assistance in validating the instrument. The completion of the form serves as evidence that the student actually validated the instrument

Thanks for your anticipated assistance.

Dr. C.S. Tukura

HEAD, Dept of Educational Technology, Fed. University of Technology, 15 JUN 2021, P.M.B. 65 Minna, Niger State. Sign........

Head of Department (Signature, Date & Official Stamp)

Student's Surname......UBIMAGO.................................. Other Names..KENNEDY.O.

Registration Number..2015/1/57908BT... Programme...B.TECH..................

Title of the Instrument...MATHEMATICS ACHIEVEMENT TEST............

ATTESTATION SECTION

Summary of the Remark on the Instrument..

....

.......Satisfactory...

I hereby attest that the above named student brought his instrument for validation

Name of Attester.....Mr. J. D. Awoyemi

Designation..........Teaching

Name and Address of Institution...Model Secondary School FUT Minna

Phone Number.....08037632158.........E.- Mail.......................

Please comment on the following

1. Appropriateness of the instrument for the purpose it's design for.......... for the purpose it is meant for
2. Clarity and simplicity for the level of the language used....... The language is clear
3. Suability for the level of the targeted audience .... Suitable
4. The extent in which the items cover the topic it meant to cover...... It cover the topic
5. The structuring of the Questionnaire.......... well - structure
6. Others (grammatical errors, spelling errors and others:........ fair
7. General overview of the Instrument.......... It is appropriate

Suggestions for improving the quality of the Instrument

1. Make all the Cleaner
2. ....
3. ....
4. ....
5. ....

Name of Validator... Mr T. D. Aiyeyemi

Area of Specialization........ Mathematics

Name of Institution... FUT Minna .... Designation... Teaching

Signature........ .... Date... 17-6-2021

Thank You

FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA
SCHOOL OF SCIENCE AND TECHNOLOGY EDUCATION
DEPARTMENT OF EDUCATIONAL TECHNOLOGY

Dear Sir/Madam,

Instrument Validation Form

The bearer is a student of the above named University and Department. She/he is conducting a research and you have been selected as one of those with requisite expertise to validate his/her instrument. Kindly grant him/her all necessary assistance to make the exercise a success.

Your competency and expertise was considered as factors that will serve to improve the quality of his/her research instrument. We therefore crave for your assistance in validating the instrument. The completion of the form serves as evidence that the student actually validated the instrument

Thanks for your anticipated assistance.

Dr. C.S. Tukura

DEPT. Dept of Educational Technology Fed. University of Technology 15 JUN 2021 P.M.B. 65 Minna, Niger State Sign...

Head of Department (Signature, Date & Official Stamp)

Student's Surname..UBIMAGO.................................. Other Names..KENNEDY

Registration Number..2015/1/57906BT..... Programme....B-TECH

Title of the Instrument. MATHEMATICS ACHIEVEMENT TEST

ATTESTATION SECTION

Summary of the Remark on the Instrument...The Instrument is well structured and carry much information but the validator afraid not know the level of the student that is made for.

I hereby attest that the above named student brought his instrument for validation

Name of Attester..Dr (Mrs) R. W. Gimba

Designation....Associate Professor

Name and Address of Institution...FUT, Minna

Phone Number....08032852603..............E.-Mail. r.omotayogimba@futminna.edu

Please comment on the following

1. Appropriateness of the instrument for the purpose it's design for........................
   Appropriate
2. Clarity and simplicity for the level of the language used...............................
   clear and Simple
3. Suability for the level of the targeted audience ....
   Suitable
4. The extent in which the items cover the topic it meant to cover..........................
   Covered to an extent
5. The structuring of the Questionnaire...
   Well Structured
6. Others (grammatical errors, spelling errors and others..
7. General overview of the Instrument..

Suggestions for improving the quality of the Instrument

1. ....
2. ....
3. ....
4. ....
5. ....

Name of Validator... Dr (Mrs) R. W. Gimba

Area of Specialization... Mathematics Education

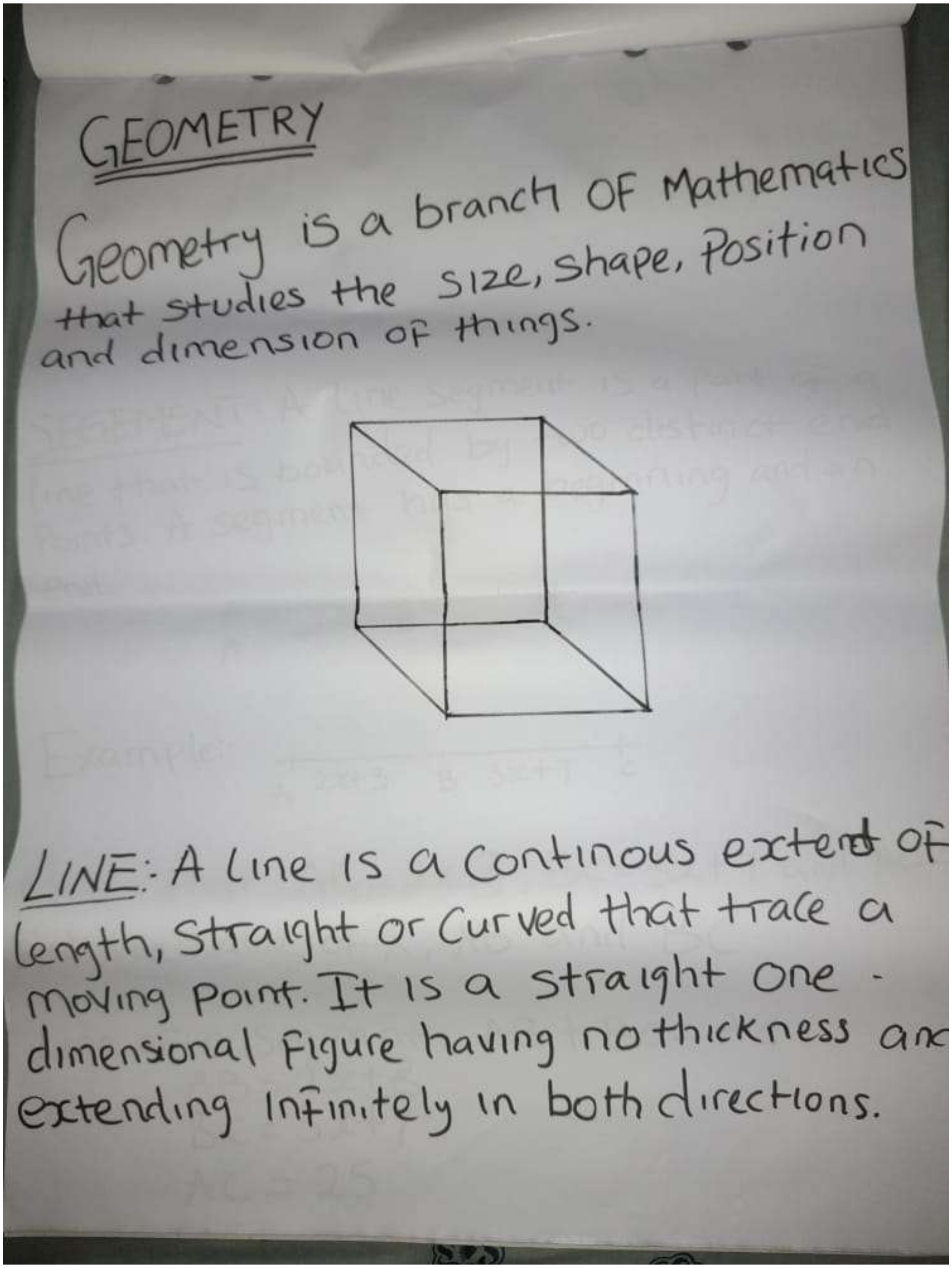
Name of Institution... F.U.T. Minna ...... Designation... AP

Signature.............. Date... 16/06/2021

Thank You

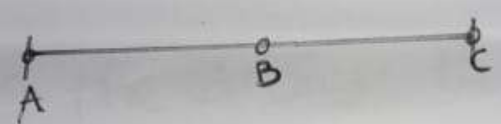
APPENDIX F

Non-Projected Media Instrument

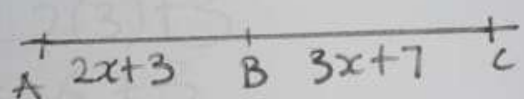


In geometry, a line has two arrows that extends in opposite directions.

SEGEMENT: A line segment is a part of a line that is bounded by two distinct end Points. A segment has a beginning and an end.



Example:



Given that AB = 2x+3, BC = 3x+7 and AC=2

find the value of X, AB and BC

Line of a Segment: AB + BC = AC

$AB = 2x+3$

$BC = 3x+7$

$AC = 25$

Solution: $AB + BC = AC$

$$(2x+3)+(3x+7) = 25$$

$$2x + 3x + 3 + 7 = 25$$

$$5x + 10 = 25$$

$$5x = 25 - 10$$

$$\frac{5x}{5} = \frac{15}{5}$$

$$\therefore x = 3$$

b) Using the Answer to Find AB

$$AB = 2x + 3$$

$$= 2(3) + 3$$

$$= 6 + 3$$

$$\therefore AB = 9$$

c) To Find BC

$$BC = 3x + 7$$

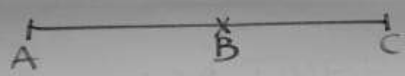
$$= 3(3) + 7$$

$$= 9 + 7$$

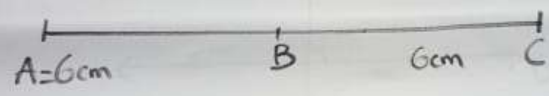
$$\therefore BC = 16$$

MID-POINT: If we have a segment AC and B is the middle or mid-point. It means B is in the middle, so B is the mid-point of AC.

AB = BC = AC



E.g: Find the mid point of the figure



Solution:-

AB = 6cm , BC = 6cm , Find AC

$AC = AB + BC$

$= 6 + 6$

$\therefore AC = 12cm$

PARALLEL LINES:: They are lines that are of the same length but never Intersect. They do not touch each other.

A//B = A is parallel to B

PERPENDICULAR LINE:: Are lines that Come in Contact with each other. They Intersect each other at a 90°

A⊥B = A is Perpendicular to B

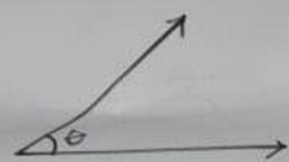
ANGLES:: An angle is a figure formed by two rays.

Types of angles:

1) Right angle (2) Acute angle

3) Obtuse angle (4) Straight angle

- Acute Angles: Are angles that are greater than 0° but less than 90°

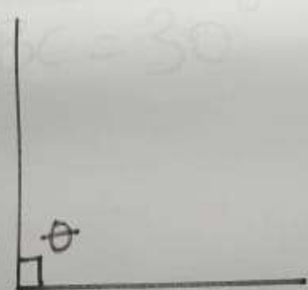


$0^\circ < \theta < 90^\circ$

- Obtuse Angle: Are angles greater than 90° but less than 180°

$90^\circ < \theta < 180^\circ$

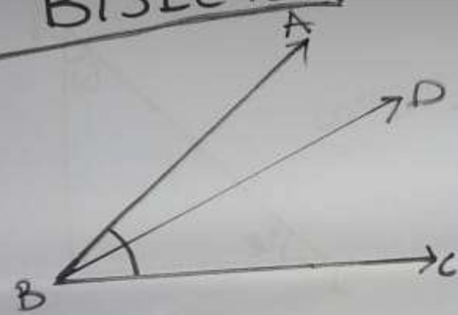
- Right Angle: Are angles that are equal to 90°.



$\theta = 90^\circ$

Straight Angle: are angles that has a measure of 180°

ANGLE BISECTOR:



If $\angle ABC = 60°$

Then D is an angle bisector

given $\angle ABD = 30°$

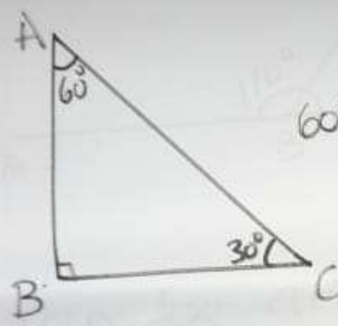
$\angle DBC = 30°$

COMPLEMENTRY ANGLE::

Are angles that when added up together gives you 90°

Example:

1) Find if the Figure below is a complementry angle



$60° + 30° = 90°$

2) What can you add to 50° to get a complementry angle

Sum of the total = 90°

$50° + x = 90°$

$x = 90° - 50°$

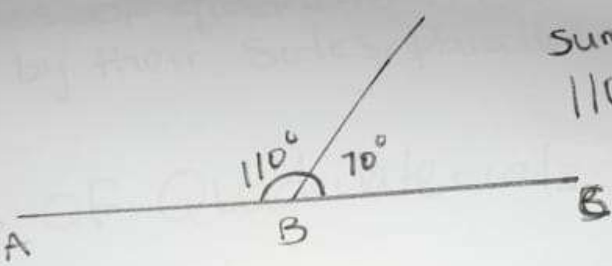
$x = 40°$

∴ We can add 40° to 50° to make a complementry angle.

SUPPLEMENTARY ANGLES::

Are angles that Sum added together to get 180°

Eg:: Find if the figure is supplementary



Sum total = 180°

$110^\circ + 70^\circ = 180^\circ$

2) What can be added to 90° to get a supplementry angle:

Sum of the total = 180°

$90^\circ + x = 180^\circ$

$x = 180^\circ - 90^\circ$

$x = 90^\circ$

Therefore, we can add 90° to 90° to make a supplementry angle.

Quadrilaterals:

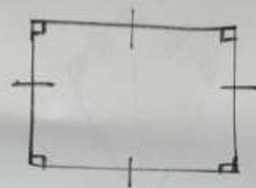
They are shapes with 4 sides. Examples are Square, Rectangle, Kite.

They have 4 sides, 4 angles, 4 Vertices. There are 5 types of quadrilateral, each can be classified by their sides, Parallel or Perpendicul

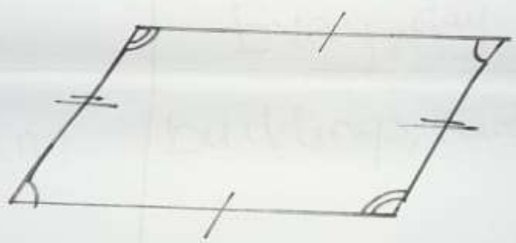
⇒ TYPES OF Quadrilaterials

1) Rectangle:- A rectangle is a quadrilateral in which each angle are in right angles. The horizontal lenght of the line is longer than Vertical.

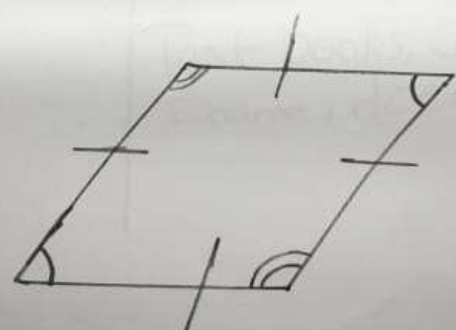
2) Square:- A square is a type of rectangle with all four sides in equal length



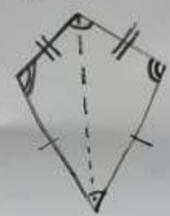
3) Parallelogram:- A Parallelogram is a quadrilate with two pairs of parallel sides



4) Rhombus:- A rhombus is a quadrilateral with all four sides equal in length



5) Kite:: A Kite is a quadrilateral with one diagonal as a line of Symmentry



⇒ Every day examples of shapes

Shape	Every day Examples
Parallelogram	buildings, card paper
Kite	Kite
Square	Floor tiles, box, Sugar cube
Rectangle	Text books, cell phones, Picture Frame, doors e.t.c.