

**EFFECT OF USING MATHEMATICS LABORATORY IN TEACHING
MATHEMATICS AMONG HIGH SCHOOL STUDENTS
RESEARCH PROJECT REPORT**



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DECLARATION

I Dr.R.PARVATHI, Senior Lecturer, District Institute of Education and Training, Krishnagiri, Krishnagiri district declare that the research project entitled “**Effect of using Mathematics laboratory in teaching Mathematics among High school students**” is the bonafide record of the original research work and submitted to in partial fulfilment for the project of District Institute of Education and Training, Krishnagiri, Krishnagiri district is first hand research work carried out by me during the year 2023–2024. This report or part of this report has not been submitted earlier either to this Department or to any other Institution for the fulfilment of the requirement of a course of study or project or published/presented for any other purpose.

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CERTIFICATE

This is to certify that the project work entitled “**EFFECT OF USING MATHEMATICS LABORATORY IN TEACHING MATHEMATICS AMONG HIGH SCHOOL STUDENTS**” submitted by **Dr.R.PARVATHI**, Senior lecturer, DIET, Krishnagiri is a bonafide record of research project work done under my supervision and the project work has not formed the basis for the award to the scholar for any Degree, Diploma, Associate ship, Fellowship or any other similar title and I also certify that the project work represents an independent work on the part of the candidate.

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Dr.R.PARVATHI

RESEARCH PROJECT ABSTRACT: KGI 04

NAME OF THE DIET: Krishnagiri

NAME AND DESIGNATION OF THE RESEARCHER: Dr.R. PARVATHI

Senior lecturer

TITLE: Effect of using Mathematics Laboratory in Teaching Mathematics among High school students.

1.INTRODUCTION:

Learning mathematics involves learning ways of thinking. It involves, learning powerful mathematical ideas rather than a collection of disconnected procedures for carrying out calculations. High school Students are capable of learning mathematics with understanding and create new ideas but opportunities to do so is not available. Teachers need training to update their knowledge in content and methodology.

2.NEED AND SIGNIFICANCE:

The purpose of this study is to investigate the effect of using mathematics laboratory in teaching mathematics for High school students. The study focus on the achievement of Control and experimental group after using the mathematics laboratory.

3.OBJECTIVES:

- ❖ To find out the student's prior knowledge in using mathematics laboratory.
- ❖ To develop module for class IX mathematics lab.
- ❖ To Organize training program for teachers handling class 9 mathematics.
- ❖ To find out the effect of mathematics laboratory in improving the student's achievement of Control and experimental group.
- ❖ To find out the effect of mathematics achievement in improving the classroom teaching of Control and experimental group.

4.HYPOTHESIS:

- ❖ There is no significant difference between pre test scores on achievement in mathematics for experimental group and control group students for total sample.
- ❖ There will be a significant difference between post test scores on achievement in mathematics for experimental group and control group students for total sample
- ❖ There will be a significant difference between pretest and post test scores on achievement in mathematics for experimental group and control group for total sample.
- ❖ There is no significant difference between pretest and post test scores on achievement in mathematics for experimental group and control group boys and girls.

- ❖ There is no significant difference between pretest and post test score scores on achievement in mathematics for experimental group and control group GHS and GHSS students.

5.METHODOLOGY:

a) METHOD: The researcher adopted Quasi-experimental design.

Experimental phase involves following steps:

Pre- test → training → supply of lab material → classroom implication → monitoring → post-test

Pre- test was conducted for all the 10 schools. Training was given for experimental group teachers. Lab manual consist of following learning out comes.

- ❖ To use set language in solving life-oriented word problems.
- ❖ To visualize the real numbers on the number line.
- ❖ To understand the scientific notation
- ❖ Able to draw graph for a given linear equation
- ❖ To understand the properties of quadrilaterals and use them in problem solving.
- ❖ To understand the mid-point formula and use it in problem solving.
- ❖ To understand the usage of trigonometric tables.

b) SAMPLE: The researcher selected 125 students studying class IX as experimental group and 95 students studying class IX as control group as sample of the study.

c) INTERVENTION:

- Traditional method of teaching was adopted for control group schools.
- Lab manual was prepared.
- Training was given to the teachers in experimental schools
- Lab activity was carried out for experimental group schools.
- Worksheet was practiced for experimental group students.

d) TOOL: one tool was constructed for both pre-test and post-test for class IX students. This tool was constructed and administered for 10 teachers handling class IX mathematics. This

tool was administered before preparing the module. Questionnaire consist of 10 questions each carries 5 marks. Total score is 50.

e) **DATA ANALYSIS:** Mean, Variance & t value are used for data analysis

6. MAJOR FINDINGS:

- ❖ The mean score obtained by experimental group Student's achievement in mathematics for pre- test is 27.09 and for post- test is 68.19
- ❖ The mean score obtained by control group student's achievement in mathematics for pre- test is 23.92 and for the post- test is 50.84
- ❖ Mean score of experimental group Student's achievement is higher than control group student's achievement on both pre & post test scores.
- ❖ There is no significant difference between pre- test scores on achievement in mathematics for experimental group and control group students for total sample.
- ❖ There is significant difference between post test scores on achievement in mathematics for experimental group (Mean 68.19) and control group (50.84) students for total sample ($t=5.74$)
- ❖ Experimental and control group boys and girls do not differ in their achievement in pre & post test.
- ❖ Experimental group GHS and GHSS students differ in their achievement in pre test. High mean score is found in GHSS (31.39) compared to GHS (16.44).

7. CONCLUSION:

- It is concluded that Math lab activity for class 9 was successful in all the experimental schools.
- Traditional method adopted in control group shows low achievement.
- Math lab activity gives active participation for all students.
- Students show interest in learning while doing.
- Students prepared lab materials in groups.
- Students learnt the concept and practiced problems in peer group.
- worksheet gives more practice and able to remember the concept.

8. EDUCATIONAL IMPLICATIONS:

- Maths lab is needed in all level of schooling.
- In secondary and higher secondary schools' mathematics lab activity to be incorporated in the classroom transaction.

- In- service training to be given to the teachers.
- Practical mark can be given in common board exam based on math lab performance.

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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION:

In the realm of high school education, the teaching of mathematics stands as a cornerstone of academic development and cognitive growth. However, the traditional methods of instruction often struggle to fully engage students and instil a deep understanding of mathematical concepts. Recognizing this challenge, educators have increasingly turned to innovative approaches such as mathematics laboratories to enhance the learning experience.

The integration of mathematics laboratories into high school mathematics education represents a dynamic shift towards experiential learning and active engagement. By providing a hands-on environment for exploration and discovery, these laboratories aim to bridge the gap between abstract mathematical concepts and real-world applications. Through interactive experiments, problem-solving activities, and collaborative projects, students are encouraged to explore mathematical principles in depth, fostering a deeper understanding and appreciation for the subject.

This project seeks to investigate the effects of utilizing mathematics laboratories in teaching mathematics among high school students. By examining the impact on student engagement, comprehension, problem-solving skills, and overall academic performance, the researcher aims to discern the efficacy of this innovative approach in enhancing the learning outcomes of high school mathematics education.

Through empirical research, data analysis, and qualitative feedback from students and educators, this project endeavours to shed light on the potential benefits and challenges associated with integrating mathematics laboratories into the high school curriculum. Ultimately, the findings of this study aim to inform educational practices and contribute to the ongoing dialogue surrounding effective pedagogical strategies in mathematics education.

1.2 CONCEPTUAL NATURE OF MATHEMATICS:

The conceptual nature of mathematics refers to its foundational principles, abstract structures, and interconnected concepts that underpin the discipline. Unlike many other subjects, mathematics is not merely a collection of isolated facts and procedures; instead, it is a coherent system built upon fundamental ideas and relationships.

At its core, mathematics is about understanding patterns, relationships, and structures. Concepts such as numbers, shapes, functions, and operations serve as building blocks that form the basis of mathematical thinking. These concepts are interconnected, with each new idea building upon previously established ones.

One of the key aspects of the conceptual nature of mathematics is its emphasis on abstraction. Mathematicians often work with abstract symbols and representations to explore mathematical ideas and relationships beyond concrete examples. This abstraction allows mathematicians to generalize their findings and apply them to a wide range of contexts. Moreover, mathematics is inherently logical and rigorous. It relies on deductive reasoning and precise definitions to establish the validity of mathematical arguments and proofs. This emphasis on logic and rigor ensures that mathematical conclusions are reliable and universally applicable.

Another important aspect of the conceptual nature of mathematics is its role as a universal language. Mathematics provides a common framework for expressing ideas and solving problems across different fields and disciplines. From physics to economics to computer science, mathematics serves as a powerful tool for modelling, analysing, and understanding the world around us. Overall, the conceptual nature of mathematics reflects its deep theoretical underpinnings and its broad applicability across diverse domains. By understanding and appreciating the conceptual aspects of mathematics, learners can develop a deeper understanding of the subject and its relevance to the world they inhabit.

1.3 STRATEGIES TO ENHANCE MATHEMATICS LEARNING:

Learning mathematics is a multifaceted process that involves understanding concepts, developing problem-solving skills, and building a strong foundation of mathematical knowledge. Here are some strategies to enhance learning of math:

1. **Understanding Concepts:** Focus on understanding the underlying concepts rather than just memorizing procedures.
2. **Practice Regularly:** Mathematics is a skill that improves with practice. Work on a variety of problems regularly to reinforce student's understanding and build confidence.

3. **Start with Basics:** Student has to strong grasp of basic mathematical concepts before moving on to more advanced topics. Review foundational topics like arithmetic, algebra, and geometry as needed.
4. **Seek Clarification:** Don't hesitate to ask questions or seek clarification when student encounter difficulties. Utilize resources such as textbooks, online tutorials, or asking a teacher or tutor for help.
5. **Use Multiple Resources:** Explore different learning resources such as textbooks, online courses, educational videos, and interactive websites to find the methods that work best for student.
6. **Apply Mathematics:** Look for opportunities to apply mathematical concepts to real-world problems or situations. This can help reinforce student understanding and demonstrate the practical relevance of mathematics.
7. **Work with Peers:** Collaborate with classmates or join study groups to discuss concepts, solve problems together, and learn from each other's perspectives.
8. **Stay Organized:** Keep notes, assignments, and study materials organized to facilitate learning and revision. Breaking down larger topics into smaller, manageable chunks can also make learning more manageable.
9. **Practice Critical Thinking:** Mathematics often involves critical thinking and problem-solving.

1.4 TEACHING MATHEMATICS AT HIGH SCHOOL LEVEL:

Teaching mathematics at the high school level is a rewarding yet challenging endeavour that requires both subject expertise and effective pedagogical strategies. Here are some key principles to consider when teaching maths at high school level:

- ❖ **Clear Learning Objectives:** Start each lesson with clear learning objectives that outline what students are expected to learn and accomplish. This provides direction and focus for the lesson.
- ❖ **Engage Students:** Capture students' interest and curiosity by making connections between mathematical concepts and real-world applications. Engaging activities, demonstrations, and examples can help make abstract concepts more tangible and relevant.

- ❖ **Differentiated Instruction:** Recognize that students have diverse learning styles, abilities, and backgrounds. Differentiate instruction by providing various teaching methods, resources, and support to meet the needs of all learners.
- ❖ **Active Learning:** Encourage active participation and inquiry-based learning in the classroom. Incorporate activities, discussions, and problem-solving tasks that require students to apply mathematical concepts and think critically.
- ❖ **Scaffold Learning:** Break down complex concepts into smaller, more manageable steps, and provide scaffolding support as needed. Gradually release responsibility to students as they gain confidence and proficiency.
- ❖ **Use of Technology:** Integrate technology tools such as graphing calculators, interactive whiteboards, and educational software to enhance instruction and facilitate visualization of mathematical concepts.
- ❖ **Formative Assessment:** Use formative assessment strategies, such as quizzes, exit tickets, and classroom discussions, to monitor student understanding and provide timely feedback. Adjust instruction based on assessment data to address misconceptions and promote deeper learning.
- ❖ **Promote Mathematical Reasoning:** Emphasize the importance of mathematical reasoning, problem-solving strategies, and mathematical communication skills. Encourage students to explain their thinking, justify their solutions, and engage in mathematical discourse.
- ❖ **Real-World Connections:** Explore connections between mathematical concepts and their applications in various fields, such as science, engineering, finance, and art. This helps students appreciate the relevance and utility of mathematics in everyday life.
- ❖ **Cultivate Growth Mindset:** Foster a growth mindset culture in the classroom by promoting resilience, perseverance, and a positive attitude towards learning and overcoming challenges in mathematics.
- ❖ **Collaborative Learning:** Encourage collaboration and peer interaction through group work, cooperative learning activities, and peer tutoring. Collaboration can promote deeper understanding, communication skills, and teamwork.
- ❖ **Professional Development:** Stay current with best practices in mathematics education through ongoing professional development, collaboration with colleagues, and participation in workshops or conferences.

By implementing these principles and strategies, teachers can create a supportive and engaging learning environment that fosters students' mathematical understanding, confidence, and enthusiasm for learning.

1.5 LEARNING MATHEMATICS AT SECONDARY STAGE:

It is at this stage that Mathematics comes to the student as an academic discipline. In a sense, at the elementary stage, mathematics education is (or ought to be) guided more by the logic of children's psychology of learning rather than the logic of mathematics. But at the secondary stage, the student begins to perceive the structure of mathematics. For this, the notions of argumentation and proof become central to curriculum now. Mathematical terminology is highly stylised, self-conscious and rigorous. The student begins to feel comfortable and at ease with the characteristics of mathematical communication, carefully defined terms and concepts, the use of symbols to represent them, precisely stated propositions using only terms defined earlier, and proofs justifying propositions.

The student appreciates how an edifice is built up, arguments constructed using propositions justified earlier, to prove a theorem, which in turn is used in proving more. For long, geometry and trigonometry have wisely been regarded as the arena wherein students can learn to appreciate this structure best. In the elementary stage, if students have learnt many shapes and know how to associate quantities and formulas with them, here they start reasoning about these shapes using the defined quantities and formulas. Algebra, introduced earlier, is developed at some length at this stage. Facility with algebraic manipulation is essential, not only for applications of mathematics, but also internally in mathematics. Proofs in geometry and trigonometry show the usefulness of algebraic machinery. It is important to ensure that students learn to geometrically visualise what they accomplish algebraically.

A substantial part of the secondary mathematics curriculum can be devoted to consolidation. This can be and needs to be done in many ways. Firstly, the student needs to integrate the many techniques of mathematics she has learnt into a problem-solving ability. For instance, this implies a need for posing problems to students which involve more than one content area: algebra and trigonometry, geometry and mensuration, and so on. Secondly, mathematics is used in the physical and social sciences, and making the connections explicit can inspire students immensely. Thirdly, mathematical modelling, data analysis and

interpretation, taught at this stage, can consolidate a high level of literacy. For instance, consider an environment related project, where the student has to set up a simple linear approximation and model a phenomenon, solve it, visualise the solution, and deduce a property of the modelled system. The consolidated learning from such an activity builds a responsible citizen, who can later intuitively analyse information available in the media and contribute to democratic decision making. At the secondary stage, a special emphasis on experimentation and exploration may be worthwhile. Mathematics laboratories are a recent phenomenon, which hopefully will expand considerably in future. Activities in practical mathematics help students immensely in visualisation.

1.6 PROBLEMS IN TEACHING AND LEARNING OF MATHEMATICS :

Any analysis of mathematics education in our schools will identify a range of issues as problematic. We structure our understanding of these issues around the following four problems which we deem to be the core areas of concern:

1. A sense of fear and failure regarding mathematics among a majority of children
2. A curriculum that disappoints both a talented minority as well as the non-participating majority at the same time
3. Crude methods of assessment that encourage perception of mathematics as mechanical computation
4. Lack of teacher preparation and support in the teaching of mathematics

1.7 LEARNING OUTCOMES FOR HIGH SCHOOL MATHEMATICS:

Developing children's abilities for mathematisation is the main goal of mathematics education. The twin concerns of the mathematics curriculum are: What can mathematics education do to engage the mind of every student and develop the student's inner resources to make them critical and creative? It is at this stage that Mathematics comes to the students as an academic discipline and they begin to perceive the structure of mathematics. For this, the notions of argumentation and proof become central to curriculum. Mathematical terminology is highly stylised, self-conscious and rigorous. The student appreciates how an edifice is built

up, arguments constructed using propositions justified earlier, to prove a theorem, which in turn is used in proving further theorems.

At the secondary stage, a special emphasis on experimentation and exploration may be worthwhile. Mathematics laboratories are a recent phenomenon, which hopefully will expand considerably in future. Activities in practical mathematics help students immensely in visualisation. It is therefore, essential at this stage that the curriculum should focus on development of higher levels of learning mathematics through opportunities to explore, experiment, verify and prove conjectures that are obtained from patterns. Visualising relationships among various topics of mathematics and among other subjects is expected from the students. Thus, the learning outcomes of mathematics should be seen integrated with other subjects at this stage like numbers related with geometry (points on a number line and real numbers), with usage in Science and Social Science and later with problem solving skills.

Children are often assessed with paper pencil tests which include certain types of questions without proper analysis whether these questions have potential to assess child's level of understanding in a particular class. For many children learning of mathematics is limited to solving the problems given in a textbook that too with the limited algorithms and procedures. However, the students should be able and competent to critically analyse various processes and to create newer algorithms.

This document lays emphasis on the learning outcomes in terms of competencies and skills that every child is expected to acquire in Classes IX and X. The classroom interaction therefore, must provide opportunities to students to achieve learning outcomes in Mathematics and other subject areas. Learning Outcomes for Mathematics deals with the overall vision of Mathematics, expectations of the mathematics curriculum, variety of suggested pedagogic processes along with the learning outcomes. The suggested pedagogic processes and activities are presented merely as exemplars. Users may think of more such processes in a given situation.

Further at the secondary stage, students begin to perceive the structure of mathematics as a discipline. They become familiar with the characteristics of mathematical communication: carefully defined terms and concepts, the use of symbols to represent them, precisely stated propositions and proofs justifying them. Thus, they acquire a special language which serves as a medium of thought that involves a combination of words, symbols having logical reasoning, formulas, etc. These aspects are developed particularly in the area of geometry. Students

develop these aspects with algebra, which is important not only in the application of mathematics, but also within mathematics in providing justifications and proofs. At this stage, students integrate many concepts and skills that they have learnt into a problem-solving ability.

1.8 CURRICULAR EXPECTATIONS:

At this stage learners are expected to develop ability and attitude for

- Mathematisation (ability to think logically, formulate and handle abstractions) rather than knowledge of procedures (formal and mechanical).
- Mathematical vocabulary.
- Consolidation and generalisation of the concepts learnt so far.
- Understanding and proving mathematical statements.
- Addressing problems that come from other domains such as, science and social sciences.
- Integration of concepts and skills that the children have learnt into a problem-solving ability.
- Analysing and constructing the processes involved in mathematical reasoning.
- Establishing linkages between mathematics and daily life experiences and across the curriculum.

1.9 LEARNING OUTCOMES FOR CLASS IX&X MATHEMATICS

PRESCRIBED BY NCERT:

CLASS IX	CLASS X
<p>The learner—</p> <ul style="list-style-type: none"> • Applies logical reasoning in classifying real numbers, proving their properties and using them in different situations. 	<p>The learner—</p> <ul style="list-style-type: none"> • Generalises properties of numbers and relations among them studied earlier to evolve results, such as, Euclid’s division algorithm, Fundamental Theorem of Arithmetic and applies them to

	<p>solve problems related to real life contexts.</p>
<ul style="list-style-type: none"> • Identifies/classifies polynomials among algebraic expressions and factorises them by applying appropriate algebraic identities. 	<ul style="list-style-type: none"> • Develops a relationship between algebraic and graphical methods of finding the zeroes of a polynomials.
<ul style="list-style-type: none"> • Relates the algebraic and graphical representations of a linear equation in one or two variables and applies the concept to daily life situations. 	<ul style="list-style-type: none"> • Finds solutions of pairs of linear equations in two variables using graphical and different algebraic methods.
<ul style="list-style-type: none"> • Identifies similarities and differences among different geometrical shapes. 	<ul style="list-style-type: none"> • Demonstrates strategies of finding roots and determining the nature of roots of a quadratic equation.
<ul style="list-style-type: none"> • Derives proofs of mathematical statements particularly related to geometrical concepts, like parallel lines, triangles, quadrilaterals, circles, etc., by applying axiomatic approach and solves problems using them. 	<ul style="list-style-type: none"> • Develops strategies to apply the concept of A.P. to daily life situations.
<ul style="list-style-type: none"> • Finds areas of all types of triangles by using appropriate formulae and apply them in real life situations. 	<ul style="list-style-type: none"> • Works out ways to differentiate between congruent and similar figures
<ul style="list-style-type: none"> • Constructs different geometrical shapes like bisectors of line segments, angles and triangles under given conditions and 	<ul style="list-style-type: none"> • Establishes properties for similarity of two triangles logically using different geometric criteria established earlier such as,

<p>provides reasons for the processes of such constructions.</p>	<p>Basic Proportionality Theorem, etc.</p>
<ul style="list-style-type: none"> • Develops strategies to locate points in a Cartesian plane 	<ul style="list-style-type: none"> • Derives formulae to establish relations for geometrical shapes in the context of a coordinate plane, such as, finding the distance between two given points, to determine the coordinates of a point between any two given points, to find the area of a triangle, etc
<ul style="list-style-type: none"> • Calculates empirical probability through experiments and describes its use in words. 	<ul style="list-style-type: none"> • Determines all trigonometric ratios with respect to a given acute angle (of a right triangle) and uses them in solving problems in daily life contexts like finding heights of different structures or distance from them.
<ul style="list-style-type: none"> • Identifies and classifies the daily life situations in which mean, median and mode can be used 	<ul style="list-style-type: none"> • Derives proofs of theorems related to the tangents of circles. • constructs— • a triangle similar to a given triangle as per a given scale factor. • a pair of tangents from an external point to a circle and justify the procedures.

	<ul style="list-style-type: none"> • Examines the Steps of geometrical constructions and reason out each
<ul style="list-style-type: none"> • Analyses data by representing it in different forms like, tabular form (grouped or ungrouped), bar graph, histogram (with equal and varying width and length), and frequency polygon. 	Finds surface area and volumes of objects in the surroundings by Visualising them as a combination of different solids like cylinder and a cone, cylinder and a hemisphere, combination of different cubes, etc
<ul style="list-style-type: none"> • Derives formulae for surface areas and volumes of different solid objects like, cubes, cuboids, right circular cylinders/ cones, spheres and hemispheres and applies them to objects found in the surroundings. 	<ul style="list-style-type: none"> • Calculates mean, median and mode for different sets of data related with real life contexts.
<ul style="list-style-type: none"> • Solves problems that are not in the familiar context of the child using above learning. These problems should include the situations to which the child is not exposed earlier. 	<ul style="list-style-type: none"> • Determines the probability of an event and applies the concept in Daily life problems

1.10 MATHEMATICS LABORATORY:

Mathematics laboratory is a room wherein we find collection of different kinds of materials and teaching/learning materials, needed to help the students understand the concepts through relevant, meaningful and concrete activities. These activities may be carried out by the teacher or the students to explore the world of mathematics, to learn, to discover and to develop an interest in the subject.

1.10.1 PHYSICAL INFRASTRUCTURE AND MATERIALS:

It is envisaged that every school will have a Mathematics Laboratory with a general design with suitable change, if desired, to meet its own requirements. The minimum materials required to be kept in the laboratory may include all essential equipment, raw materials and other essential things to carry out the activities included in the document effectively. The quantity of different materials may vary from one school to another depending upon the size of the group.

1.10.2 HUMAN RESOURCES:

It is desirable that a person with minimum qualification of graduation (with mathematics as one of the subjects) and professional qualification of Bachelor in Education be made in charge of the Mathematics Laboratory. He/she is expected to have special skills and interest to carry out practical work in the subject. It will be an additional advantage if the in charge possesses related experience in the profession. The concerned mathematics teacher will accompany the class to the laboratory and the two will jointly conduct the desired activities. A laboratory attendant or laboratory assistant with suitable qualification and desired knowledge in the subject can be an added advantage.

1.11 EFFECT OF MATHEMATICAL LABORATORY:

1. Hands-on Learning: Laboratories provide a hands-on learning experience, allowing students to interact directly with mathematical concepts. This can deepen their understanding and retention of mathematical principles.

2. Visualization: Many mathematical concepts can be abstract and challenging to grasp. Laboratories offer visual aids and concrete examples, making it easier for students to visualize and comprehend abstract concepts.

3. Problem-Solving Skills: Laboratory activities often involve solving real-world problems or conducting experiments, which can enhance students' problem-solving skills. This practical application of mathematics reinforces its relevance and utility.

4. Active Engagement: Laboratories encourage active participation and engagement from students. They are more likely to be actively involved in their learning process, which can lead to increased motivation and interest in mathematics.

5. Collaboration and Communication: Laboratory activities often involve group work, fostering collaboration and communication skills among students. They learn to work

together, share ideas, and explain concepts to their peers, which are valuable skills in both academic and professional settings.

6. Critical Thinking: Laboratories promote critical thinking by encouraging students to analyse data, draw conclusions, and evaluate the validity of their results. This helps develop analytical skills that are essential for success in mathematics and beyond.

7. Experiential Learning: Through hands-on experimentation, students can experience the practical applications of mathematical concepts. This experiential learning approach can deepen their understanding and appreciation of mathematics as a discipline.

1.12 THE MATHEMATICS LAB IN THE CLASSROOM:

A successful laboratory requires careful planning and implementation of activities in order to maximize the benefits to students. Begin by spending a small amount of time periodically developing the format which will be used during the laboratory sessions. As the students become more proficient in working in the laboratory setting, the time spent there can be gradually increased until it reaches the time period which has been allotted for laboratory activities. There is no optimum amount of time which should be spent by the students in a laboratory situation, the time which is allotted will depend on the needs of the students and the teacher's desire. Experimentation of the teacher's part will soon indicate the appropriate amount of time required for the laboratory activities. Since most student would not have worked in a mathematics laboratory before, one of the first tasks will be to instruct the students in the laboratory method, or how to work meaningfully in a laboratory situation.

A student will be better able to solve problems presented to him in a laboratory if he first has an opportunity to work on skills which may be needed. First, the student should work on identifying the problem. He should be encouraged to think about a situation which is to be explored; he should ask question which lead to the identification of one or more problems associated with the given situation. At first the questions will probably be vague and not yield much information. As the student thinks about the situation with which he is confronted, he should ask questions such as these: How do I see the situation described here? What questions are raised by the situation? Is the situation like one which I have solved before? What kind of solution am I looking for? What kind of data will I collect? How will I know whether or not

my solution makes sense? These questions and others help to develop problem-solving skills; their use should be strongly encouraged.

Second, the student should work on finding ways to attack the found problems and decide on those ways which seem most likely to bring about a solution to the problem. Unfortunately, typical exercises in textbooks do not provide encouragement of different methods. Problems in the same section are usually designed to be solved with a single method, and so the student is not encouraged to seek different method. “Brainstorming” is a good technique, and the laboratory provides an excellent place to encourage such activity and the teacher can give encouragement by positively reinforcing good suggestions from the students. After one or more methods for attacking the problems have been determined, the student should proceed to implement the chosen “plan of attack”. During that implementation the child may realize that the plan may need revision or a complete change.

A final step is that of evaluating results and drawing conclusions. Again, the student should be encouraged to question himself: Have the questions raised in the problem been answered? Did I find what I expected or was it totally different? Are the results going to be true for similar situations? The mathematics laboratory offers a situation in which the child can practice all the four-area mentioned above. Such practice is vital in the development of the thinking process in each child.

1.12.1 ORGANIZING THE LABORATORY:

Basically, two physical situations exist when attempting to set up a math lab. One is to have a separate room for such activities; the other is to have only the regular classroom available. The latter situation is probably more prevalent. If a separate room is available, all of the supplies and materials can be stored there. It may be possible to buy or build cabinets and shelves in which to store items. If tables are not available for work space, push several desks together and place a piece of drywall or plywood on top. The floor can be used, if needed.

Depending on the needs of the student and the mathematics instructional program, the room may be used two or three times each week. A double period offers an opportunity for student to have ample time to explore and solve problems. When other teachers wish to use the room for math lab activities, a schedule for the room’s use become imperative. Even though several teachers may use the lab, it is best to have one person responsible for the inventory of materials and supplies and the replacement of needed items. If a separate room is not available,

a math lab may be set up in the regular classroom. A distinct advantage to having the math lab in the regular classroom is that the lab can be set up and used at any desired time, whereas with a separate room the lab can occur only at certain times. This additional flexibility may be very helpful because children can work on lab activities at any time during the day when finished with other assigned tasks.

1.12.2 SOURCES OF ACTIVITIES:

A multitude of activities may be used in the mathematics laboratory. Still, one must gather and modify the activities in order to serve the required purposes in the best possible way. An excellent source for ideas is the children themselves. Finding and developing problems which are of interest to them may provide many stimulating and useful sessions in the laboratory; indeed, this technique should not be limited to the laboratory situation but should be employed often in other learning experiences. The creativity of the teacher is another source. Making use of the past experiences with children and using the teacher's own ideas which may be "offshoots" of those of the students can provide many excellent activities. Professional publications such as *The Arithmetic Teacher*, *Instructor* and *Grade Teacher* have contained math laboratory ideas, most of which have been tried in the classroom.

1.12.3 CONDUCTING THE ACTIVITIES IN MATHEMATICS LABORATORY:

Initially, while the students are learning to work with the laboratory method, the teacher may need to use the technique of teacher demonstration with all of the students handling identical materials. The teacher's role should not be one of total dominance. The teacher should only be helping the students to formulate problems, to help them attack the problems at hand, and to ask questions about the problem that will help stimulate each student's thinking. There will be a point, however, when the children begin to exhibit independent, responsible behaviour, then put them on their own to explore collectively, in small groups, or individually certain aspects of the problem.

The teacher may also conduct lab sessions in which the entire class is working on the same problem with identical materials but in which your only role is to assist with problem areas. Each child is free to consult with others or to work by himself on open-ended questions which he himself has posed or which have been posed for him. A third method is to have the students working in teams on different problems. For this purpose, utilize activity cards (also called assignment, task, work, or job cards). These are simply cards on which a problem and

open-ended questions about the problem are stated. The cards provide the basis for a problem-solving session by a single student or by a group of students who have decided to seek a solution.

1.12.4 ASSESSING THE STUDENTS:

Assessing students in a math lab can be an engaging and comprehensive process. Here's a general outline of assessment:

1. Objective Assessment: Determine the specific objectives or skills you want to assess. This could include computational skills, problem-solving abilities, understanding of mathematical concepts, ability to use mathematical tools and technology, etc.

2. Pre-Assessment: Before students begin any activities in the math lab, consider giving them a pre-assessment to gauge their current knowledge and skills.

3. Observation: While students are working in the math lab, observe their actions, interactions, and problem-solving strategies. Look for evidence of understanding, persistence, collaboration, and critical thinking.

4. Performance Tasks: Design performance tasks or activities that require students to apply their mathematical knowledge and skills in real-world contexts. These tasks should be authentic and relevant, allowing students to demonstrate their understanding in meaningful ways.

5. Rubrics: Develop clear and specific rubrics to assess student performance on the tasks or activities. Include criteria related to mathematical accuracy, reasoning, communication, and problem-solving strategies.

6. Feedback: Provide timely and constructive feedback to students as they work in the math lab. Highlight their strengths, identify areas for improvement, and offer suggestions for further development.

7. Self-Assessment: Encourage students to reflect on their own learning and performance in the math lab. Provide opportunities for them to assess their progress, set goals, and identify strategies for improvement.

8. Post-Assessment: After students have completed their work in the math lab, administer a post-assessment to measure their growth and achievement. Compare the results to the pre-assessment to evaluate their progress over time.

9. Reflection and Review: Take time to reflect on the assessment process and outcomes. Consider what went well, what could be improved, and how to use the assessment data to inform instruction and support student learning.

By following these steps, teacher can effectively assess student learning in a mathematics lab and provide valuable insights into their mathematical knowledge and skills.

1.13 EQUIPMENT FOR MATHEMATICS LAB:

List of methods and materials used in the mathematics laboratory

- Paper folding
- Collage (Paper cutting & pasting)
- Unit Cubes (wooden or any material)
- Geo-board, rubber band
- Transparency sheets, cello tape
- Graph paper
- Pins & threads
- Broom sticks ix. Chart papers, glazed papers, sketch pens.
- Stationeries

1.14 SCOPE OF THE STUDY:

Learning mathematics with interest is a great task. As the researcher visited schools and examined the achievement of the students for the purpose of using maths lab for the achievement in learning concept. This study will motivate the student to learn mathematics with interest and confident. Mathematics laboratory make student to think and bring out their creativity. This will automatically arouse their interest. Lab manual prepared by the researcher makes the process of using mathematics laboratory for the achievement of concept attainment. So, this study will surely help the students and teachers.

1.16 NEED AND SIGNIFICANCE OF THE STUDY:

Research helps identify innovative teaching methods and tools, such as math labs, that can enhance students' understanding and engagement with mathematical concepts. By investigating the effectiveness of these methods, educators can continuously improve their

teaching practices. Studies on maths lab can inform the development of curriculum materials and resources that align with educational standards and promote mathematical proficiency among high school students. This ensures that maths instruction remains relevant and rigorous.

Research can uncover learning gaps or misconceptions that students may have in mathematics and suggest targeted interventions to address these issues. Maths labs provide a hands-on environment where students can explore concepts and receive personalized support to overcome challenges. By examining the impact of math labs on diverse student populations, researchers can identify strategies for promoting equity and inclusion in mathematics education. This includes addressing barriers to learning and ensuring that all students have access to high-quality math instruction.

Maths skills are essential for success in higher education and many careers. Research on math labs can help educators better prepare students for these opportunities by fostering critical thinking, problem-solving abilities, and mathematical fluency. Research studies provide valuable insights for teacher professional development, offering guidance on how to effectively implement math labs in the classroom and support student learning. This empowers teachers to continually improve their instructional practices and adapt to the evolving needs of their students.

Research studies on maths lab in high school mathematics education are significant for driving pedagogical innovation, informing curriculum development, addressing learning gaps, promoting equity and inclusion, preparing students for future success, supporting teacher professional development, and guiding evidence-based decision-making in education. The lack of mathematics laboratory and non-use of laboratory techniques in teaching mathematics is one of the major factors that contribute to poor performance in mathematics by secondary school students. Therefore, this study is designed to find out the effect of using mathematics laboratory in teaching mathematics at secondary stage.

1.16 RATIONALE OF THE STUDY:

Mathematics, according to National Education Policy 1986 in India, should be visualized as the instrument to train a child to think, reason, analyse and articulate logically. Taking into consideration the national aspirations and expectations reflected in the recommendations of the National Curriculum Framework developed by NCERT, the Central

Board of Secondary Education had introduced a number of steps to make teaching and learning of mathematics at school stage activity-based and experimentation oriented.

The purpose of this study is to investigate the effect of using mathematics laboratory in teaching mathematics for High school students. Specifically, the study sought the following;

- ❖ To study the student's prior achievement level
- ❖ To investigate the extent to which the use of mathematics laboratory will enhance the student's achievement in mathematics.
- ❖ To compare the achievement of Control and experimental group after using the mathematics laboratory.

CHAPTER-II

REVIEW OF RELATED LITERATURE

2.1 INTRODUCTION:

Review of Little Literature provides a path to identify the studies related to the topic“ **Effect of using Mathematics Laboratory in Teaching Mathematics among High school students.**” It also helped the researcher in selecting appropriate method of study and analysis of data. It enables a researcher to

- Define and limit the problem .

- Place the study in a historical and associational perspective.
- Avoid unintentional and unnecessary reputation.
- Select promising methods and measures.
- Relate the findings to previous knowledge and suggest further research.

The investigator reviewed foreign studies and Indian studies related to the present study.

2.2 NEED FOR RELATED STUDIES:

In educational research, a review of literary literature serves several important purposes: It provides a comprehensive overview and synthesis of existing scholarly literature on a specific topic within the field of education. This helps researchers and educators understand the historical context, theoretical frameworks, and key concepts related to their area of study. It helps identify gaps in current knowledge and research, as well as emerging trends and areas of debate within the field of education. This is crucial for researchers to determine where their study can contribute new insights or address unanswered questions.

It assists in formulating research questions that are grounded in existing literature and address relevant issues or gaps identified. By reviewing literature, researchers can refine their focus and ensure their study builds upon prior work rather than duplicating efforts. Literature reviews contribute to theory building by synthesizing theoretical perspectives and conceptual frameworks used in previous studies. This helps researchers establish a solid theoretical foundation for their own research and articulate the conceptual framework guiding their investigation.

Reviewing literature provides insights into various research methodologies and methods employed in previous studies within the field of education. Researchers can learn from methodological approaches that have been successful or identify challenges and limitations to be addressed in their own study. It supports evidence-based practice in education by identifying empirical evidence, findings, and recommendations from previous research that can inform educational policies, practices, and interventions. This is particularly important for educators and policymakers seeking to implement effective strategies based on research evidence.

A literature review involves critically evaluating the strengths and weaknesses of existing studies, including their methodologies, findings, and interpretations. This critical

analysis helps researchers assess the quality of evidence available and identify areas where further research is needed. Overall, a review of literary literature in educational research serves as a foundation for advancing knowledge, shaping research agendas, and informing evidence-based practices in the field of education. It plays a crucial role in guiding researchers toward meaningful contributions and ensuring the relevance and impact of their work.

2.3 STUDIES RELATED TO MATHEMATICS LAB:

Okigbo .E Osuafor A. (2008) conducted a study on the Effect of Using Mathematics Laboratory in Teaching Mathematics on the Achievement of Mathematics Students. The study investigated the effect of using mathematics laboratory in teaching on students' achievement in Junior Secondary School Mathematics. A total of 100 JS 3 Mathematics students were involved in the study. The study is quasi-experimental research. Results were analyzed using mean, standard deviation and analysis of covariance (ANCOVA). From the findings, it was observed that the use of mathematics laboratory enhanced achievement in mathematics.

The results also showed that no significant difference exists in the achievement of male and female mathematics students taught with mathematics laboratory. The study recommended that teachers should be encouraged to use mathematics laboratory in teaching plane geometry and algebraic expression and mathematics student teachers should be trained on its use in their methodology class.

Ebele C. Okigbo and Abigail M. Osuafor (2008) conducted a study on the effect of using mathematics laboratory in teaching on achievement of mathematics students. Findings of the study were that the students who were taught mathematics with mathematics laboratory achieved more than those taught without mathematics laboratory and there were no significant differences in achievement with regard to gender.

Leveal khasim pasha sd, Nalla Janardhan Rao and, P.Veerababu (2012) conducted a study on the Importance of Mathematics Laboratories in High school Abstract: This research paper deals the importance's of mathematics laboratory in teaching mathematics in high school mathematics. A total of 200 Mathematics students were involved in the study. The study is quasi-experimental research. Results were analysed using mean, standard deviation and

analysis of covariance. It was observed that the use of mathematics laboratory enhanced achievement in mathematics.

This results also showed that no significant difference exists in the achievement of male and female mathematics students taught with mathematics laboratory. By implementing this we are given more knowledge to students by concrete scene. Key words: High school students, plane geometry, methodology class, mathematics aids.

Kaushik Das(2019) conducted a study on the Significant of Mathematics Laboratory Activities for Teaching and Learning. The present study examined the significance of the Mathematics Laboratory for Mathematics teaching in Schools, Colleges & Teacher Training Institutes in India. Researchers present the overview of Math-Lab for effective mathematics teaching and discuss the important roles of the mathematics laboratory for mathematics learning. The mathematics laboratory classroom solves this problem by combining these environments. Laptop computers address the needs of software and networking but there are fewer pro levels that help maintain a more balanced classroom environment. In the teaching and learning of mathematics, the mathematics laboratory, with the support and companionship of both the student-teachers, can play a significant role and can have a significant impact on the progress of the students in mathematics.

The main objective of the present study is to find out the major factors of Mathematics Laboratory in Mathematics-Education. This study discusses the concepts of mathematics in the classroom, the mathematics laboratory and its importance, and how to use the mathematics laboratory for trained teachers, from beginning to elementary level mathematics education. The methodology of the study is a mixed type involving an interpretative approach where qualitative data were collected and study secondary sources, like books, articles, journals, thesis, university news, expert opinion, and websites, etc. Finally, meaningful suggestions are offered.

R Vineetha N and Geetha. C(October2014) conducted a study on Exploring the Use of Mathematics Laboratory in Teaching Mathematics at Secondary Schools. The teaching of mathematics should enhance the child's resources to think and reason, to visualize and handle abstractions, to formulate and solve problems. This broad spectrum of aims can be covered by teaching relevant and important mathematics embedded in the child's experience. Succeeding in mathematics should be seen as the right of every child. For this, mathematics laboratory

teaching concepts give the suitable solution. In this study researcher intends to explore the justifications of the opinions of the mathematics teachers about the use of mathematics laboratory in mathematics teaching. Key words: secondary school, hard spot, mathematics laboratory.

R Vineetha N and Geetha. C(2021) conducted a study on Effectiveness of using mathematics laboratory in teaching chemistry on achievement of secondary school students. The present study investigated the Effectiveness of Using Mathematics Laboratory in Teaching Chemistry on Achievement of Secondary School Students. Using Laboratory is a procedure for stimulating the activities of the students and to encourage them to make discoveries and it is also based on the principle of learning by doing. Researcher adopted 'Pre-test'- 'Post-test' Experimental and control group design under True Experimental Research. The sample consisted of 80 students of standard X from National Public School, Shivamogga, Karnataka. 40 students were assigned to the experimental group and 40 students in the control group equate through academic performance of previous year.

The experimental group was taught using Mathematics Laboratory and the Control Group was taught through the Conventional method. The data were analysed using t-test. From the findings, it was observed that the use of mathematics laboratory in teaching chemistry Enhanced Achievement in Chemistry. This method is suitable for teaching chemistry to the lower classes and higher classes as at this stage teaching is done with the help of concrete things and examples.

Khasim pasha, Nalla Janardhan Rao and P. Veerababu (2012) conducted a study on the importance's of mathematics laboratory in teaching mathematics in high school mathematics IOSR Journal of Mathematics (IOSRJM) ISSN: 2278-5728 Volume 1, Issue 4 (July-Aug 2012), PP 24-28 www.iosrjournals.org This research paper deals the importance's of mathematics laboratory in teaching mathematics in high school mathematics. A total of 200 Mathematics students were involved in the study. The study is quasi-experimental research. Results were analysed using mean, standard deviation and analysis of covariance. It was observed that the use of mathematics laboratory enhanced achievement in mathematics. This results also showed that no significant difference exists in the achievement of male and female mathematics students taught with mathematics laboratory. By implementing this we are given more knowledge to students by concrete scene.

Dr. Mahua Basu Mallik (2014) conducted a study on Exploring the Use of Mathematics Laboratory in Teaching Mathematics at Secondary Schools. Objectives of the study: The study aimed at fulfilling the following objectives: 1. To collect the opinion of mathematics teachers in regard to the existence of hard spots in secondary school curriculum. 2. To analysis the reason behind these hard spots given by the teachers. 3. To identify and list down some hard spots in school mathematics. 4. To collect the opinion of the practicing mathematics teachers in regard to the use of mathematics laboratory in general and also for remedial measure towards hard spots.

Research design: This research was basically a survey approach with some orientation to explorations of opinion finding their roots and also to implement them to actions. Therefore, the present researcher used a mixed approach in educational research. Sample of the study: The present researcher selected 3 retired mathematics teachers and 14 servicing mathematics teachers with the following criteria: i. Teachers of Bengali medium. ii. Schools recognized by WBBSE. Researcher found that 1. About 94% of the total respondents agree that there are some hard spots in school level mathematics curriculum. 2. Respondents cited eight types of reasons against their opinion for hard spots in school curriculum.

Dr . Abigail M. Osuafor (2021) made a study on Effect of Usability of Mathematics Laboratory Facilities on the Achievement of Junior Secondary School Students in Number and Numeration. The study investigated the effect of using mathematics laboratory in teaching on students' achievement in Junior Secondary School Mathematics. A total of 100 JS 3 Mathematics students were involved in the study. The study is quasi-experimental research. Results were analysed using mean, standard deviation and analysis of covariance (ANCOVA). From the findings, it was observed that the use of mathematics laboratory enhanced achievement in mathematics. The results also showed that no significant difference exists in the achievement of male and female mathematics students taught with mathematics laboratory. The study recommended that teachers should be encouraged to use mathematics laboratory in teaching plane geometry and algebraic expression and mathematics student teachers should be trained on its use in their methodology class.

Nasiruddin Ayinde MALIK, Kennedy Otuniuya AKUDO, Debo Sulaimon ARIKEWUYO and Gafar Adeboye OGUNLEYE (2021) conducted a study on Effect of Usability of Mathematics Laboratory Facilities on the Achievement of Junior Secondary School Students in Number and Numeration. The study focused on the effect of the usability

of mathematics laboratory facilities on achievement of students in number and numeration at junior secondary schools in Lagos State, Nigeria. Purposive sampling was used to select two schools in Ikorodu Zone, Education District II and 59 students from two intact classes were selected. The quasi-experimental research design was adopted which involved pre-test and post-test non-equivalent control group. The instrument used for the study was the Number and Numeration Achievement Test (NNAT) which consisted 20 objective questions was adopted from Lagos State Unified Basic Education Certificate Examination past questions validated by Lagos State Ministry of Education Examinations Board. The reliability of the instrument was 0.73 with the use of Spearman rank correlation coefficient. The two research questions raised were answered with the aid of means and Bar-charts, while the three null hypotheses were tested using Analysis of Covariance (ANCOVA).

The findings revealed that the use of mathematics laboratory enhanced achievement in Number and Numeration unlike conventional method. It also showed that there is no significant effect of gender on the achievement of students taught number and numeration using mathematics laboratory approach. Lastly, there is no significant interaction effect of Mathematics laboratory method and gender on students' achievement scores. It was recommended that mathematics laboratory should be established, and laboratory approach of teaching mathematics should be adopted in our schools.

Anthony Asiyai (2023) made a study on effect of laboratory practical exposure on students' and academic achievements in secondary schools in delta state, Nigeria

This study examined the effect of exposure of science students to laboratory practical work in secondary schools in Agbor and Boji-Boji Owa Education Zone, Delta State, Nigeria. Three research questions were asked and answered and one hypothesis was formulated and tested. The study employed survey research design. The population comprised all the public secondary schools.

The sample of the study comprised of 140 Senior Secondary Schools 3 science students, 40 science teachers and 20 principals. A questionnaire sub-divided into three sections was the instrument for collection of data from the respondents. The questionnaire was validated by two experts who are Professors of science education. The reliability of the instrument was

determined using test-retest method and an index of 0.88 was computed using Pearson Product Moment Formula. The items stability over time was thus justified. Data analysis was conducted using mean scores to answer the research questions and one way Analysis of Variance (ANOVA) to test the hypothesis at 0.05 alpha level.

The findings revealed that students, teachers and principals perceived the exposure of students to laboratory practical work to be of great effect to their academic achievement. There was no significant difference among the mean perception scores of students, teachers and principals regarding the effect of exposure of science students to laboratory practical work on their academic achievement in secondary schools in Agbor and Boji-Boji Owa education zone Delta State, Nigeria.

Abuja, Nigeria Katcha, M. A. and Wushishi, D. I (2015) conducted a study on Effects of laboratory equipment on secondary school students' performance and attitude change to biology learning in federal capital territory. The study examined the effects of laboratory equipment on performance and attitude change to biology learning among Senior Secondary School Students in Federal Capital Territory (FCT) Abuja. The study adopted a quasi-experimental pre-test and post -test matched group design. The sample consisted of 136 Senior Secondary School class II (SSSII) biology students. They were drawn from two (2) coeducational Secondary Schools using criterion sampling techniques. Four null hypotheses were tested at 0.05 alpha levels. Three instruments were used. They include: Biology Laboratory Equipment Check List (BLCL), Biology Practical's Achievement Test (BIOPAT) and Biology Students' Attitude Change Questionnaire (BSACQ). The reliability indices of BIOPAT and BSACQ were determined using split-half methods and 0.78 and 0.82 indices respectively were established and considered adequate for the study. The reliability index of BLCL was determined using split-half method and a reliability index of 0.75 were established, which was considered adequate for the study.

The findings indicated a significant difference between the performance of biology students exposed to adequately equipped laboratory and those exposed to inadequately equipped laboratory. The difference was in favour of those exposed to adequately equipped laboratory. Also, that, the attitude change of biology students exposed to adequately equipped laboratory is not gender-related. It is therefore recommended that school authorities and stakeholders should ensure that Science laboratories are adequately equipped in Senior

Secondary Schools so that they could remain centres of excellence where future scientists, engineers etc are prepared for university education in order to meet the goals of MDGS, EFA and vision 20-2020.

Sunday Adewale Olanrewaju(2021) conducted a study on Mathematics Laboratory: Practical Solution to Classroom "Mathemagics" in Schools. Mathematics is a language of science, and its understanding is paramount to any nation that desires growth and development in the 21 st century that is technologically driven. Practical mathematical approach in the mathematics laboratory is a panacea and cure to the demonstrated mathematics phobia by many students in class. This paper described what mathematics laboratory should look like, the equipment expected in the laboratory, the setting and the maintenance of the instructional resources, and the principles to guide the behaviours of the mathematics laboratory users. The paper also stressed the need for each school to have functional mathematics laboratory in terms of equipment, and of course good mathematics teachers for the students to acquire the mathematical skills facilitated through laboratory experience.

Panel Steve Murphy and Naomi Ingram (2023) conducted a study on A scoping review of research into mathematics classroom practices and affect. Despite much research exploring affect within a mathematics context, poor student engagement in mathematics persists internationally. There is limited research examining mathematics classroom practice and students' affect, with the potential to inform teachers' practice. This scoping review analysed this limited literature. Of 250 papers analysed, only 26 papers adequately described classroom practices, considered students' affective state in response to the practice, and considered mathematics learning outcomes. Collectively, these explore very few of the practices used in mathematics classrooms, highlighting the need for more and improved practice-focussed research to better inform efforts to improve student engagement in mathematics.

Mihret, Zemenu; Alemu, Mekbib; Assefa, Shimeles (2022) examined the effect of blended laboratory experiments on pre-service physics teachers' (PSPTs') attitudes toward physics laboratories. The research design was a quasi-experimental pre-test and post-test comparing groups. Participants were 63 2nd-year PSPTs' enrolled in a physics diploma program from three colleges of teacher education. The treatment groups performed blended and virtual laboratory experiments, whereas the comparison group conducted real laboratory experiments. Data were collected before and after intervention using a 34-item adapted attitude toward physics laboratory questionnaire with a Cronbach alpha value of 0.765. Data were

analysed using descriptive statistics, paired-sample t-test, one-way ANOVA, and Tukey post hoc comparisons. The findings revealed a statistically significant difference in mean post-test results between the treatment and comparison group. The Tukey HSD "post hoc" analysis revealed that the difference in mean between blended and real was statistically significant, but not on other combinations. Descriptive statistics showed slight attitudinal improvement from pre-test to post-test. This improvement was statistically significant for blended and virtual groups but not in real groups. Blending physics laboratory experiments can be used to enhance attitudes toward physics laboratories. Based on the conclusions, recommendations are made.

Çelik, Harun; Pektas, Hüseyin Miraç; Karamusta faoglu, Orhan(2021) examined the Effects of the Flipped Classroom Model on the Laboratory Self-Efficacy and Attitude of Higher Education Students. In class environments, the flipped classroom (FC) model has been found to increase students' attitudes, achievement, and motivation. However, the practical effects of the FC model in laboratory environments have not been introduced into the literature. Therefore, in this study, the effects of the FC model on the laboratory self-efficacy skills and attitudes of higher education students were investigated within the scope of the physics laboratory course. The data were purposively collected from a group of 84 first-year university students aged between 18-20, who were, then, sorted out into two groups: experimental and control. The sequential explanatory design model by Creswell was used, which is a subcategory of the mixed-methods design. While the FC model was applied to the experimental group, the traditional classroom model was used in the control group. In the data collection process, qualitative and quantitative data collection tools were used sequentially. The experimental results obtained at the end of a six-week study showed that the FC model significantly improved the laboratory self-efficacy and attitude towards the laboratory of higher education students. Therefore, the FC model was also found to have positive effects in laboratory environments.

Berežný, Štefan (2017) Laboratories for Teaching of Mathematical Subjects adapted our two laboratories at our department based on our research results, which were presented at the conference CADGME 2014 in Halle and published in the journal. In this article we describe the hardware and software structure of the Laboratory 1: LabIT4KT-1: Laboratory of Computer Modelling and the Laboratory 2: LabIT4KT-2: Laboratory of Numerical Mathematics. We explain the functionality of these laboratories in teaching mathematics courses at our faculty with priority given to usage of freely available software. We describe why we have made some

changes in the laboratories and how these changes assist in their operation. We focus mainly to teach the following mathematical subjects at these laboratories: Operational Analysis, Linear and Quadratic Programming, Numerical Mathematics, Applied Statistics, Queuing Theory, Software Computing Resources, Software tools for modeling processes, Applications of Differential Equations, Optimization Methods, and Fundamentals of the TeX, (LaTeX).

Donnipad (2009) conducted a study “A study of the use of mathematics laboratory for teaching mathematics by developing a Strategy and testing its effectiveness”. The objectives of the study were: (i) To find out various methods being used in teaching mathematics, (ii) to find out teachers view about Mathematics laboratory set-up, (iii) to develop a strategy to be used in mathematics laboratory set-up, (iv) to test the effectiveness of the strategy developed for teaching mathematics laboratory set-up, (v) to suggest recommendation for the development of mathematics laboratory and training of Mathematics teachers. The findings were summarised as follows: Teachers who were trained through behaviourist model were not aware of methods like cooperative learning, guided-expository and problem-solving method integrated with modeling. So, these methods were less preferred to teach mathematics as compared to traditional didactic methods like Lecture, Lecture- Demonstration methods. Mathematics laboratory is not an integral part of curriculum framework in Maharashtra. Mathematics laboratory cultivated research attitude among students, when it was integrated with strategy evolved. Mathematics laboratory and its utility were given less importance during teaching degree pursuit. Majority of in-service teachers lack the knowledge of the modus-operandi using mathematics laboratory for teaching mathematics at school level. Majority of teachers were not given in-service training in using computers and software to teach mathematics. Use of computer and mathematical software to teach and provide conceptual knowledge of mathematics in a Mathematics Laboratory yielded positive reinforcement among students. Use of computers and allied software was not in the curriculum of teaching degree pursuit. Hence teachers of mathematics were not aware of using computer and allied software to teach mathematics. Strategy evolved to teach mathematics helped in effective content management.

Computer and mathematical software used in Mathematical Laboratory has provided hands-on experience of mathematical knowledge taught. The strategy evolved has also helped students to know the social relevance of knowledge learnt. 3rd stage of the strategy helped teacher to create learning problems and situations that will actively involve students and

stimulate interest in how mathematics is applied in real life situations. There is significant difference between the mean scores of Experimental Group and Control group. The t-test revealed that the t-value statistically arrived was 5.59 for the degree of freedom 78. When t-value was compared with 0.05 level and 0.01 levels of significance for the same degree of freedom, the t-value arrived was significantly greater than both levels of significance. So, the strategy evolved for teaching mathematics in a mathematics laboratory was effective than didactic traditional methods.

Rajendra Kunwar(2020) made a study on Mathematics Laboratory in School Level Education in Nepal. This article seeks to discourse the mathematics laboratory in the sense of classroom teaching. The main focus of this article is to create knowledge and awareness to the mathematics teacher about the importance and use of mathematics laboratory especially in school level education. The study is descriptive in nature and is mainly based on the previous literature. In this study, a short glimpse of mathematics education and teaching mathematics has been presented to overview the mathematics laboratory more clearly and also different aspects of mathematics laboratory have been discussed. It provides the mutual support for teaching and learning mathematics and helps to overcome the constraints while transforming knowledge through classroom practice. It also provides the chance of experience sharing by working together with the use of varied modern tools and technology in the classroom. Equally, it helps to encourage the students to participate actively in the learning process as well as to make them clear in different mathematical concepts. It also suggests to the concern mathematics teachers and administrators of the school to facilitate for the establishment and utilization of mathematics laboratory for effective mathematics teaching.

Nwoke, B.I., Ogoke, C.J. and Anyanwu (2020) conducted a study on Availability and Utilization of Mathematics Laboratory Facilities for Pedagogical Purposes in Secondary Schools The study investigated the availability and utilization of Mathematics laboratory facilities for pedagogical purposes in secondary schools in Imo State. Based on the purpose and objectives of the study, four research questions and two hypotheses guided the study. The descriptive survey research design was adopted in carrying out the study. The population of the study was made up of all Senior Secondary two (SS2) students of Government owned secondary schools in Owerri Municipal council of Imo State. A sample of 226 Senior Secondary two (SS2) students were selected for the study using simple random sampling

technique. The instrument for data collection was a researcher made rating scale titled “Availability and Utilization of Mathematics Laboratory Facilities for Pedagogical Purposes (AUMLFPP)” with reliability coefficient of 0.76 determined using Cronbach alpha formula. The instrument was administered to the respondents on face-to-face basis. The data generated was analysed using mean and standard deviation to answer research questions while the hypotheses were tested using independent sample t-test at 0.05 level of significance. The result of the study revealed that Mathematics laboratory facilities were available at a low extent and their utilization for pedagogical purposes was also low. Based on the findings, it was recommended that Government should provide mathematics laboratory and facilities to enable teachers and students use them during mathematics classes.

DR. T. MOSES ITYAVZUA conducted study on the Effect of virtual mathematics laboratory on senior secondary school students’ interest in circle geometry in north-central geopolitical zone, Nigeria. This study was empirically designed to determine the effect of virtual mathematics laboratory on senior secondary school students’ interest in circle geometry in North-Central geopolitical Zone, Nigeria. The interest of students taught circle geometry using Virtual Mathematics Laboratory (VML) and Traditional Mathematics Laboratory (TML) were compared. The study also determined the influence of gender on students’ interest in circle geometry. The interact effect of type of mathematics laboratory and gender on students’ interest in circle geometry were determined as well. Three research questions and nine hypotheses guided the study. A quasi-experimental research design was used. Specifically, non-equivalent pre-test, post-test control groups design, involving two intact classes. The population for this study consisted of a total of 5657 students in SS2 from Co-educational Federal Government Colleges in the North-Central. The sample for this study consisted of 96 students (55 males and 41 females). A purposively sampling technique was first employed to select ten (10) Co-educational Federal Government Colleges in the North-Central. A simple random sampling technique was then employed to draw two Co-educational Colleges and one intact class from each college and assigned to Experimental (VML) and Control (TML) groups.

The instrument for data collection was Geometry Interest Inventory (GII) developed and validated by the researchers. The internal consistency of GII was determined and established to be 0.92 using Cronbach’s Alpha (α). The research questions were answered using mean and standard deviation while the hypotheses were tested using Analysis of Covariance

(ANCOVA) at 0.05 significant level. The results obtained from this study indicated that type of mathematics laboratory had significant effect on students' interest in circle geometry. Students taught circle geometry using VML had significant higher interest in circle geometry than those taught with TML. However, gender did not significantly influence students' interest in circle geometry. It was also revealed from this study that, type of mathematics laboratory and gender had no significant interaction effect on students' interest in circle geometry. It was recommended among others that mathematics teachers and students should endeavour to use VML to teach and learn circle geometry in senior secondary schools respectively. Suggestions for further studies were highlighted among which a study on the remaining circle theorems and other aspect of mathematics were made

Canel Steve Murphy and Naomi Ingram (2023) conducted a study on A scoping review of research into mathematics classroom practices and affect. Despite much research exploring affect within a mathematics context, poor student engagement in mathematics persists internationally. There is limited research examining mathematics classroom practice and students' affect, with the potential to inform teachers' practice. This scoping review analyzed this limited literature. Of 250 papers analyzed, only 26 papers adequately described classroom practices, considered students' affective state in response to the practice, and considered mathematics learning outcomes. Collectively, these explore very few of the practices used in mathematics classrooms, highlighting the need for more and improved practice-focused research to better inform efforts to improve student engagement in mathematics.

Varun Kumar D. Rathod (2020) conducted a study Mathematics is all around us, it has an important role in our life. Mathematics is important in all the sphere of science, technology, and economics. No field is untouched from mathematical involvements. Knowledge of Mathematical concepts and phenomena is essential for an increasingly complex global society. It is crucial to impart mathematics education to the students in a simple and interesting way. One of the objectives of this study was to explore the effectiveness of the mathematics laboratory-based teaching learning programme meant for understanding the quadrilaterals unit of mathematics of standard-VIII. The pre-test post-test control group design was used for the study. The experimental group was treated with mathematics laboratory-based teaching learning programme and the controlled group was taught by conventional method. After teaching, the achievement test in mathematics was administered to measure their attainment in mathematics. The mathematical achievement was measured using t-test to test the effectiveness

of the treatment. The findings of the research revealed that the achievement of the experimental group was higher than that of the conventional group. It can be ascertained that the laboratory-based teaching learning programme in content delivery of quadrilaterals unit of mathematics for standard -VIII was more effective in developing mathematical concepts than the traditional method.

Pascal Kaneza, Jean Baptiste Nkurunziza&Innocent Twagilimana (2023) made a study on Effect of Hands-on Laboratory Experiment and Demonstration Teaching Techniques on Rwandan Secondary School Students' Academic Performance in Solutions and Titration. The main objective of this intervention study was to investigate the effect of three teaching approaches, namely the traditional teaching method (TTM), a teacher-based demonstration experiment (TBDE) and a student hands-on experiment (SHE), on students' academic performance. A total number of 324 senior five students studying chemistry as one of the main subjects in their combinations were selected from four provinces and Kigali city in Rwanda. The data were collected using a chemistry achievement test comprising 30 multiple-choice questions. This test was administered before and after teaching intervention to measure the effect of the three teaching approaches on students' academic performance of solutions and titration. The Kruskal–Wallis test indicated that both SHE and TBDE had a higher mean rank after the intervention than the TTM group. The post-hoc test showed a statistically significant difference in the mean score of TTM vs. TBDE, as well as TTM vs. SHE. However, there was no significant statistical difference between the SHE vs TBDE groups. The results indicate that providing laboratory experiments through SHE or TBDE approaches significantly improved students' academic performance of solutions and titration. Chemistry teachers are advised to use laboratory experiments provided either through SHE or TBDE as an effective remedial tool that could improve students' performance in solutions and titration.

2.4 CONCLUSION:

Thus, the review of studies related to the area of investigation enabled the investigator to plan the course of research and in the formulation of suitable hypotheses for the study. The description of the tool, the sample and the statistical techniques used in this study are given in the forthcoming chapter.

CHAPTER III

METHODOLOGY

3.1 INTRODUCTION:

Learning mathematics involves learning ways of thinking. It involves, learning powerful mathematical ideas rather than a collection of disconnected procedures for carrying out calculations. High school Students are capable of learning mathematics with understanding and create new ideas but opportunities to do so is not available. Teachers need training to update their knowledge in content and methodology. The present study aims to do so.

This chapter deals with objectives, hypothesis, delimitations, assumptions, statement of the problem, definition of keywords, operational definitions, experimental method ,training design ,experimental phase, sample, research tool, data collection and scheme of data analysis of the present study.

3.2 OBJECTIVES:

- ❖ To find out the student's prior knowledge in using mathematics laboratory.
- ❖ To develop module for class IX mathematics lab.
- ❖ To Organize training program for teachers handling class 9 mathematics.
- ❖ To find out the effect of mathematics laboratory in improving the student's achievement of Control and experimental group.
- ❖ To find out the effect of mathematics achievement in improving the classroom teaching of Control and experimental group.

3.3 HYPOTHESES:

1. There is no significant difference between pre test scores on achievement in mathematics for experimental group and control group students for total sample.
2. There will be a significant difference between post test scores on achievement in mathematics for experimental group and control group students for total sample.
3. There will be a significant difference between pre- test and post test scores on achievement in mathematics for experimental group total sample.
4. There will be a significant difference between pre- test and post test scores on achievement in mathematics for control group total sample.
5. There is no significant difference between pre test scores on achievement in mathematics for experimental group boys and girls.

6. There is no significant difference between post test scores on achievement in mathematics for experimental group boys and girls.
7. There is no significant difference between pretest scores on achievement in mathematics for control group boys and girls.
8. There is no significant difference between post test scores on achievement in mathematics for control group boys and girls.
9. There is no significant difference between pretest scores on achievement in mathematics for experimental group GHS and GHSS students.
10. There is no significant difference between post test scores on achievement in mathematics for experimental group GHS and GHSS students.
11. There is no significant difference between pre test scores on achievement in mathematics for control group GHS and GHSS students.
12. There is significant difference between post test scores on achievement in mathematics for control group GHS and GHSS students.
13. There will be a significant mean difference between pretest and post test scores on achievement in mathematics for experimental group students.
14. There will be a is significant mean difference between pretest and post test scores on achievement in mathematics control group students.
15. There will be a significant mean difference between pretest and post test scores on achievement in mathematics for experimental group school E1students in concept attainment.
16. There will be a significant mean difference between pretest and post test scores on achievement in mathematics for experimental group school E2 students in concept attainment.
17. There will be a significant mean difference between pretest and post test scores on achievement in mathematics for experimental group school E3 students in concept attainment.
18. There will be a significant mean difference between pretest and post test scores on achievement in mathematics for experimental group school E4 students in concept attainment.
19. There will be a significant mean difference between pretest and post test scores on achievement in mathematics for experimental group school E5 students in concept attainment.

20. There will be a significant mean difference between pretest and post test scores on achievement in mathematics for control group school C1 students in concept attainment.
21. There will be a significant mean difference between pretest and post test scores on achievement in mathematics for control group school C2 students in concept attainment.
22. There will be a significant mean difference between pretest and post test scores on achievement in mathematics for control group school C3 students in concept attainment.
23. There will be a significant mean difference between pretest and post test scores on achievement in mathematics for control group school C4 students in concept attainment.
24. There will be a significant mean difference between pretest and post test scores on achievement in mathematics for control group school C5 students in concept attainment.

3.4 DELIMITATIONS:

- The mathematics laboratory training was conducted for 5 experimental group school teachers.
- The study was conducted for class IX students studying in five blocks namely Krishnagiri, Kaveripattinam, Bargur, Veppanapalli and Soolagiri.
- The study was restricted to class IX mathematics.
- The study was confined to mathematics syllabus.

3.5 ASSUMPTIONS:

In- service training helps teachers to improve their teaching skill. For all the teachers teaching classes from I to X must attend 20 days in -service training per year. These trainings are organized by SCERT and Samakra Siksha scheme. Apart from these trainings the investigator being a mathematics senior lecturer working in DIET prepared a module with the help of the teachers and gave training to the teachers for this study. This training will clear the doubts in using mathematics laboratory for class IX mathematics. The training approach will improve the achievement of the students. This training will bring positive attitude towards the training programme. The mathematics laboratory materials will change the classroom teaching method. Also, it will change the classroom environment.

3.6 STATEMENT OF THE PROBLEM:

High school teachers are loaded with lot of works apart from teaching. They are filling forms and school particulars. They are engaged to take election census and election duty whenever election comes, attending 20 days in- service training programmes, distributing the

government sanctioning benefits to the students. Even if they have interest to teach for each student individually, they don't have enough time. Present system of education focuses on syllabus completion and examination. In high school up to class IX all students are promoted to other classes compulsorily. There is no failure even though they do not achieve the learning outcomes. They need attendance. Irregularity in attendance of students affects the quality of Education. so to overcome these problems present study focuses on mathematics lab activity. Hence the researcher has chosen the topic **“Effect of using Mathematics Laboratory in Teaching Mathematics among High school students.”**

3.7 LEARNING OUTCOMES FOR CLASS IX MATHEMATICS:

901. Applies logical reasoning in proving their properties and using them in different Situations.
902. Identifies/ Classifies polynomials among algebraic expressions and factors them by applying appropriate algebraic identities.
903. Relates the algebraic and graphical representations of a linear equation in one/ two variables and applies the concepts to daily life situations.
904. Identifies similarities and differences among different geometrical shapes.
905. Derives proofs of mathematical statements particularly related to geometrical concepts like parallel lines, triangles, quadrilaterals, circles etc by applying axiomatic approach and solves problem in using them.
906. Finds areas of all types of triangles by applying appropriate formulae.
907. Constructs different geometrical shapes like bisector of line segments, angles and triangles under given conditions and provides reasons for the processes of such constructions.
908. Develops strategies to locate points in a cartesian plane.
909. Identifies and classifies the daily life situations in which mean, median, and mode can be used.
910. Analyses data by representing it in different forms like tabular form [grouped or ungrouped], bar graph, histogram (with equal and varying width and length), and frequency polygon.
911. Calculates empirical probability through experiments.
912. Derives formulas for surface areas and volumes of different solid objects like, cubes, spheres and hemispheres and applies them to objects found in the surroundings.
913. Solves problems that are not in familiar context of the child using above learning. These problems should include the situations about which child is not exposed earlier.

3.8 DEFINITION OF KEY TERMS:

The key terms in the study are

- ❖ Mathematics Laboratory
- ❖ Teaching Mathematics
- ❖ High school

Mathematics Laboratory:

The National Curriculum Framework for school education (NCFSE) developed by NCERT emphasizes that mathematics learning should be facilitated through activities from the very beginning of school education. These activities may involve the use of concrete materials, models, patterns, charts, pictures, posters, games, puzzles and experiments. Mathematics laboratory is a room wherein we find collection of different kinds of materials and teaching/learning aids, needed to help the students understand the concepts through relevant, meaningful and concrete activities. These activities may be carried out by the teacher or the students to explore the world of mathematics, to learn, to discover and to develop an interest in the subject.

Teaching Mathematics:

At secondary stage Mathematics comes to the student as an academic discipline. In a sense, at the elementary stage, mathematics education is (or ought to be) guided more by the logic of children's psychology of learning rather than the logic of mathematics. But at the secondary stage, the student begins to perceive the structure of mathematics. For this, the notions of argumentation and proof become central to curriculum now. Mathematical terminology is highly stylised, self-conscious and rigorous. propositions using only terms defined earlier, and proofs justifying propositions.

High school:

In Tamil Nadu school education high school has class6-8 as upper primary class and class9 &10 as secondary class.

3.9 RESEARCH DESIGN:

Experimental design is the blueprint of procedures that enable the researcher to test by reaching valid conclusions about relationships between independent and independent variables.

Three categories of experimental design are as follows:

1. Pre- experimental design
2. True experimental design

3. Quasi-experimental design

3.10 EXPERIMENTAL DESIGN:

Ten schools were taken for study. 5 schools were treated as experimental group and 5 schools were treated as control group. Pre-test was conducted for experimental group and control group. Training was given to the teachers working in experimental groups schools. Mathematics lab material and module were supplied to the experimental group schools. Teaching mathematics using mathematics lab was carried out in experimental group schools. Traditional method of teaching was adopted in control group. At the end of the period post test was conducted for both experimental and control group schools.

3.11 SCHEMATIC REPRESENTATION OF EXPERIMENTAL DESIGN:

**TABLE 3.1 SCHEMATIC REPRESENTATION OF
EXPERIMENTAL DESIGN**

S.NO	TYPE	SOURCES
1	Category of experimental design	Quasi-experimental design
2	Variables	1.Inservice training 2.Achievement
3	Tool Used	Student tool- Achievement test
4	Population	Students studying class IX in Krishnagiri district
5	Sampling technique	stratified random sampling
6	sample	students
7	Sample details: students	Experimental group Boys: 44

		Girls: 81 Total: 125 Control group Boys: 57 Girls:38 Total: 95
8	Statistical techniques used	Mean& Variation and 't' test

3.12 TRAINING DESIGN:

The Researcher conducted pretest for class IX students in the beginning of the project. It is found that student's achievement is low. Then special focus is given for preparing module for mathematics laboratory. Mathematics lab materials were prepared with the help of the teachers and given to the experimental group school teachers. Traditional method of teaching was carried in control group schools. Module was prepared and it was given to experts like teacher educators, high school teachers, Senior lecturer and lecturer working in DIET for establishing validity.

TABLE 3.2 CHART FOR TRAINING DESIGN

Pre- test for experimental group post test was conducted post- test was conducted	Pre- test for control group
Mathematics laboratory material and module were supplied	Traditional method of teaching
Frequent classroom supervision and monitoring by the researcher	Classroom separation by the teacher
Post test was conducted	Post test was conducted

3.13 EXPERIMENTAL PHASE:

Experimental phase involves following steps:

Pre- test → training → supply of lab material → classroom implication → monitoring → post-test

Pre- test was conducted for all the 10 schools. Training was given for experimental group teachers. Lab manual consist of following learning out comes.

- ❖ To use set language in solving life-oriented word problems.
- ❖ To visualize the real numbers on the number line.
- ❖ To understand the scientific notation
- ❖ Able to draw graph for a given linear equation
- ❖ To understand the properties of quadrilaterals and use them in problem solving.
- ❖ To understand the mid-point formula and use it in problem solving.
- ❖ To understand the usage of trigonometric tables.

Following list of materials were prepared and used in the class room

- Vegetables (Potato, Tomato, Brinjal, Bitter guard & Capsicum)

- Fruits (Apple, Banana, Chikkoo, Grapes & Orange)

- BioDegradable: Cloth, paper cup, paper plate, newspaper, fruits, leaves, vegetables, cooked food

- Non- Bio Degradable: Blade, gas bandages, expired medicine

- Graph sheet, Pencil, eraser
- Scale, Pencil, Paper & pen
- Chart & Marker
- Picture of solar system
- Folding graph sheets in large size, Marker pen, A₄ size graph sheet, scale, pencil
- Quadrilaterals-drawn in chart, paper folding & models
- 3 sided and 5 sided shapes
- Graph sheet, rectangular box, protractor, ruler
- Matching board, Velcro strips, protractor, ruler and flash cards
- Paper, Scissor, Colour sheets, scale, eraser
- Chart, Sketch, pencil, paper, scale, eraser, pictures of trees, mountains, building

3.14 SAMPLE:

Krishnagiri district has 10 blocks.6 blocks in krishnagiri educational district and 4 blocks in Hosur educational district. From krishnagiri educational district sample was selected from Krishnagiri, Kaveripattinam ,Bargur and Veppanapalli blocks .From Hosur educational district Sample was selected from soolagiri block .From each block 2 schools were selected. One school as experimental and one as control group.

TABLE3.3 DETAILS OF SAMPLE-EXPERIMENTAL GROUP

S.NO	NAME OF THE SCHOOL	TOTAL BOYS	TOTAL GIRLS	TOTAL STRENGTH
1	GHS, Jaheer Venkatapuram	8	14	22
2	GHSS, Ramapuram	15	22	37
3	GHSS, Vennampalli	6	8	14
4	GMHSS, Veppanapalli	15	19	34
5	GGHSS, Soolagiri	0	18	18
TOTAL		44	81	125

TABLE3.4 DETAILS OF SAMPLE-CONTROL GROUP

S.NO	NAME OF THE SCHOOL	TOTAL BOYS	TOTAL GIRLS	TOTAL STRENGTH
1	GHS, Gangaleri	11	9	20
2	GHS, Nattanmaikottai	8	7	15
3	GHSS, Varattanapalli	3	8	11
4	GHSS, Kundarapalli	16	14	30
5	GBHSS, Soolagiri	19	0	19
TOTAL		57	38	95

Total sample for experimental group: 125

Total sample for control group: 95

Total sample for the study:

220 students studying class IX

3.15 RESEARCH TOOL:

one tool was constructed for both pre-test and post-test for class IX students. This tool was constructed and administered for 10 teachers handling class IX mathematics. This tool was administered before preparing the module. Questionnaire consist of 10 questions each carries 5 marks. Total score is 50.

TABLE 3.5 BLUE PRINT

QUESTION NO	TOPIC
1	Set language
2	Set language
3	Real numbers
4	Real numbers
5	Algebra
6	Algebra
7	Geometry
8	Co-ordinate Geometry
9	Co-ordinate Geometry
10	Trigonometry

Content validity:

After construction of the questionnaire Some questions were revised with the guidance of the experts.

Reliability:

Reliability of the tool was developed by Kuder- Richardson and it was found to be 0.83 which is highly significant.

Scoring:

Each question carries 5 marks

3.16 DATA COLLECTION:

The researcher conducted pre-test for all the 10 schools using the constructed tool. Traditional method of teaching was done in control group schools. Module was prepared with the help of the DIET senior lecturer, Lecturer and the teachers. Lab material was prepared and training was given to the experimental school teachers.

Frequent visit was done by the researcher. During school visit doubts raised by the teachers were cleared. Teachers' comment on the module was satisfactory. Students' feel happy to work with the lab materials. To study the effectiveness of the training post-test was administered to the students

Collected data were analysed using 't' test.

CHAPTER – IV

ANALYSIS AND INTERPRETATION OF THE DATA

4.1. INTRODUCTION:

The present study aims at assessing the effect of using mathematics laboratory in teaching mathematics among high school students of class9 of 5 blocks of Krishnagiri district. Pretest and post test scores were analysed for both experimental group and control group. Student questionnaire was analysed. Data were analysed in two different ways. They are

1. Descriptive analysis
2. Differential analysis

Present study was conducted for 5 experimental group schools and 5 control group schools. For convenience the schools were named as follows.

EXPERIMENTAL GROUP SCHOOLS

E1-GHS Jaheer Venkata Puram

E2-GHSS Rama Puram

E3-GHS Vennampalli

E4-GMHSS Veppanaplli

E5-GGHSS Soolagiri

CONTROL GROUP SCHOOLS

C1-GHS Gangaleri

C2-GHS Nattanmaikottai

C3-GHSS Varattanapalli

C4-GHSS Kundarapalli

C5-GBHSS Soolagiri

4.2 DESCRIPTIVE ANALYSIS:

It involves computing of measures of central tendency such as the mean and the measures of variability such as standard deviation. The computed values are used to describe the properties of the different sub-samples.

TABLE 4.1 SCHEMATIC REPRESENTATION OF EXPERIMENTAL DESIGN

Phase number	Assessment of effect of Maths lab activities	Sample Experimental schools	Sample Control group schools	Statistical tool
1.1	Pretest Students	125	96	't' Value
1.2	Module preparation	5	-	
1.3	Training program	5	-	

1.4	Post-test Students	125	95	't' Value
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TABLE 4.2 MEAN AND VARIANCE OF EXPERIMENTAL GROUP AND CONTROL GROUP STUDENTS' ACHIEVEMENT IN USE OF MATHEMATICS LABORATORY AMONG PRE-TEST AND POST TEST

Type of school	N	Pre test		Post test	
		Mean	Variance	Mean	Variance
Experimental group	125	27.09	469.77	68.19	575.45
Control group	95	23.92	493.69	50.84	425.5

- ❖ It is observed from table 4.2 the mean score obtained by experimental group Student's achievement in mathematics for pretest is 27.09 and for posttest is 68.19
- ❖ The mean score obtained by control group student's achievement in mathematics for pretest is 23.92 and for the post test is 50.84
- ❖ Mean score of experimental group Student's achievement is higher than control group student's achievement

FIGURE4.1

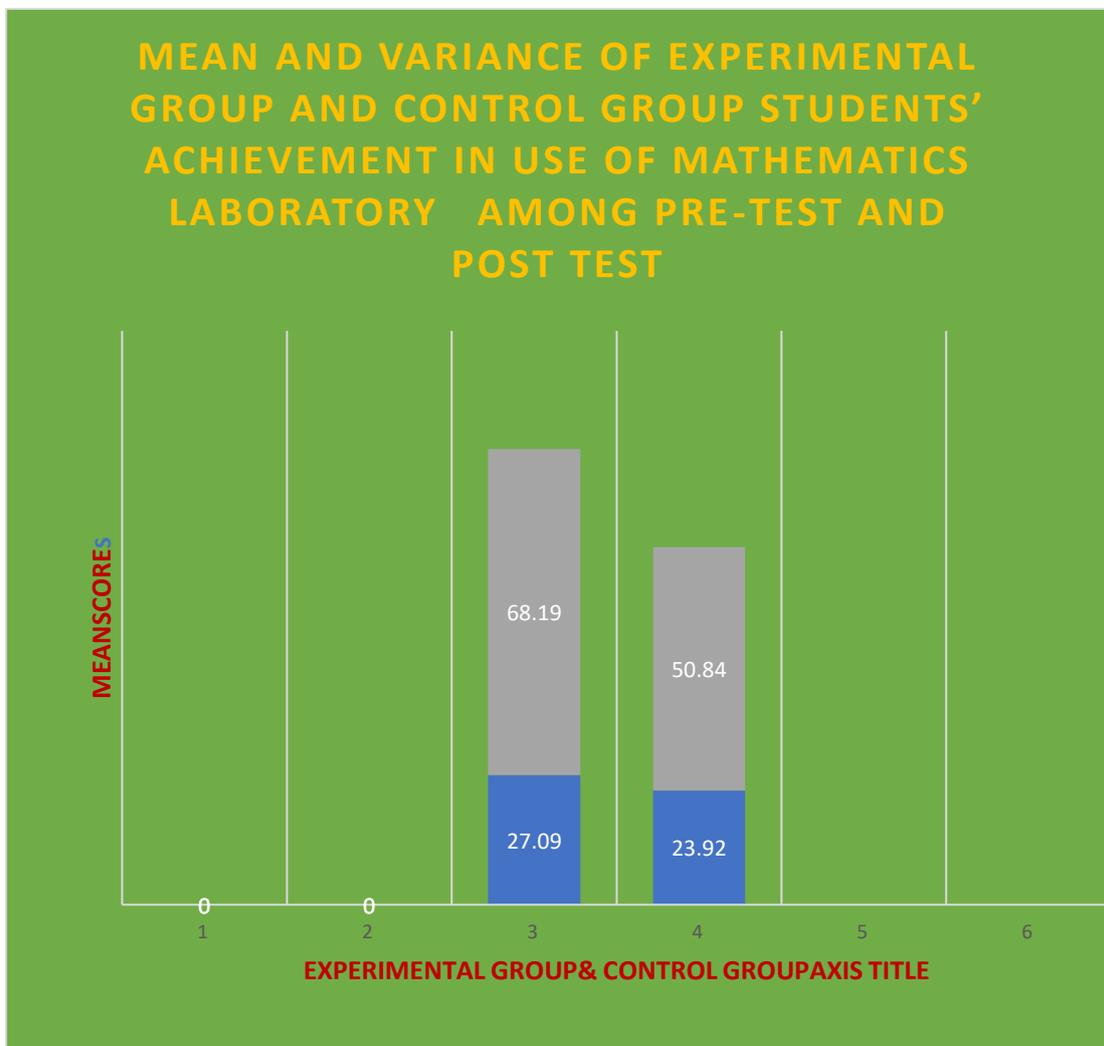


TABLE 4.3 MEAN AND VARIANCE OF EXPERIMENTAL GROUP BOYS AND GIRLS' ACHIEVEMENT IN USE OF MATHEMATICS LABORATORY AMONG PRE-TEST AND POST TEST

Gender	N	Pre test		Post test	
		Mean	Variance	Mean	Variance
Boys	44	28	380.65	61.95	633.58
Girls	81	26.59	522.84	71.58	518.37

- ❖ It is observed from table 4.3 the mean score obtained by experimental group boy's achievement in mathematics for pretest is 28 and for posttest is 61.95
- ❖ The mean score obtained by experimental group girl's achievement in mathematics for pretest is 26.59 and for posttest is 71.58
- ❖ In pretest mean score of experimental group boy's achievement is higher than girl's achievement.
- ❖ In posttest mean score of experimental group boy's achievement is less than girl's achievement.

TABLE 4.4 MEAN AND VARIANCE OF CONTROL GROUP BOYS AND GIRLS' ACHIEVEMENT IN USE OF MATHEMATICS LABORATORY AMONG PRE-TEST AND POST TEST

Gender	N	Pre test		Post test	
		Mean	Variance	Mean	Variance
Boys	57	26.32	371.83	49.86	381.69
Girls	38	20.32	669.3	52.32	499.57

- ❖ It is observed from table 4.4 the mean score obtained by control group boy's achievement in mathematics for pretest is 26.32 and for posttest is 49.86

- ❖ The mean score obtained by control group girl's achievement in mathematics for pretest is 20.32 and for posttest is 52.32
- ❖ In pretest mean score of control group boy's achievement is higher than girl's achievement.
- ❖ In posttest mean score of control group boy's achievement is less than girl's achievement.

TABLE 4.5 MEAN AND VARIANCE OF EXPERIMENTAL GROUP STUDENT'S ACHIEVEMENT IN USE OF MATHEMATICS LABORATORY AMONG PRE-TEST AND POST TEST

Name of the school	N	Pre test		Post test	
		Mean	Variance	Mean	Variance
E1	22	4.9	22.37	35.45	214.55
E2	37	53.08	249.69	73.84	442.31
E3	14	34.57	104.26	73.43	95.65
E4	34	15.35	98.11	76.29	466.21
E5	18	17.11	65.99	77.22	321.01

It is found from table 4.5 that

- ❖ For school E1 the mean score for pretest is 4.9 and for posttest is 35.45
- ❖ For school E2 the mean score for pretest is 53.08 and for posttest is 73.84
- ❖ For school E3 the mean score for pretest is 34.57 and for posttest is 73.43
- ❖ For school E4 the mean score for pretest is 15.35 and for posttest is 76.29
- ❖ For school E5 the mean score for pretest is 17.11 and for posttest is 77.22
- ❖ Out of 5 schools in pretest high mean score is found in school E2 and in posttest high mean score is found in school E4

FIGURE 4.2

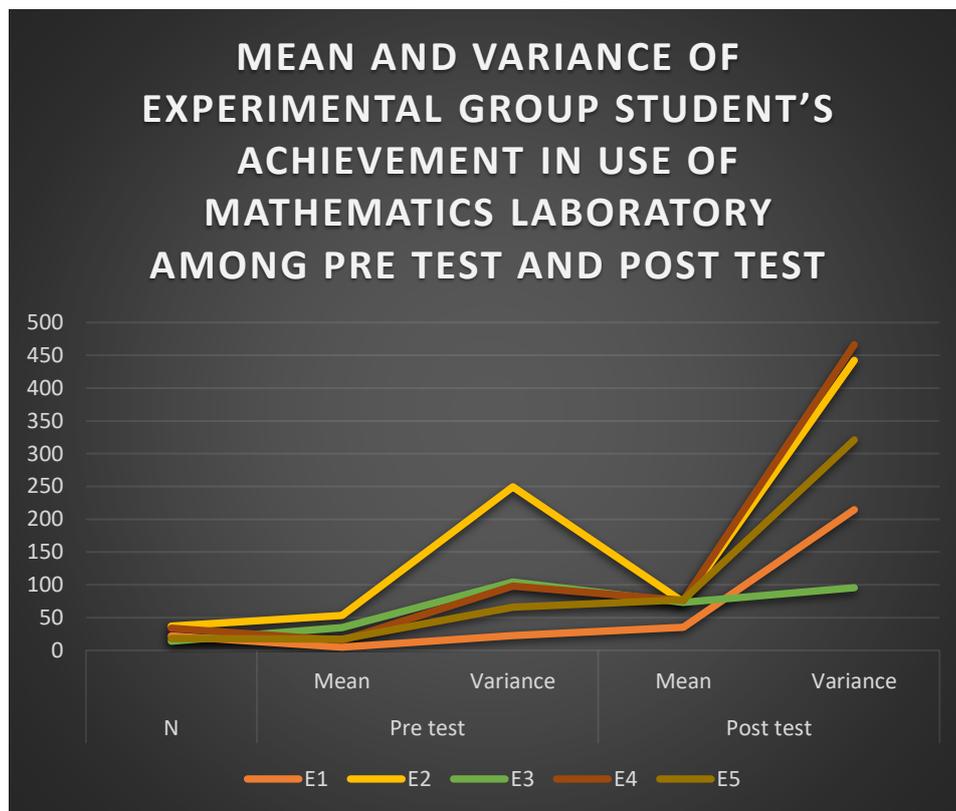


TABLE 4.6 MEAN AND VARIANCE OF CONTROL GROUP STUDENT'S ACHIEVEMENT IN USE OF MATHEMATICS LABORATORY AMONG PRE-TEST AND POST TEST

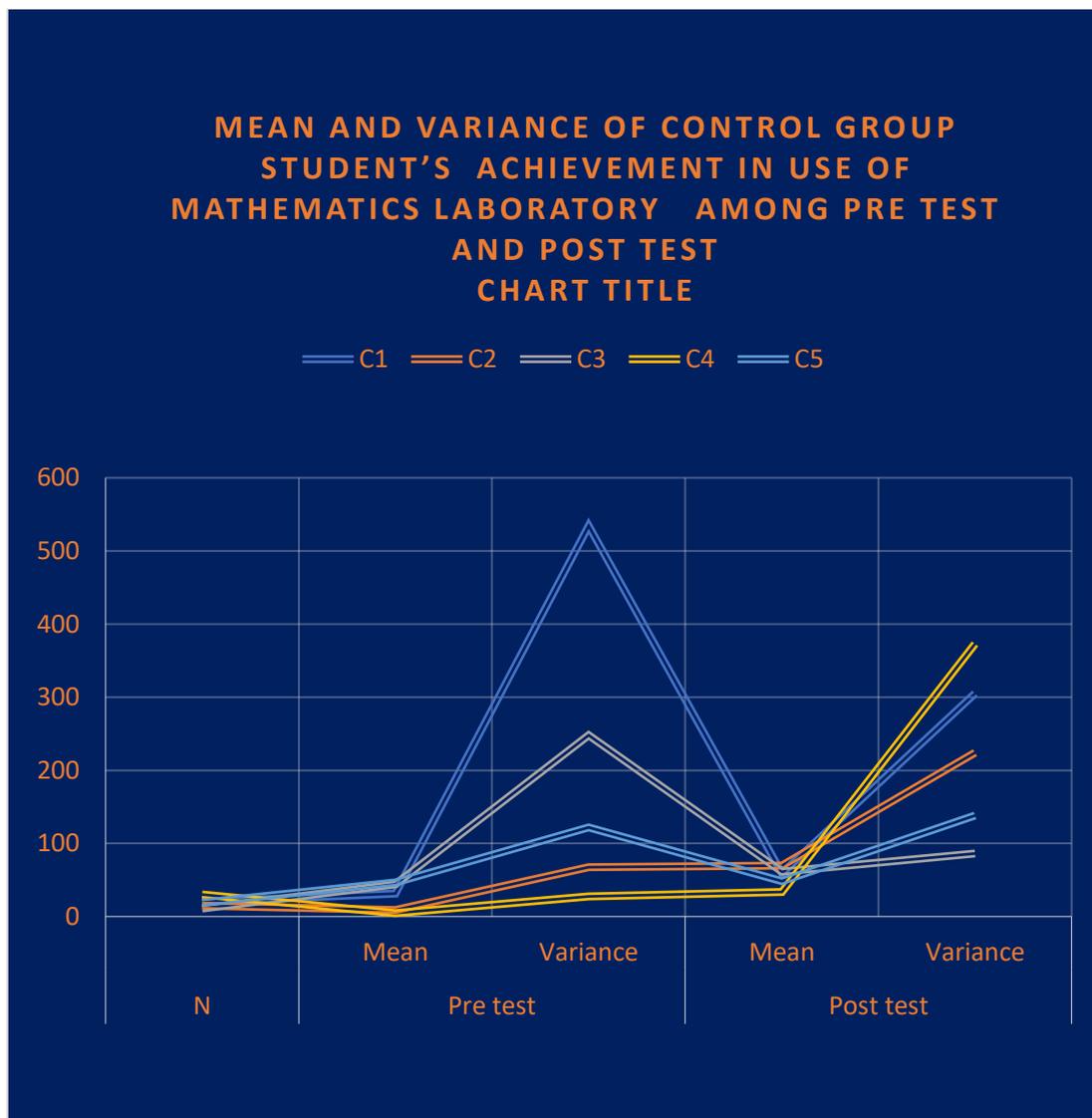
Name of the school	N	Pre test		Post test	
		Mean	Variance	Mean	Variance

C1	20	31.4	534.36	59.2	305.01
C2	15	8.93	67.35	69.6	224.11
C3	11	44	248	61.45	86.47
C4	30	4.67	27.4	33.67	372.99
C5	19	46.63	121.8	48.21	138.18

It is found from table 4.6 that

- ❖ For school C1 the mean score for pretest is 31.4 and for posttest is 59.2
- ❖ For school C2 the mean score for pretest is 8.93 and for posttest is 69.6
- ❖ For school C3 the mean score for pretest is 44 and for posttest is 61.45
- ❖ For school C4 the mean score for pretest is 4.67 and for posttest is 33.67
- ❖ For school C5 the mean score for pretest is 46.63 and for posttest is 48.21
- ❖ Out of 5 schools in pretest high mean score is found in school C5 and in posttest high mean score is found in school C2

FIGURE4.3



4.3 DIFFERENTIAL ANALYSIS:

The 't' test is a numerical procedure that takes into account the difference between the means of two sub-groups, the size of the sample in each group and the amount of variation of spread present in the scores. Thus the 't' test is a technique to find whether the difference between the mean performance of the two groups is significant or not.

TABLE 4.7 SIGNIFICANCE OF DIFFERENCE IN THE MEAN SCORES OF PRE-TEST ON ACHIEVEMENT IN USE OF MATHEMATICS LABORATORY FOR EXPERIMENTAL GROUP & CONTROL GROUP STUDENTS (TOTAL SAMPLE)

Maximum score :100

Category	N	Mean	S. D	't' value		Result at 0.01 level
				Calculated	Table	
Experimental group	125	27.09	21.6	1.06	2.576	Not significant
Control group	95	23.92	22.22			

- ❖ From table 4.7 it is observed that the calculated 't' value 1.06 is less than the table value 2.576 at 0.01 level. There is no significant difference between pre test scores on achievement in mathematics for experimental group and control group students for total sample. Hence the null hypothesis is accepted.
- ❖ It is clear from the table that the students' achievement in mathematics is same before using the mathematics laboratory.

FIGURE4.4

SIGIFICANCE OF DIFFERENCE IN THE MEAN SCORES OF PRE TEST ON ACHIEVEMENT IN USE OF MATHEMATICS LABORATORY FOR EXPERIMENTAL GROUP & CONTROL GROUP STUDENTS (TOTAL SAMPLE)

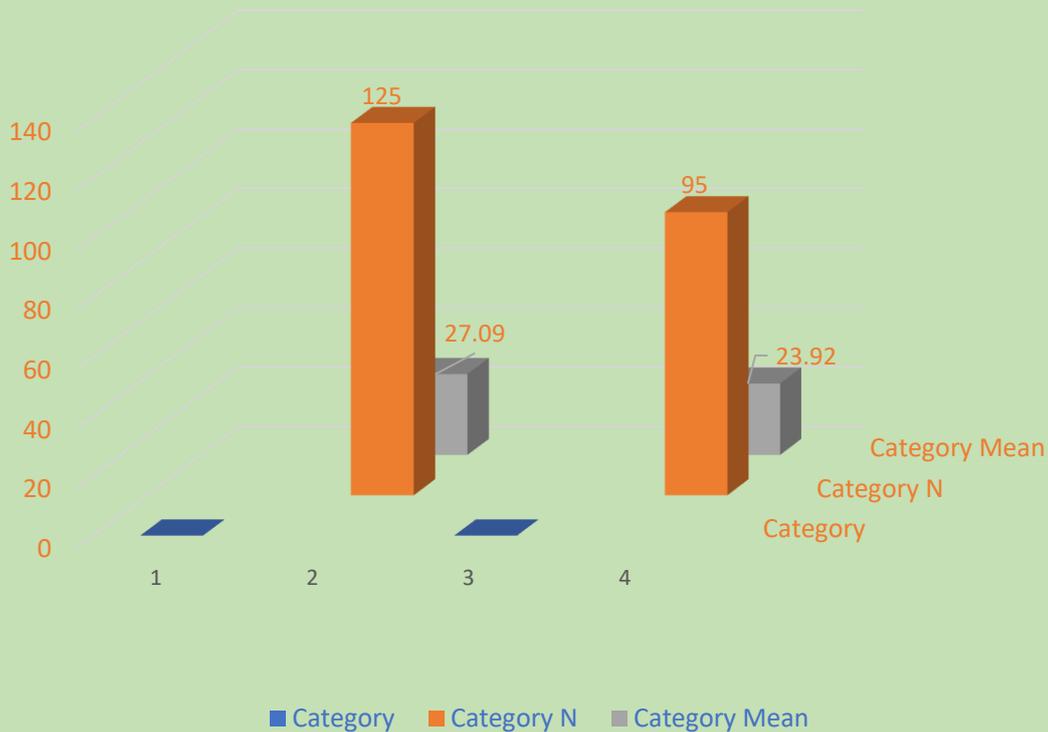


TABLE 4.8 SIGIFICANCE OF DIFFERENCE IN THE MEAN SCORES OF POST TEST ON ACHIEVEMENT IN USE OF MATHEMATICS LABORATORY FOR EXPERIMENTAL GROUP & CONTROL GROUP STUDENTS (TOTAL SAMPLE)

Maximum score :100

Category	N	Mean	S. D	't' value		Result at 0.01 level
				Calculated	Result at 0.01 level	
Experimental group	125	68.19	23.99	5.74	2.576	Significant
Control group	95	50.84	20.63			

- ❖ From table 4.8 it is observed that the calculated 't' value 5.74 is greater than the table value 2.576 at 0.01 level. There is significant difference between post test scores on achievement in mathematics for experimental group and control group students for total sample. Hence the null hypothesis is rejected.
- ❖ While comparing the mean scores, it is found that the experimental group students scored more than the control group. The treatment given has helped students to improve their achievement in mathematics.

FIGURE4.5

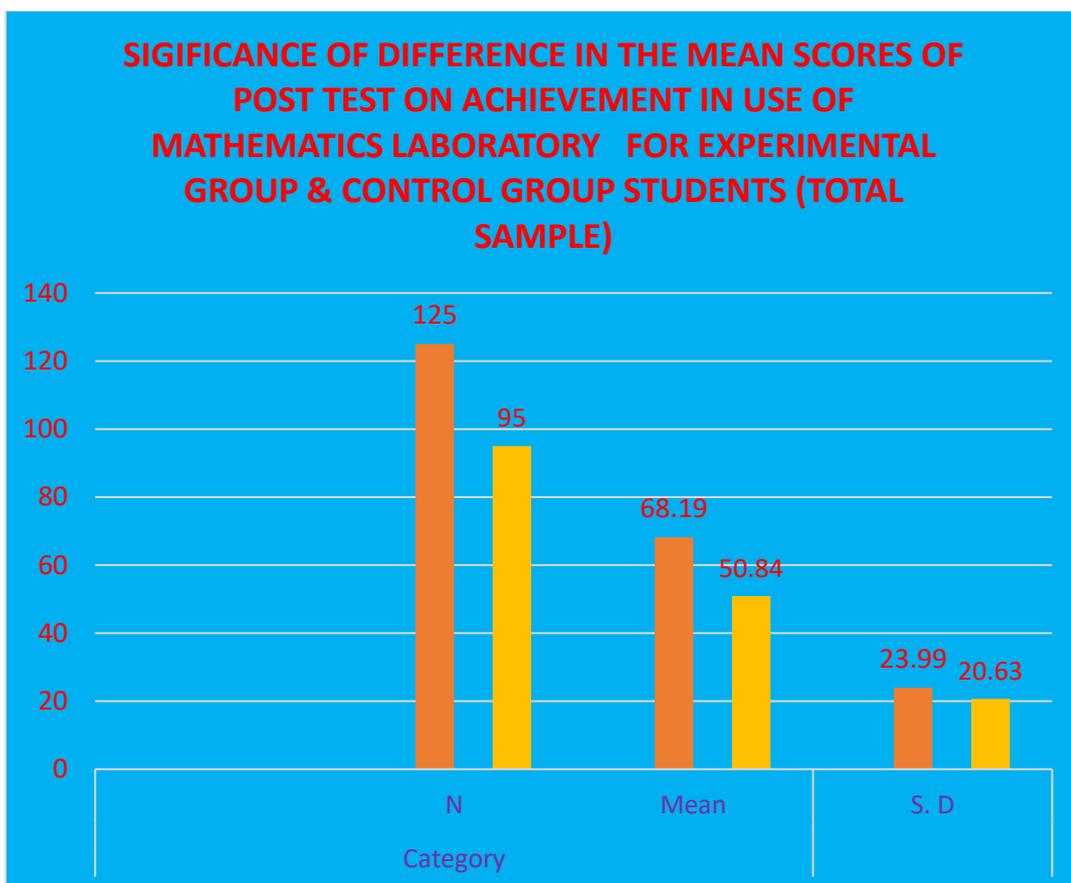


TABLE 4.9 SIGIFCANCE OF DIFFERENCE IN THE MEAN SCORES OF PRE TEST AND POST TEST ON ACHIEVEMENT IN MATHEMATICS FOR EXPERIMENTAL GROUP STUDENTS (TOTAL SAMPLE)

Category	N	Mean	S. D	't' value		Result at 0.01 level
				Calculated	Table	
Pre test	125	27.09	21.67	14.21	2.576	Significant
Post test	125	68.19	24.0			

❖ From table 4.9 it is observed that the calculated 't' value 14.21 is greater than the table value 2.576 at 0.01 level. There is significant difference between pretest and post test

scores on achievement in mathematics for experimental group total sample. Hence the null hypothesis is rejected.

- ❖ From the above table it is concluded that the high mean score is found in post test. Mathematics laboratory activities improved achievement of students.

FIGURE4.6

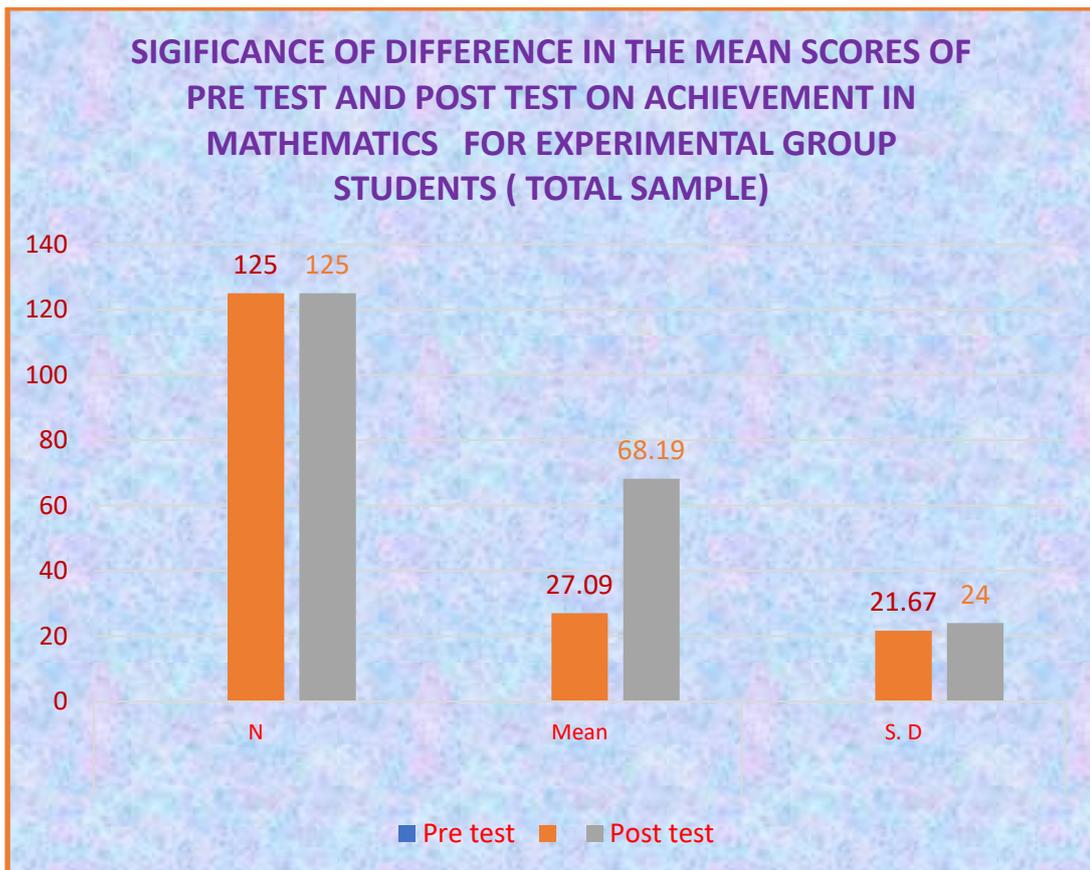


TABLE 4.10 SIGIFICANCE OF DIFFERENCE IN THE MEAN SCORES OF PRE TEST AND POST TEST ON ACHIEVEMENT IN MATHEMATICS FOR CONTROL GROUP STUDENTS (TOTAL SAMPLE)

Category	N	Mean	S. D	't' value		Result at 0.01 level
				Calculated	Table	
Pre test	95	23.92	22.22	8.66	2.576	Significant
Post test	95	50.84	20.63			

- ❖ From table 4.10 it is observed that the calculated 't' value 8.66 is greater than the table value 2.576 at 0.01 level. There is significant difference between pretest and post test scores on achievement in mathematics for control group total sample. Hence the null hypothesis is rejected.
- ❖ From the above table it is concluded that the high mean score is found in post test.

FIGURE4.7

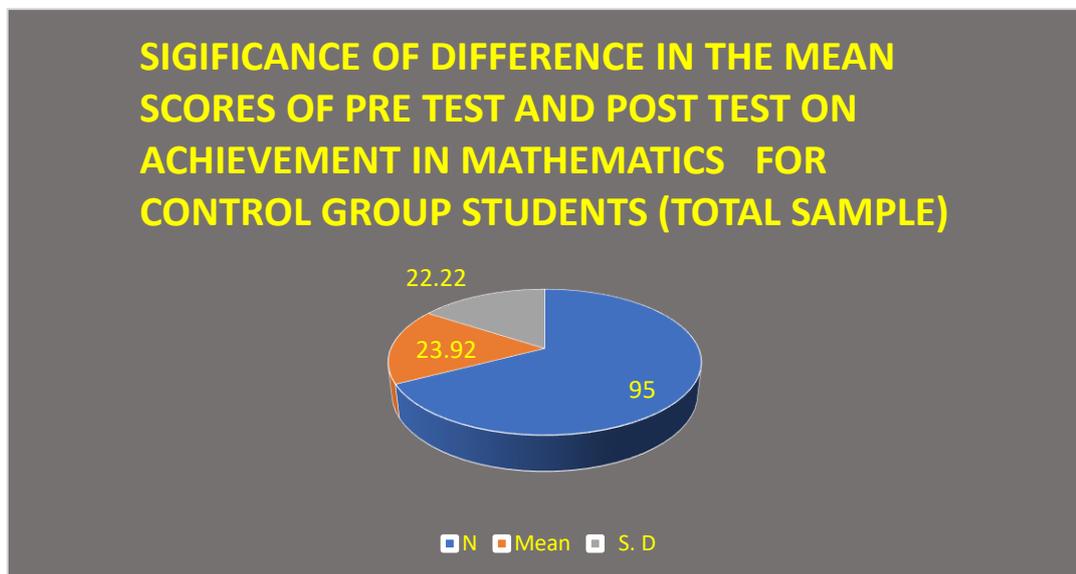


TABLE 4.11 SIGIFICANCE OF DIFFERENCE BETWEEN PRE TEST SCORES ON ACHIEVEMENT IN MATHEMATICS FOR EXPERIMENTAL GROUP BOYS AND GIRLS

Maximum score :100

Category	N	Mean	S. D	't' value		Result at 0.01 level
				Calculated	Table	
Boys	44	28	19.5	0.35	2.576	Not Significant
Girls	81	26.59	22.87			

- ❖ From table 4.11 it is observed that the calculated 't' value 0.35 is less than the table value 2.576 at 0.01 level. There is no significant difference between pre test scores on achievement in mathematics for experimental group boys and girls. Hence the null hypothesis is accepted.
- ❖ It is concluded that experimental group boys and girls do not differ in their achievement in pretest.

TABLE 4.12 SIGIFICANCE OF DIFFERENCE BETWEEN POST TEST SCORES ON ACHIEVEMENT IN MATHEMATICS FOR EXPERIMENTAL GROUP BOYS AND GIRLS

Maximum score :100

Category	N	Mean	S. D	't' value		Result at 0.01 level
				Calculated	Table	
Boys	44	61.95	25.17	2.17	2.576	Not Significant
Girls	81	71.58	22.77			

- ❖ From table 4.12 it is observed that the calculated 't' value 2.17 is less than the table value 2.576 at 0.01 level. There is no significant difference between post test scores on achievement in mathematics for experimental group boys and girls. Hence the null hypothesis is accepted.
- ❖ It is concluded that experimental group boys and girls do not differ in their achievement in posttest.

TABLE 4.13 SIGIFICANCE OF DIFFERENCE BETWEEN PRE-TEST SCORES ON ACHIEVEMENT IN MATHEMATICS FOR CONTROL GROUP BOYS AND GIRLS

Maximum score :100

Category	N	Mean	S. D	't' value		Result at 0.01 level
				Calculated	Table	
Boys	57	26.32	19.28	1.29	2.576	Not Significant
Girls	38	20.32	25.87			

- ❖ From table 4.13 it is observed that the calculated 't' value 1.29 is less than the table value 2.576 at 0.01 level. There is no significant difference between pretest scores on achievement in mathematics for control group boys and girls. Hence the null hypothesis is accepted.
- ❖ It is concluded that control group boys and girls do not differ in their achievement in pretest.

TABLE 4.14 SIGIFICANCE OF DIFFERENCE BETWEEN POST TEST SCORES ON ACHIEVEMENT IN MATHEMATICS FOR CONTROL GROUP BOYS AND GIRLS

Maximum score :100

Category	N	Mean	S. D	't' value		Result at 0.01 level
				Calculated	Table	
Boys	57	49.86	19.54	0.57	2.576	Not Significant
Girls	38	52.32	22.35			

- ❖ From table 4.14 it is observed that the calculated 't' value 0.57 is less than the table value 2.576 at 0.01 level. There is no significant difference between post test scores on achievement in mathematics for control group boys and girls. Hence the null hypothesis is accepted.
- ❖ It is concluded that control group boys and girls do not differ in their achievement in posttest.

TABLE 4.15 SIGIFICANCE OF DIFFERENCE BETWEEN PRE-TEST SCORES ON ACHIEVEMENT IN MATHEMATICS FOR EXPERIMENTAL GROUP GHS AND GHSS STUDENTS

Maximum score :100

category	N	Mean	S. D	't' value		Result at 0.01 level
				Calculated	Table	
GHS	36	16.44	16.35	3.66	2.576	Significant
GHSS	89	31.39	22.15			

❖ From table 4.15 it is observed that the calculated ‘t’ value 3.66 is greater than the table value 2.576 at 0.01 level. There is significant difference between pre test scores on achievement in mathematics for experimental group GHS and GHSS students. Hence the null hypothesis is rejected.

It is concluded that experimental group GHS and GHSS students. differ in their achievement in pretest. High mean score is found in GHSS (31.39) GHS (16.44)

FIGURE 4.8

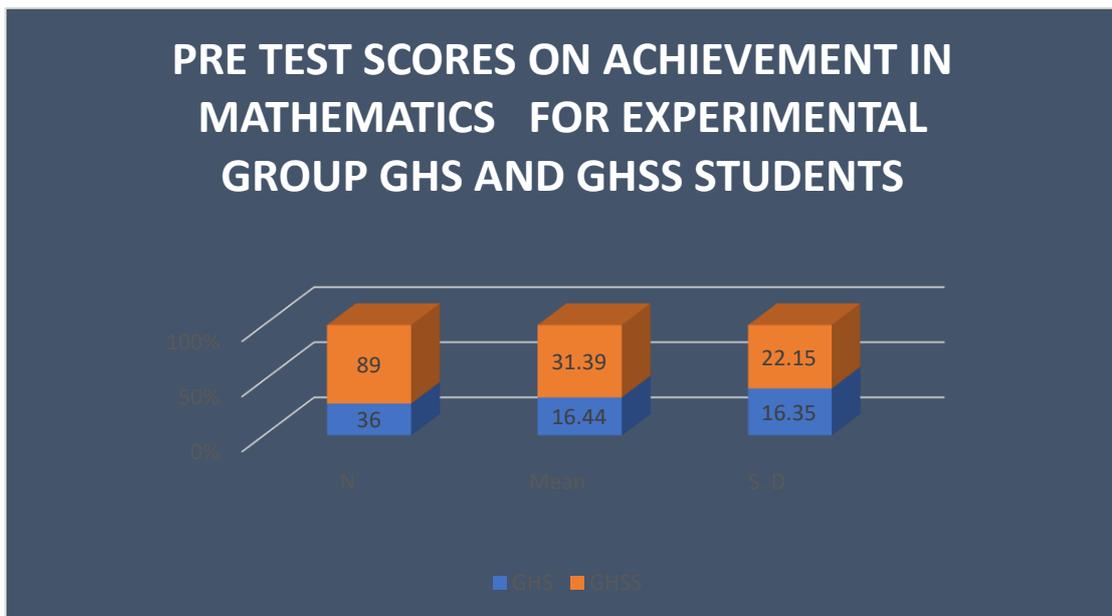


TABLE 4.16 SIGIFICANCE OF DIFFERENCE BETWEEN POST TEST SCORES ON ACHIEVEMENT IN MATHEMATICS FOR EXPERIMENTAL GROUP GHS AND GHSS STUDENTS

Maximum score :100

Category	N	Mean	S. D	't' value		Result at 0.01 level
				Calculated	Table	
GHS	36	50.22	22.73	6.04	2.576	Significant
GHSS	89	75.46	20.49			

- ❖ From table 4.16 it is observed that the calculated 't' value 6.04 is greater than the table value 2.576 at 0.01 level. There is significant difference between post test scores on achievement in mathematics for experimental group GHS and GHSS students. Hence the null hypothesis is rejected.

It is concluded that experimental group GHS and GHSS students. differ in their achievement in post test.

FIGURE4.9

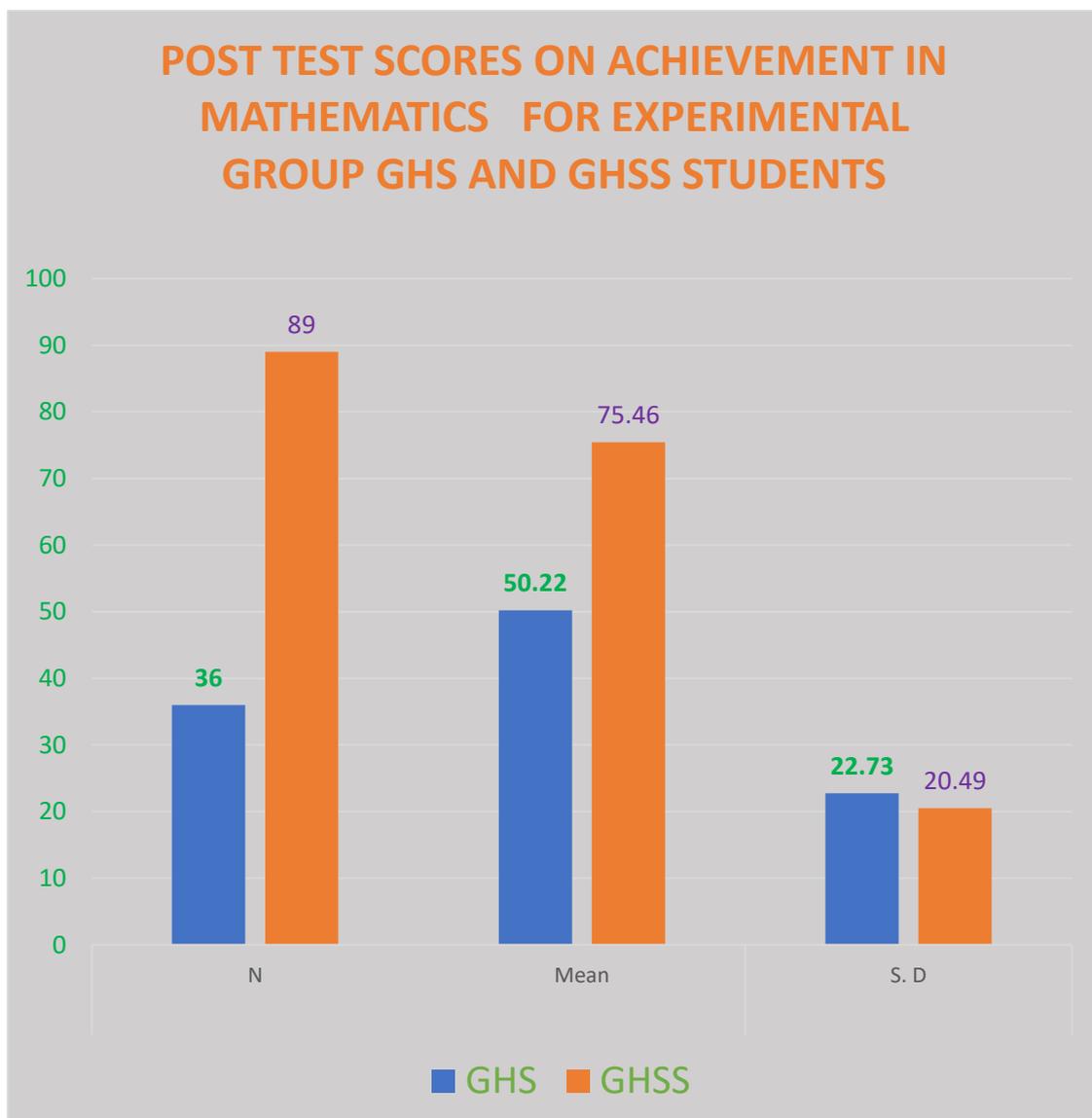


TABLE 4.17 SIGIFICANCE OF DIFFERENCE BETWEEN PRE-TEST SCORES ON ACHIEVEMENT IN MATHEMATICS FOR CONTROL GROUP GHS AND GHSS STUDENTS

Maximum score :100

ategory	N	Mean	S. D	't' value		Result at 0.01 level
				Calculated	Table	
GHS	35	21.77	21.3	0.72	2.576	Not Significant
GHSS	60	25.17	22.82			

❖ From table 4.17 it is observed that the calculated 't' value 0.72 is less than the table value 2.576 at 0.01 level. There is no significant difference between pretest scores on achievement in mathematics for control group GHS and GHSS students. Hence the null hypothesis is accepted.

It is found that control group GHS and GHSS students do not differ in their achievement in pretest.

TABLE 4.18 SIGIFICANCE OF DIFFERENCE BETWEEN POST TEST SCORES ON ACHIEVEMENT IN MATHEMATICS FOR CONTROL GROUP GHS AND GHSS STUDENTS

Maximum score :100

ategory	N	Mean	S. D	't' value		Result at 0.01 level
				Calculated	Table	
GHS	35	63.66	17.02	5.23	2.576	Significant
GHSS	60	43.37	18.88			

- ❖ From table 4.18 it is observed that the calculated 't' value 5.23 is greater than the table value 2.576 at 0.01 level. There is significant difference between post test scores on achievement in mathematics for control group GHS and GHSS students. Hence the null hypothesis is rejected.

It is concluded that control group GHS and GHSS students differ in their achievement in posttest.

TABLE 4.19 SIGIFICANCE OF DIFFERENCE IN THE MEAN SCORES OF PRE TEST AND POST TEST ON ACHIEVEMENT IN MATHEMATICS FOR EXPERIMENTAL GROUP STUDENTS

Name of the school	N	Pre test		Post test		't' value		Result at 0.01 level
		Mean	S. D	Mean	S. D	Calculated	Table	
E1	22	4.91	4.73	35.45	14.65	9.31	2.704	Significant
E2	37	53.08	15.8	73.84	21.03	4.08	2.66	Significant
E3	14	34.57	10.21	73.43	9.78	10.26	2.779	Significant
E4	34	15.35	9.9	76.29	21.59	14.96	2.66	Significant
E5	18	17.11	8.12	77.22	17.92	12.96	2.75	Significant

From table 4.19 it is found that

- ❖ For school E1 calculated 't' value 9.31 is greater than the table value 2.704 at 0.01 level.
- ❖ For school E2 calculated 't' value 4.08 is greater than the table value 2.66 at 0.01 level.
- ❖ For school E3 calculated 't' value 10.26 is greater than the table value 2.779 at 0.01 level.
- ❖ For school E4 calculated 't' value 14.96 is greater than the table value 2.66 at 0.01 level.
- ❖ For school E5 calculated 't' value 12.96 is greater than the table value 2.75 at 0.01 level.
- ❖ Highest 't' value is found in school E4
- ❖ There is significant mean difference between pretest and post test scores on achievement in mathematics for experimental group students. Hence the null hypothesis is rejected for all experimental group schools.
- ❖ It is found that Math lab activity for class 9 was successful in all the five schools.

FIGURE4.10

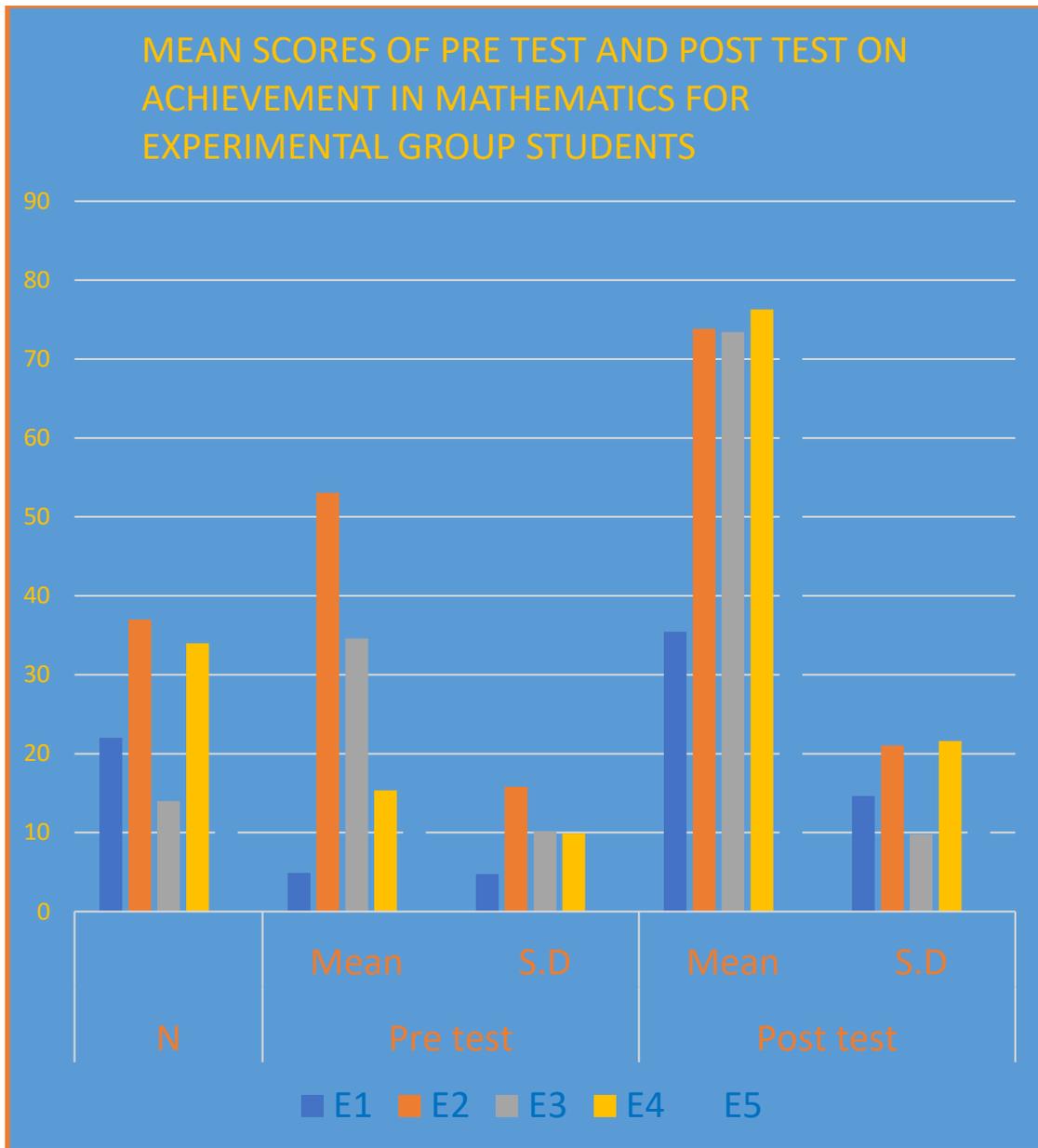


TABLE 4.20 SIGIFICANCE OF DIFFERENCE IN THE MEAN SCORES OF PRE TEST AND POST TEST ON ACHIEVEMENT IN MATHEMATICS FOR CONTROL GROUP STUDENTS

Name of the school	N	Pre test		Post test		't' value		Result at 0.01 level
		Mean	S. D	Mean	S. D	Calculated	Table	
C1	20	31.4	23.12	59.2	17.46	4.29	2.704	Significant
C2	15	8.93	8.21	69.6	14.97	13.76	2.763	Significant
C3	11	44	15.75	61.45	9.3	3.17	2.845	Significant
C4	30	4.67	5.23	33.67	19.31	7.94	2.66	Significant
C5	19	46.63	11.03	48.21	11.75	0.43	2.704	Not Significant

From table 4.20 it is found that

- ❖ For school C1 calculated 't' value 4.29 is greater than the table value 2.704 at 0.01 level.
- ❖ For school C2 calculated 't' value 13.76 is greater than the table value 2.763 at 0.01 level.
- ❖ For school C3 calculated 't' value 3.17 is greater than the table value 2.845 at 0.01 level.
- ❖ For school C4 calculated 't' value 7.94 is greater than the table value 2.66 at 0.01 level.
- ❖ For school C5 calculated 't' value 0.43 is less than the table value 2.704 at 0.01 level.
- ❖ Highest 't' value is found in school C2
- ❖ There is significant mean difference between pretest and post test scores on achievement in mathematics for C1, C2, C3&C4 school students. Hence the null hypothesis is rejected for schools C1, C2, C3&C4.
- ❖ There is no significant mean difference between pretest and post test scores on achievement in mathematics for C5 school students. Hence the null hypothesis is accepted for school C4.

- ❖ For schools C1, C2, C3&C4 the improvement may be due to monitoring of officials and revision given by the teachers.

FIGURE4.11

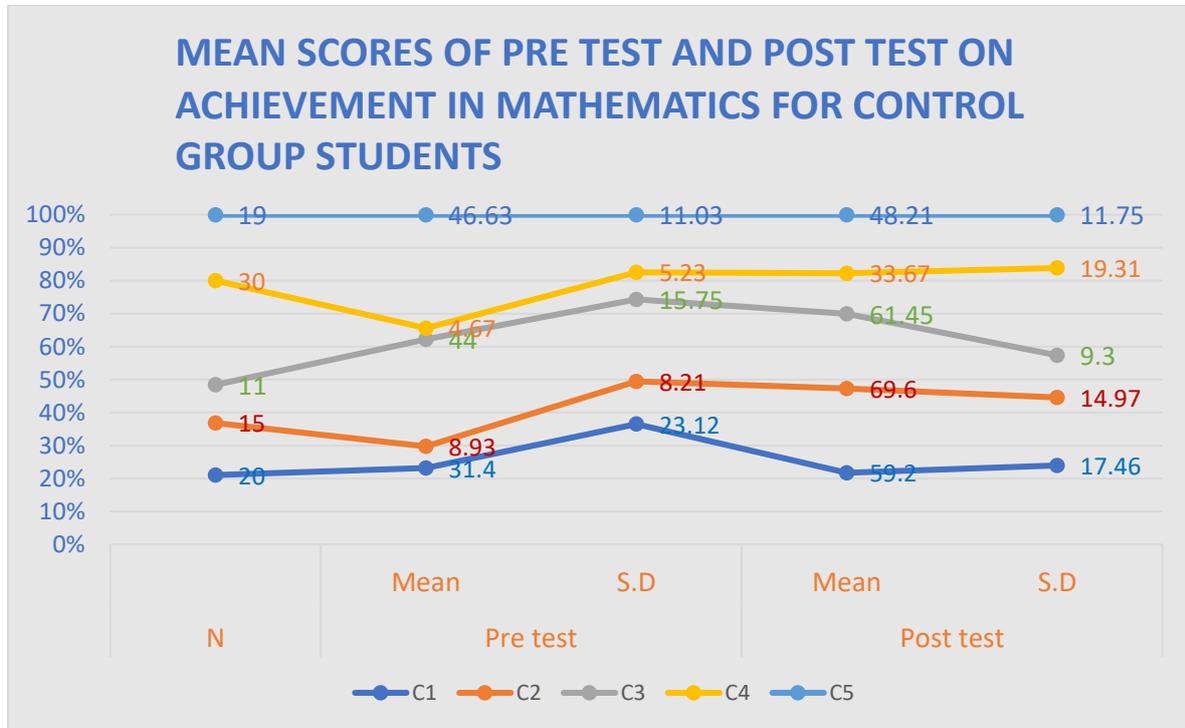


TABLE 4.21 SIGIFICANCE OF DIFFERENCE IN THE MEAN SCORES OF PRE TEST AND POST TEST ON ACHIEVEMENT IN MATHEMATICS FOR EXPERIMENTAL GROUP SCHOOL E1 STUDENTS BASED ON CONCEPT ATTAINMENT

Question	N	Pre test		Post test		‘t’ value		Result at 0.01 level
		Mean	S. D	Mean	S. D	Calculated	Table	
Q1&Q2	22	2.73	4.38	14.27	5.73	7.5	2.704	Significant
Q3&Q4	22	0.27	0.93	6.91	5.77	5.38	2.704	Significant
Q5&Q6	22	0	0	6.27	5.6	5.25	2.704	Significant
Q7	22	1.91	3.57	4.18	4.97	1.74	2.704	Not Significant

Q8&Q9	22	0	0	3.73	3.77	4.64	2.704	Significant
Q10	22	0	0	0.79	0.42	1.0	2.704	Not significant

From table 4.21 it is found that in school E1

- ❖ For Q1&Q2 calculated 't' value 7.5 is greater than the table value 2.704 at 0.01 level.
- ❖ For Q3&Q4 calculated 't' value 5.38 is greater than the table value 2.704 at 0.01 level.
- ❖ For Q5&Q6 calculated 't' value 5.25 is greater than the table value 2.704 at 0.01 level.
- ❖ For Q7 calculated 't' value 1.74 is less than the table value 2.704 at 0.01 level.
- ❖ For Q8&Q9 calculated 't' value 4.64 is greater than the table value 2.704 at 0.01 level.
- ❖ For Q10 calculated 't' value 1.0 is less than the table value 2.704 at 0.01 level.
- ❖ Highest 't' value is found in Q3&Q4
- ❖ There is significant mean difference between pretest and post test scores on achievement in mathematics for experimental group school E1 students in Qn 1,2,3,4,5,6,8&9. Hence the null hypothesis is rejected for these questions.
- ❖ There is no significant mean difference between pretest and post test scores on achievement in mathematics for experimental group school E1 students in Qn 7&10. Hence the null hypothesis is accepted for these questions.

TABLE 4.22 SIGIFICANCE OF DIFFERENCE IN THE MEAN SCORES OF PRE-TEST AND POST TEST ON ACHIEVEMENT IN MATHEMATICS FOR EXPERIMENTAL GROUP SCHOOL E2 STUDENTS BASED ON CONCEPT ATTAINMENT

Question	N	Pre test		Post test		't' value		Result at 0.01 level
		Mean	S. D	Mean	S. D	Calculated	Table	
Q1&Q2	37	15.08	5.64	18.05	3.98	2.62	2.66	Not Significant
Q3&Q4	37	16.22	3.26	17.57	3.92	1.61	2.66	Not Significant
Q5&Q6	37	1.68	2.56	8.72	8.45	4.85	2.66	Significant
Q7	37	8.76	3.24	9.41	1.99	1.04	2.66	Not Significant
Q8&Q9	37	4.97	5.11	12.54	7.57	5.04	2.66	Significant

Q10	37	6.38	5.39	7.78	3.55	1.32	2.66	Not significant
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From table 4.22 it is found that in school E2

- ❖ For Q1&Q2 calculated 't' value 2.62 is less than the table value 2.66 at 0.01 level.
- ❖ For Q3&Q4 calculated 't' value 1.61 is greater than the table value 2.66 at 0.01 level.
- ❖ For Q5&Q6 calculated 't' value 4.85 is greater than the table value 2.66 at 0.01 level.
- ❖ For Q7 calculated 't' value 1.04 is less than the table value 2.66 at 0.01 level.
- ❖ For Q8&Q9 calculated 't' value 5.04 is greater than the table value 2.66 at 0.01 level.
- ❖ For Q10 calculated 't' value 1.32 is less than the table value 2.66 at 0.01 level.
- ❖ Highest 't' value is found in Q8&Q9
- ❖ There is significant mean difference between pretest and post test scores on achievement in mathematics for experimental group school E2 students in Qn 5,6,8&9. Hence the null hypothesis is rejected for these questions.
- ❖ There is no significant mean difference between pretest and post test scores on achievement in mathematics for experimental group school E2 students in Qn 1,2,3,4,7&10. Hence the null hypothesis is accepted for these questions.

TABLE 4.23 SIGIFICANCE OF DIFFERENCE IN THE MEAN SCORES OF PRE TEST AND POST TEST ON ACHIEVEMENT IN MATHEMATICS FOR EXPERIMENTAL GROUP SCHOOL E3 STUDENTS BASED ON CONCEPT ATTAINMENT

Question	N	Pre test		Post test		't' value		Result at 0.01 level
		Mean	S. D	Mean	S. D	Calculated	Table	
Q1&Q2	14	10.43	4.01	19.71	1.07	8.36	2.779	Significant
Q3&Q4	14	14.57	6.0	16.14	2.98	0.88	2.779	Not Significant
Q5&Q6	14	4.29	4.63	14	4.51	5.62	2.779	Significant
Q7	14	4.57	3.46	9.43	2.14	4.47	2.779	Significant
Q8&Q9	14	0.57	1.45	8.0	3.77	6.89	2.779	Significant
Q10	14	0.14	0.54	6.14	3.37	6.58	2.779	significant

From table 4.23 it is found that in school E3

- ❖ For Q1&Q2 calculated 't' value 8.36 is greater than the table value 2.79 at 0.01 level.
- ❖ For Q3&Q4 calculated 't' value 0.88 is less than the table value 2.79 at 0.01 level.
- ❖ For Q5&Q6 calculated 't' value 5.62 is greater than the table value 2.79 at 0.01 level.
- ❖ For Q7 calculated 't' value 4.47 is greater than the table value 2.79 at 0.01 level.
- ❖ For Q8&Q9 calculated 't' value 6.89 is greater than the table value 2.79 at 0.01 level.
- ❖ For Q10 calculated 't' value 6.58 is greater than the table value 2.79 at 0.01 level.
- ❖ Highest 't' value is found in Q1&Q2
- ❖ There is significant mean difference between pretest and post test scores on achievement in mathematics for experimental group school E3 students in Qn 1,2,5,6,7,8,9&10. Hence the null hypothesis is rejected for these questions.
- ❖ There is no significant mean difference between pretest and post test scores on achievement in mathematics for experimental group school E3 students in Qn 3&4. Hence the null hypothesis is accepted for these questions.

TABLE 4.24 SIGIFICANCE OF DIFFERENCE IN THE MEAN SCORES OF PRE TEST AND POST TEST ON ACHIEVEMENT IN MATHEMATICS FOR EXPERIMENTAL GROUP SCHOOL E4 STUDENTS BASED ON CONCEPT ATTAINMENT

Question	N	Pre test		Post test		't' value		Result at 0.01 level
		Mean	S. D	Mean	S. D	Calculated	Table	
Q1&Q2	34	3.0	5.47	17.29	5.70	10.56	2.66	Significant
Q3&Q4	34	9.41	5.49	18.82	2.66	8.99	2.66	Significant
Q5&Q6	34	0.06	0.35	12.94	6.03	12.43	2.66	Significant
Q7	34	1.82	3.32	9.06	2.62	9.99	2.66	Significant
Q8&Q9	34	1.06	1.79	12.12	6.93	9.01	2.66	Significant
Q10	34	0	0	6.06	4.76	7.42	2.66	significant

From table 4.24 it is found that in school E4

- ❖ For Q1&Q2 calculated 't' value 10.56 is greater than the table value 2.66 at 0.01 level.

- ❖ For Q3&Q4 calculated 't' value 8.99 is greater than the table value 2.66 at 0.01 level.
- ❖ For Q5&Q6 calculated 't' value 12.43 is greater than the table value 2.66 at 0.01 level.
- ❖ For Q7 calculated 't' value 9.99 is greater than the table value 2.66 at 0.01 level.
- ❖ For Q8&Q9 calculated 't' value 9.01 is greater than the table value 2.66 at 0.01 level.
- ❖ For Q10 calculated 't' value 7.42 is greater than the table value 2.66 at 0.01 level.
- ❖ Highest 't' value is found in Q5&Q6
- ❖ There is significant mean difference between pretest and post test scores on achievement in mathematics for experimental group school E4 students in Qn 1to10. Hence the null hypothesis is rejected for these questions.

TABLE 4.25 SIGIFICANCE OF DIFFERENCE IN THE MEAN SCORES OF PRE TEST AND POST TEST ON ACHIEVEMENT IN MATHEMATICS FOR EXPERIMENTAL GROUP SCHOOL E5 STUDENTS BASED ON CONCEPT ATTAINMENT

Question	N	Pre test		Post test		't' value		Result at 0.01 level
		Mean	S. D	Mean	S. D	Calculated	Table	
Q1&Q2	18	3.22	6.06	15.67	7.68	5.4	2.75	Significant
Q3&Q4	18	10.78	4.4	17	4.41	4.24	2.75	Significant
Q5&Q6	18	0	0	14.11	5.59	10.7	2.75	Significant
Q7	18	1.44	2.73	9.44	2.36	9.42	2.75	Significant
Q8&Q9	18	1.67	3.84	13.89	6.04	7.25	2.75	Significant
Q10	18	0	0	7.11	3.64	8.28	2.75	significant

From table 4.25 it is found that in school E5

- ❖ For Q1&Q2 calculated 't' value 5.4 is greater than the table value 2.75 at 0.01 level.
- ❖ For Q3&Q4 calculated 't' value 4.24 is greater than the table value 2.75 at 0.01 level.
- ❖ For Q5&Q6 calculated 't' value 10.7 is greater than the table value 2.75 at 0.01 level.
- ❖ For Q7 calculated 't' value 9.42 is greater than the table value 2.75 at 0.01 level.
- ❖ For Q8&Q9 calculated 't' value 7.25 is greater than the table value 2.75 at 0.01 level.
- ❖ For Q10 calculated 't' value 8.28 is greater than the table value 2.75 at 0.01 level.
- ❖ Highest 't' value is found in Q5&Q6

- ❖ There is significant mean difference between pretest and post test scores on achievement in mathematics for experimental group school E4 students in Qn 1to10. Hence the null hypothesis is rejected for these questions.

TABLE 4.26 SIGIFICANCE OF DIFFERENCE IN THE MEAN SCORES OF PRE TEST AND POST TEST ON ACHIEVEMENT IN MATHEMATICS FOR CONTROL GROUP SCHOOL C1 STUDENTS BASED ON CONCEPT ATTAINMENT

Question	N	Pre test		Post test		't' value		Result at 0.01 level
		Mean	S. D	Mean	S. D	Calculated	Table	
Q1&Q2	20	7.9	8.37	17.6	4.57	4.55	2.704	Significant
Q3&Q4	20	9.4	4.55	15.6	5.83	3.75	2.704	Significant
Q5&Q6	20	0.53	2.29	7.4	6.52	4.34	2.704	Significant
Q7	20	6.0	5.03	8.5	3.66	1.8	2.704	Not Significant
Q8&Q9	20	5.1	5.0	6.6	5.07	0.94	2.704	Not Significant
Q10	20	2.5	4.44	3.5	2.96	0.84	2.704	Not significant

From table 4.26 it is found that in school C1

- ❖ For Q1&Q2 calculated 't' value 4.55 is greater than the table value 2.704 at 0.01 level.
- ❖ For Q3&Q4 calculated 't' value 3.75 is greater than the table value 2.704 at 0.01 level.
- ❖ For Q5&Q6 calculated 't' value 4.34 is greater than the table value 2.704 at 0.01 level.
- ❖ For Q7 calculated 't' value 1.8 is less than the table value 2.704 at 0.01 level.
- ❖ For Q8&Q9 calculated 't' value 0.94 is less than the table value 2.704 at 0.01 level.
- ❖ For Q10 calculated 't' value 0.84 is less than the table value 2.704 at 0.01 level.
- ❖ Highest 't' value is found in Q1&Q2
- ❖ There is significant mean difference between pretest and post test scores on achievement in mathematics for control group school C1 students in Qn 1to6. Hence the null hypothesis is rejected for these questions.

- ❖ There is no significant mean difference between pretest and post test scores on achievement in mathematics for control group school C1 students in Qn 7to10. Hence the null hypothesis is accepted for these questions.

TABLE 4.27 SIGIFICANCE OF DIFFERENCE IN THE MEAN SCORES OF PRE TEST AND POST TEST ON ACHIEVEMENT IN MATHEMATICS FOR CONTROL GROUP SCHOOL C2 STUDENTS BASED ON CONCEPT ATTAINMENT

Question	N	Pre test		Post test		't' value		Result at 0.01 level
		Mean	S.D	Mean	S.D	Calculated	Table	
Q1&Q2	15	0	0	19.73	1.03	7.4	2.763	Significant
Q3&Q4	15	3.6	4.97	14.67	4.51	6.38	2.763	Significant
Q5&Q6	15	0	0	12.0	6.76	6.87	2.763	Significant
Q7	15	5.33	5.16	9.33	2.58	2.68	2.763	Not Significant
Q8&Q9	15	0	0	9.29	4.75	7.59	2.763	Significant
Q10	15	0	0	5.2	2.11	9.54	2.763	significant

From table 4.27 it is found that in school C2

- ❖ For Q1&Q2 calculated 't' value 7.4 is greater than the table value 2.763 at 0.01 level.
- ❖ For Q3&Q4 calculated 't' value 6.38 is greater than the table value 2.763 at 0.01 level.
- ❖ For Q5&Q6 calculated 't' value 6.87 is greater than the table value 2.763 at 0.01 level.
- ❖ For Q7 calculated 't' value 2.68 is less than the table value 2.763 at 0.01 level.
- ❖ For Q8&Q9 calculated 't' value 4.75 is greater than the table value 2.763 at 0.01 level.
- ❖ For Q10 calculated 't' value 9.54 is greater than the table value 2.763 at 0.01 level.
- ❖ Highest 't' value is found in Q10
- ❖ There is significant mean difference between pretest and post test scores on achievement in mathematics for control group school C2 students in Qn 1to10 exceptQ7. Hence the null hypothesis is rejected for these questions.
- ❖ There is no significant mean difference between pretest and post test scores on achievement in mathematics for control group school C2 students in Qn7. Hence the null hypothesis is accepted for these questions.

TABLE 4.28 SIGIFICANCE OF DIFFERENCE IN THE MEAN SCORES OF PRE TEST AND POST TEST ON ACHIEVEMENT IN MATHEMATICS FOR CONTROL GROUP SCHOOL C3 STUDENTS BASED ON CONCEPT ATTAINMENT

Question	N	Pre test		Post test		't' value		Result at 0.01 level
		Mean	S. D	Mean	S. D	Calculated	Table	
Q1&Q2	11	16.55	4.48	20	0	2.56	2.845	Not Significant
Q3&Q4	11	11.64	7.42	16.91	2.74	2.21	2.845	Not Significant
Q5&Q6	11	3.27	4.67	7.27	4.67	2.01	2.845	Not Significant
Q7	11	5.27	2.41	5.09	1.37	0.22	2.845	Not Significant
Q8&Q9	11	3.45	4.48	6.73	4.67	1.68	2.845	Not Significant
Q10	11	3.82	3.03	5.45	1.8	1.54	2.845	Not significant

From table 4.28 it is found that in school C3

- ❖ For Q1&Q2 calculated 't' value 2.56 is less than the table value 2.763 at 0.01 level.
- ❖ For Q3&Q4 calculated 't' value 2.21 is less than the table value 2.763 at 0.01 level.
- ❖ For Q5&Q6 calculated 't' value 2.01 is less than the table value 2.763 at 0.01 level.
- ❖ For Q7 calculated 't' value 0.22 is less than the table value 2.763 at 0.01 level.
- ❖ For Q8&Q9 calculated 't' value 1.68 is less than the table value 2.763 at 0.01 level.
- ❖ For Q10 calculated 't' value 1.54 is less than the table value 2.763 at 0.01 level.
- ❖ Highest 't' value is found in Q1&Q2

- ❖ There is no significant mean difference between pretest and post test scores on achievement in mathematics for control group school C3 students in Qn1 to Q10. Hence the null hypothesis is accepted for all the questions.

TABLE 4.29 SIGIFICANCE OF DIFFERENCE IN THE MEAN SCORES OF PRE TEST AND POST TEST ON ACHIEVEMENT IN MATHEMATICS FOR CONTROL GROUP SCHOOL C4 STUDENTS BASED ON CONCEPT ATTAINMENT

Question	N	Pre test		Post test		't' value		Result at 0.01 level
		Mean	S.D	Mean	S.D	Calculated	Table	
Q1&Q2	30	0	0	9.8	8.84	6.07	2.66	Significant
Q3&Q4	30	3.6	4.99	11.33	7.39	4.76	2.66	Significant
Q5&Q6	30	0	0	0	0	0.0	2.66	Not Significant
Q7	30	1.07	2.77	7.67	4.3	7.07	2.66	Significant
Q8&Q9	30	0	0	1.8	4.34	2.27	2.66	Not Significant
Q10	30	0	0	3.07	3.47	4.84	2.66	significant

From table 4.29 it is found that in school C4

- ❖ For Q1&Q2 calculated 't' value 6.07 is greater than the table value 2.66 at 0.01 level.
- ❖ For Q3&Q4 calculated 't' value 4.76 is greater than the table value 2.66 at 0.01 level.
- ❖ For Q5&Q6 calculated 't' value 0.0 is less than the table value 2.66 at 0.01 level.
- ❖ For Q7 calculated 't' value 7.07 is greater than the table value 2.66 at 0.01 level.
- ❖ For Q8&Q9 calculated 't' value 2.27 is less than the table value 2.66 at 0.01 level.
- ❖ For Q10 calculated 't' value 4.84 is greater than the table value 2.66 at 0.01 level.
- ❖ Highest 't' value is found in Q7.
- ❖ There is significant mean difference between pretest and post test scores on achievement in mathematics for control group school C4 students in Qn1,2,3,4,7&Q10. Hence the null hypothesis is rejected for all the questions.
- ❖ There is no significant mean difference between pretest and post test scores on achievement in mathematics for control group school C4 students in Q5,6,8&Q9 . Hence the null hypothesis is accepted for all these questions.

TABLE 4.30 SIGIFICANCE OF DIFFERENCE IN THE MEAN SCORES OF PRE TEST AND POST TEST ON ACHIEVEMENT IN MATHEMATICS FOR CONTROL GROUP SCHOOL C5 STUDENTS BASED ON CONCEPT ATTAINMENT

Question	N	Pre test		Post test		't' value		Result at 0.01 level
		Mean	S. D	Mean	S. D	Calculated	Table	
Q1&Q2	19	16.0	6.6	15.47	6.52	0.25	2.704	Not Significant
Q3&Q4	19	9.58	5.83	14.0	4.90	2.53	2.704	Not Significant
Q5&Q6	19	0	0	0.32	1.0	1.33	2.704	Not Significant
Q7	19	8.21	3.77	8.21	3.77	0.0	2.704	Not Significant
Q8&Q9	19	4.95	2.78	6.21	4.71	1.01	2.704	Not Significant
Q10	19	4.95	2.78	4.0	3.27	0.96	2.704	Not significant

From table 4.30 it is found that in school C5

- ❖ For Q1&Q2 calculated 't' value 0.25 is less than the table value 2.704 at 0.01 level.
- ❖ For Q3&Q4 calculated 't' value 2.53 is less than the table value 2.704 at 0.01 level.
- ❖ For Q5&Q6 calculated 't' value 1.33 is less than the table value 2.704 at 0.01 level.
- ❖ For Q7 calculated 't' value 0.0 is less than the table value 2.704 at 0.01 level.
- ❖ For Q8&Q9 calculated 't' value 1.01 is less than the table value 2.704 at 0.01 level.
- ❖ For Q10 calculated 't' value 0.96 is less than the table value 2.704 at 0.01 level.
- ❖ Highest 't' value is found in Q3&Q4.
- ❖ There is no significant mean difference between pretest and post test scores on achievement in mathematics for control group school C5 students in Q1 to Q10 . Hence the null hypothesis is accepted for all the questions.

4.4 CONCLUSION:

Thus, the analysis of the data generated by the administration and experimentation in mathematics laboratory on the sample of 95 control group students and 125 experimental group students in 10 schools of Krishnagiri District of Tamil Nadu has given many interesting results which are summarized in the forthcoming chapter V.

CHAPTER-V

SUMMARY

5.1 INTRODUCTION:

In the realm of high school education, the teaching of mathematics stands as a cornerstone of academic development and cognitive growth. However, the traditional methods of instruction often struggle to fully engage students and instil a deep understanding of mathematical concepts. Recognizing this challenge, educators have increasingly turned to innovative approaches such as mathematics laboratories to enhance the learning experience.

The integration of mathematics laboratories into high school mathematics education represents a dynamic shift towards experiential learning and active engagement. By providing a hands-on environment for exploration and discovery, these laboratories aim to bridge the gap between abstract mathematical concepts and real-world applications. Through interactive experiments, problem-solving activities, and collaborative projects, students are encouraged to explore mathematical principles in depth, fostering a deeper understanding and appreciation for the subject.

This project seeks to investigate the effects of utilizing mathematics laboratories in teaching mathematics among high school students. By examining the impact on student engagement, comprehension, problem-solving skills, and overall academic performance, the researcher aims to discern the efficacy of this innovative approach in enhancing the learning outcomes of high school mathematics education.

Through empirical research, data analysis, and qualitative feedback from students and educators, this project endeavours to shed light on the potential benefits and challenges associated with integrating mathematics laboratories into the high school curriculum. Ultimately, the findings of this study aim to inform educational practices and contribute to the ongoing dialogue surrounding effective pedagogical strategies in mathematics education.

5.2 OBJECTIVES:

- ❖ To find out the student's prior knowledge in using mathematics laboratory.
- ❖ To develop module for class IX mathematics lab.
- ❖ To Organize training program for teachers handling class 9 mathematics.

- ❖ To find out the effect of mathematics laboratory in improving the student's achievement of Control and experimental group.
- ❖ To find out the effect of mathematics achievement in improving the classroom teaching of Control and experimental group.

5.3 HYPOTHESES:

- ❖ There is no significant difference between pretest scores on achievement in mathematics for experimental group and control group students for total sample.
- ❖ There will be a significant difference between post test scores on achievement in mathematics for experimental group and control group students for total sample.
- ❖ There will be a significant difference between pretest and post test scores on achievement in mathematics for experimental group total sample.
- ❖ There will be a significant difference between pretest and post test scores on achievement in mathematics for control group total sample.
- ❖ There is no significant difference between pre test scores on achievement in mathematics for experimental group boys and girls.
- ❖ There is no significant difference between post test scores on achievement in mathematics for experimental group boys and girls.
- ❖ There is no significant difference between pretest scores on achievement in mathematics for control group boys and girls.
- ❖ There is no significant difference between post test scores on achievement in mathematics for control group boys and girls.
- ❖ There is no significant difference between pretest scores on achievement in mathematics for experimental group GHS and GHSS students.
- ❖ There is no significant difference between post test scores on achievement in mathematics for experimental group GHS and GHSS students.
- ❖ There is no significant difference between pretest scores on achievement in mathematics for control group GHS and GHSS students.
- ❖ There is significant difference between post test scores on achievement in mathematics for control group GHS and GHSS students.
- ❖ There will be a significant mean difference between pretest and post test scores on achievement in mathematics for experimental group students.
- ❖ There will be a is significant mean difference between pretest and post test scores on achievement in mathematics control group students.

- ❖ There will be a significant mean difference between pretest and post test scores on achievement in mathematics for experimental group school E1 students in concept attainment.
- ❖ There will be a significant mean difference between pretest and post test scores on achievement in mathematics for experimental group school E2 students in concept attainment.
- ❖ There will be a significant mean difference between pretest and post test scores on achievement in mathematics for experimental group school E3 students in concept attainment.
- ❖ There will be a significant mean difference between pretest and post test scores on achievement in mathematics for experimental group school E4 students in concept attainment.
- ❖ There will be a significant mean difference between pretest and post test scores on achievement in mathematics for experimental group school E5 students in concept attainment.
- ❖ There will be a significant mean difference between pretest and post test scores on achievement in mathematics for control group school C1 students in concept attainment.
- ❖ There will be a significant mean difference between pretest and post test scores on achievement in mathematics for control group school C2 students in concept attainment.
- ❖ There will be a significant mean difference between pretest and post test scores on achievement in mathematics for control group school C3 students in concept attainment.
- ❖ There will be a significant mean difference between pretest and post test scores on achievement in mathematics for control group school C4 students in concept attainment.
- ❖ There will be a significant mean difference between pretest and post test scores on achievement in mathematics for control group school C5 students in concept attainment.

5.4 RESEARCH DESIGN:

Experimental design is the blueprint of procedures that enable the researcher to test by reaching valid conclusions about relationships between independent and independent variables.

Three categories of experimental design are as follows:

1. Pre- experimental design
2. True experimental design
3. Quasi-experimental design

5.5 EXPERIMENTAL DESIGN:

Ten schools were taken for study. 5 schools were treated as experimental group and 5 schools were treated as control group. Pre-test was conducted for experimental group and control group. Training was given to the teachers working in experimental groups schools. Mathematics lab material and module were supplied to the experimental group schools. Teaching mathematics using mathematics lab was carried out in experimental group schools. Traditional method of teaching was adopted in control group. At the end of the period post test was conducted for both experimental and control group schools.

5.6 SAMPLE:

Krishnagiri district has 10 blocks.6 blocks in krishnagiri educational district and 4 blocks in Hosur educational district. From krishnagiri educational district sample was selected from Krishnagiri, Kaveripattinam, Bargur and Veppanapalli blocks. From Hosur educational district Sample was selected from soolagiri block. From each block 2 schools were selected. I school as experimental and one as control group.

TABLE5.1 DETAILS OF SAMPLE-EXPERIMENTAL GROUP

S.NO	NAME OF THE SCHOOL	TOTAL BOYS	TOTAL GIRLS	TOTAL STRENGTH
1	GHS,Jaheer Venkatapuram	8	14	22
2	GHSS,Ramapuram	15	22	37
3	GHSS,Vennampalli	6	8	14
4	GMHSS,Veppanapalli	15	19	34
5	GGHSS,Soolagiri	0	18	18
TOTAL		44	81	125

TABLE5.2 DETAILS OF SAMPLE-CONTROL GROUP

S.NO	NAME OF THE SCHOOL	TOTAL BOYS	TOTAL GIRLS	TOTAL STRENGTH
1	GHS,Gangaleri	11	9	20
2	GHS,Nattanmaikottai	8	7	15
3	GHSS,Varattanapalli	3	8	11
4	GHSS,Kundarapalli	16	14	30
5	GBHSS,Soolagiri	19	0	19
TOTAL		57	38	95

Total sample for experimental group: 125

Total sample for control group: 95

Total sample for the study: 220 students studying class IX

5.7 RESEARCH TOOL:

one tool was constructed for both pre-test and post-test for class IX students. This tool was constructed and administered for 10 teachers handling class IX mathematics. This tool was administered before preparing the module. Questionnaire consist of 10 questions each carries 5 marks. Total score is 50.

TABLE 5.3 BLUE PRINT

QUESTION NO	TOPIC
1	Set language
2	Set language
3	Real numbers
4	Real numbers
5	Algebra
6	Algebra
7	Geometry
8	Co-ordinate Geometry
9	Co-ordinate Geometry
10	Trigonometry

Content validity:

After construction of the questionnaire Some questions were revised with the guidance of the experts.

Reliability:

Reliability of the tool was developed by Kuder- Richardson and it was found to be 0.83 which is highly significant.

Scoring:

Each question carries 5 marks

5.8 DATA COLLECTION:

The researcher conducted pre-test for all the 10 schools using the constructed tool. Traditional method of teaching was done in control group schools. Module was prepared with the help of the DIET senior lecturer, Lecturer and the teachers. Lab material was prepared and training was given to the experimental school teachers.

Frequent visit was done by the researcher. During school visit doubts raised by the teachers were cleared. Teachers' comment on the module was satisfactory. Students' feel happy to work with the lab materials. To study the effectiveness of the training post-test was administered to the students

5.9 SCHEME OF DATA ANALYSIS:

It involves computing of measures of central tendency such as the mean and the measures of variability such as standard deviation. The computed values are used to describe the properties of the different sub-samples. Collected data were analysed using 't' test.

5.10 FINDINGS:

- ❖ The mean score obtained by control group student's achievement in mathematics for pretest is 23.92 and for the post test is 50.84. It is concluded that mean score of experimental group Student's achievement is higher than control group student's achievement.
- ❖ The mean score obtained by experimental group girl's achievement in mathematics for pretest is 26.59 and for posttest is 71.58. In pretest mean score of experimental group boy's achievement is higher than girl's achievement. In posttest mean score of experimental group boy's achievement is less than girl's achievement.
- ❖ The mean score obtained by control group girl's achievement in mathematics for pretest is 20.32 and for posttest is 52.32. In pretest mean score of control group boy's achievement is higher than girl's achievement. In posttest mean score of control group boy's achievement is less than girl's achievement.
- ❖ Out of 5 schools, in pretest high mean score is found in school E2 and in posttest high mean score is found in school E4
- ❖ Out of 5 schools in pretest high mean score is found in school C5 and in posttest high mean score is found in school C2
- ❖ There is no significant difference between pretest scores on achievement in mathematics for experimental group and control group students for total sample. It is clear from the table that the students' achievement in mathematics is same before using the mathematics laboratory.
- ❖ There is significant difference between post test scores on achievement in mathematics for experimental group and control group students for total sample. While comparing the mean scores, it is found that the experimental group students scored more than the control group. The treatment given has helped students to improve their achievement in mathematics.
- ❖ There is significant difference between pretest and post test scores on achievement in mathematics for experimental group total sample. Hence the null hypothesis is rejected.

It is concluded that the high mean score is found in posttest. Mathematics laboratory activities improved achievement of students.

- ❖ There is significant difference between pretest and post test scores on achievement in mathematics for control group total sample. It is found that the high mean score is found in posttest.
- ❖ There is no significant difference between pretest scores on achievement in mathematics for experimental group boys and girls. It is concluded that experimental group boys and girls do not differ in their achievement in pretest.
- ❖ There is no significant difference between post test scores on achievement in mathematics for experimental group boys and girls. It is concluded that experimental group boys and girls do not differ in their achievement in posttest.
- ❖ There is no significant difference between pretest scores on achievement in mathematics for control group boys and girls. It is found that control group boys and girls do not differ in their achievement in pretest.
- ❖ There is no significant difference between post test scores on achievement in mathematics for control group boys and girls. It is concluded that control group boys and girls do not differ in their achievement in posttest.
- ❖ There is significant difference between pretest scores on achievement in mathematics for experimental group GHS and GHSS students. It is concluded that experimental group GHS and GHSS students differ in their achievement in pretest. High mean score is found in GHSS(31.39)GHS(16.44)
- ❖ There is significant difference between post test scores on achievement in mathematics for experimental group GHS and GHSS students. It is found that experimental group GHS and GHSS students differ in their achievement in posttest.
- ❖ There is no significant difference between pretest scores on achievement in mathematics for control group GHS and GHSS students. It is found that control group GHS and GHSS students do not differ in their achievement in pretest.
- ❖ There is significant difference between post test scores on achievement in mathematics for control group GHS and GHSS students. It is concluded that control group GHS and GHSS students differ in their achievement in posttest.
- ❖ There is significant mean difference between pretest and post test scores on achievement in mathematics for experimental group students. It is found that Math lab activity for class 9 was successful in all the five schools.

- ❖ There is significant mean difference between pretest and post test scores on achievement in mathematics for C1, C2, C3&C4 school students.
- ❖ There is no significant mean difference between pretest and post test scores on achievement in mathematics for C5 school students. For schools C1, C2, C3&C4 the improvement may be due to monitoring of officials and revision given by the teachers.
- ❖ There is significant mean difference between pretest and post test scores on achievement in mathematics for experimental group school E1 students in Qn 1,2,3,4,5,6,8&9.
- ❖ There is no significant mean difference between pretest and post test scores on achievement in mathematics for experimental group school E1 students in Qn 7&10.
- ❖ There is significant mean difference between pretest and post test scores on achievement in mathematics for experimental group school E2 students in Qn 5,6,8&9.
- ❖ There is no significant mean difference between pretest and post test scores on achievement in mathematics for experimental group school E2 students in Qn 1,2,3,4,7&10.
- ❖ There is significant mean difference between pretest and post test scores on achievement in mathematics for experimental group school E3 students in Qn 1,2,5,6,7,8,9&10.
- ❖ There is no significant mean difference between pretest and post test scores on achievement in mathematics for experimental group school E3 students in Qn 3&4.
- ❖ There is significant mean difference between pretest and post test scores on achievement in mathematics for experimental group school E4 students in Qn 1to10.
- ❖ There is significant mean difference between pretest and post test scores on achievement in mathematics for experimental group school E4 students in Qn 1to10.
- ❖ There is significant mean difference between pretest and post test scores on achievement in mathematics for control group school C1 students in Qn 1to6.
- ❖ There is no significant mean difference between pretest and post test scores on achievement in mathematics for control group school C1 students in Qn 7to10.
- ❖ There is significant mean difference between pretest and post test scores on achievement in mathematics for control group school C2 students in Qn 1to10 exceptQ7.
- ❖ There is no significant mean difference between pretest and post test scores on achievement in mathematics for control group school C2 students in Qn7.
- ❖ There is no significant mean difference between pretest and post test scores on achievement in mathematics for control group school C3 students in Qn1 to Q10.

- ❖ There is significant mean difference between pretest and post test scores on achievement in mathematics for control group school C4 students in Qn1,2,3,4,7&Q10.
- ❖ There is no significant mean difference between pretest and post test scores on achievement in mathematics for control group school C4 students in Q5,6,8&Q9.
- ❖ There is no significant mean difference between pretest and post test scores on achievement in mathematics for control group school C5 students in Q1 toQ10

5.11DISCUSSION:

In the present study, it is found that the student's achievement has increased after the implementation of the methodology prescribed in the lab manual. The sample was selected randomly. Experimental group students scored high score in post-test compared to control group students. The reason is control group students practiced traditional method of teaching. Experimental group students have an exposure to use math lab for the attainment of the concept. Teachers teaching for experimental group students were trained in the lab manual. Activities are carried out to reach the learning outcome for the concept chosen. Students practiced in groups. Peer group learning makes them learn with interest.

5.12EDUCATIONAL IMPLICATIONS:

Teaching mathematics to ninth graders can be enriched by emphasizing the real-world applications and implications of mathematical concepts. Here are some educational implications for the effects of math lab in teaching maths for class 9:

- ❖ Real-world relevance: Showing students how math is used in various fields such as engineering, finance, and science can enhance their motivation and engagement. This can be done through examples, case studies, and projects that demonstrate the practical applications of mathematical concepts.
- ❖ Critical thinking and problem-solving skills: Teaching math involves more than just memorizing formulas and procedures. It's about developing critical thinking skills and the ability to solve complex problems. Teachers can design activities and exercises that require students to analyze, reason, and apply mathematical principles to solve real-world problems.

- ❖ **Interdisciplinary connections:** Mathematics is often interconnected with other subjects such as science, technology, engineering, and even art. Teachers can integrate interdisciplinary approaches into their lessons to help students see the connections between math and other areas of study, making math more meaningful and relevant.
- ❖ **Differentiated instruction:** Recognizing that students have different learning styles and abilities, teachers can use a variety of instructional strategies to accommodate diverse learners. This might include hands-on activities, group work, technology-based tools, and differentiated assignments to meet the needs of all students.
- ❖ **Promoting mathematical literacy:** Beyond just learning mathematical procedures, students should also develop a deep understanding of mathematical concepts and the ability to communicate their mathematical thinking effectively. Teachers can encourage mathematical discourse in the classroom, where students explain their reasoning, justify their solutions, and critique the reasoning of others.
- ❖ **Cultivating a growth mindset:** Many students develop a fixed mindset when it comes to math, believing that they either have a natural talent for it or they don't. Teachers can promote a growth mindset by emphasizing the idea that math skills can be developed through effort, perseverance, and practice. This can help students overcome math anxiety and become more confident and resilient learners.

By incorporating these educational implications into the teaching of mathematics for ninth graders, teachers can create a more dynamic and engaging learning experience that fosters both conceptual understanding and practical application of mathematical concepts.

5.13 SUGGESTIONS FOR FURTHER RESEARCH:

In the present study, the following suggestions for the further research are being given below keeping in view with the findings of the present study

- The similar study may be conducted among the students of all classes.
- A parallel study may be conducted for all the subjects from class VI to XII.
- The study may be extended to all schools.

5.14 CONCLUSION:

Experimental group Student's achievement is higher than control group student's achievement. For both Experimental group and control group boy's achievement is less than

girl's achievement. Students' achievement in mathematics is same before using the mathematics laboratory for both control and experimental schools. Experimental group students scored more than the control group after the usage of mathematics laboratory for experimental group. The treatment given has helped students to improve their achievement in mathematics. Mathematics laboratory activities improved achievement of students. Experimental group boys and girls do not differ in their achievement before and after using the lab. It is concluded that gender is not a problem in achievement.

Experimental group GHS and GHSS students. differ in their achievement. GHSS students' performance is high compared to GHS. This may be due exposure to science lab. Students find difficult to answer for algebra co-ordinate geometry and trigonometry. They feel easy to answer set along , real numbers and geometry. Overall, incorporating a mathematics syllabus laboratory into high school teaching can enrich the learning experience, foster critical skills, and enhance students' understanding and appreciation of mathematics.

APPENDIX-1
QUESTIONNAIRE
DISTRICT INSTITUTE OF EDUCATION AND TRAINING KRISHNAGIRI
RESEARCH PROJECT PRE/ POST TEST

CLASS: IX

MATHEMATICS

Mark: 10x5= 50

Do the following:

1. In an examination 50% of the students passed in Mathematics and 70% of students passed in science while 10% students failed in both subjects. 300 students passed in both the subjects. Find the total number of students who appeared in the examination, if they took examination in only two subjects.

2. In a class of 50 students, each one comes to school by bus or by bicycle or on foot. 25 by bus, 20 by bicycle, 30 on foot and 10 students by all the three. Now how many students come to school exactly by two modes of transport?

3. Represent 4.863 on the number line

4. Represent the following information in scientific notation:

(i) The world population is nearly 7000,000,000.

(ii) One light year means the distance 9460528400000000 km.

(iii) Mass of an electron is 0.000 000 000 000 000 000 000 000 00091093822 kg.

5. Two cars are 100 miles apart. If they drive towards each other they will meet in 1 hour. If they drive in the same direction they will meet in 2 hours. Find their speed by using graphical method

6. 4 Indians and 4 Chinese can do a piece of work in 3 days. While 2 Indians and 5 Chinese can finish it in 4 days. How long would it take for 1 Indian to do it? How long would it take for 1 Chinese to do it?

7. Which of the following statement is correct?

(1) Opposite angles of a parallelogram are not equal.

(2) Adjacent angles of a parallelogram are complementary.

(3) Diagonals of a parallelogram are always equal.

(4) Both pairs of opposite sides of a parallelogram are always equal

8. A(-3, 2), B (3 ,2) and C (- 3, -2) are the vertices of the right triangle, right angled at A. Show that the mid-point of the hypotenuse is equidistant from the vertices

9. If the centroid of a triangle is at (-2, 1) and two of its vertices are (1, - 6) and (-5, 2) then find the third vertex of the triangle.

10. Find the angle made by a ladder of length 5m with the ground, if one of its end is 4m away from the wall and the other end is on the wall.

APPENDIX-2
LAB MANUAL
MATHEMATICS LAB MANUAL FOR CLASS 9

Lo: To use set language in solving life-oriented word problems.

Aim: Learn to solve life-oriented word problems in set language

Prior knowledge:

Students already know about union, intersection, compliment and differences of sets

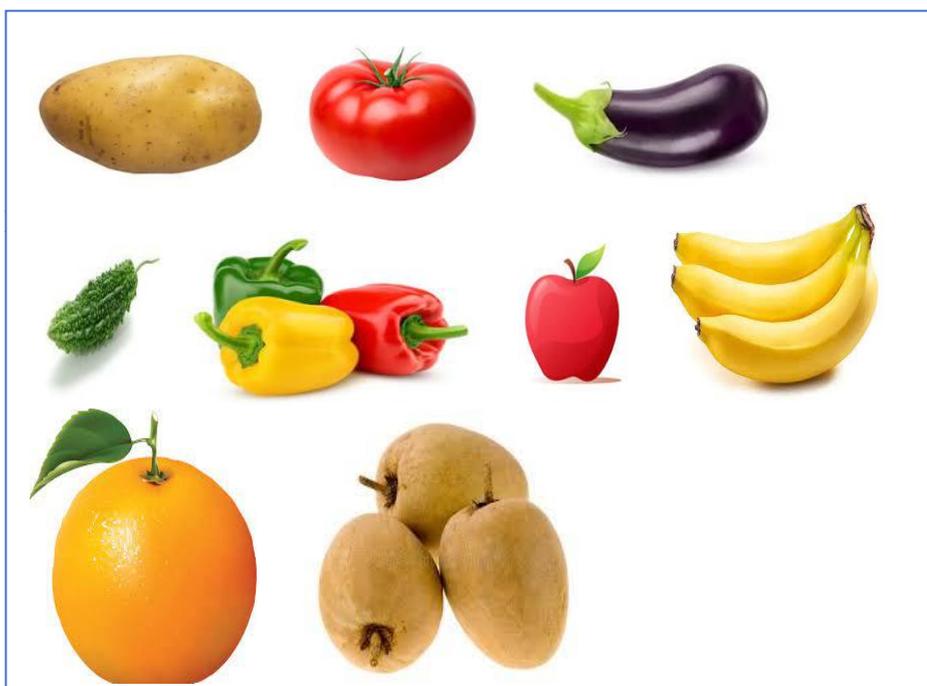
Activity:1(Group activity)

Materials required: Vegetables (Potato, Tomato, Brinjal, Bitterguard & Capsicum)

Fruits (Apple, Banana, Chikkoo, Grapes & Orange)

Procedure:

- Make vegetables as one group and fruits as another group.
- Student has to pick favorite vegetables or fruits.
- Form groups according to the item they have chosen can be noted as $n(A)$ & $n(B)$.
- Analyze the items most liked and least.



Interpretation:

Students answer the below statements

- 1.The items chosen by most number of students are -----
- 2.List the nutrient values of each
3. The items chosen by least number of students are -----
4. List the nutrient values of each

Conclusion:

From the above activity students not only learnt mathematical skills but also learnt healthy living food habits.

Thinking corner:

Do you think that only costly vegetables and fruits are rich in minerals?

Activity:2(Group activity)

Materials required: Index cards set1 & set2

Procedure:

Set1-Modern life style things



Set2-Old life style things



- Teacher ask students who likes Modern life style things and Old life style things
- Calculate the number of students in set1 & set2
- Find out which set has a more number of students.
- Ask students to say the reason for selecting set1 or 2

Interpretation:

1. Which group has a healthy life style?
2. Give the merits of old life style

Conclusion:

From the above activity students not only learnt mathematical skills but also learnt healthy living.

Thinking corner:

Do you think that modernisation brings healthy life?

Activity:3(Individual activity)

Materials required:

Bio Degradable: Cloth, paper cup, paper plate, newspaper, fruits, leaves, vegetables, cooked food...

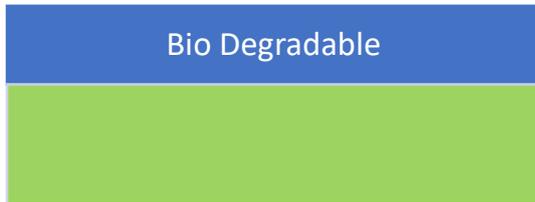
Non- Bio Degradable: Blade, gas bandages, expired medicines....

Procedure:

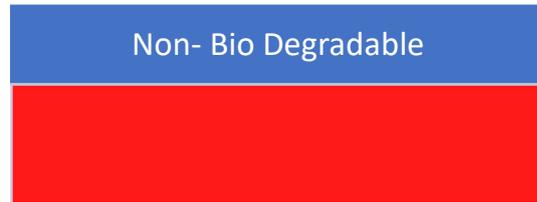
- Teacher places both the things in two different trays.
- Teacher selects 10 students.
- Arrange the 10 students in a circle and the teacher stands at the center of the circle.
- Teacher gives instructions about the things in the box.

- Ask each student to pick out a thing and put in the appropriate box (Bio Degradable, Non- Bio Degradable)

Box-1(Set)



Box-2(Set)



Interpretation:

1. Out of these two sets which set of things do we use mostly?
2. Why do we prefer bio degradable things?

Conclusion: From the above activity students learnt bio degradable and non-bio degradable things.

Thinking corner:

- Bio degradable things make the earth safer.
- Bio degradable things are eco friendly
- Non Bio degradable things spoil the environment

At the end of the activity students take a pledge to keep the earth safer.

Lo: To visualize the real numbers on the number line.

Aim: Learn to visualize the real numbers on the number line.

Prior knowledge:

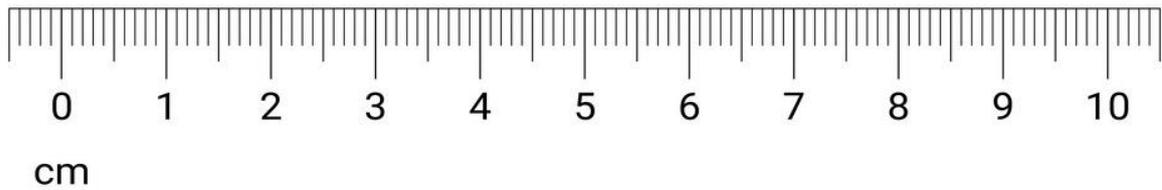
Students already know how to divide the number line into 10 equal parts and a decimal lies between which two whole numbers.

Activity:1

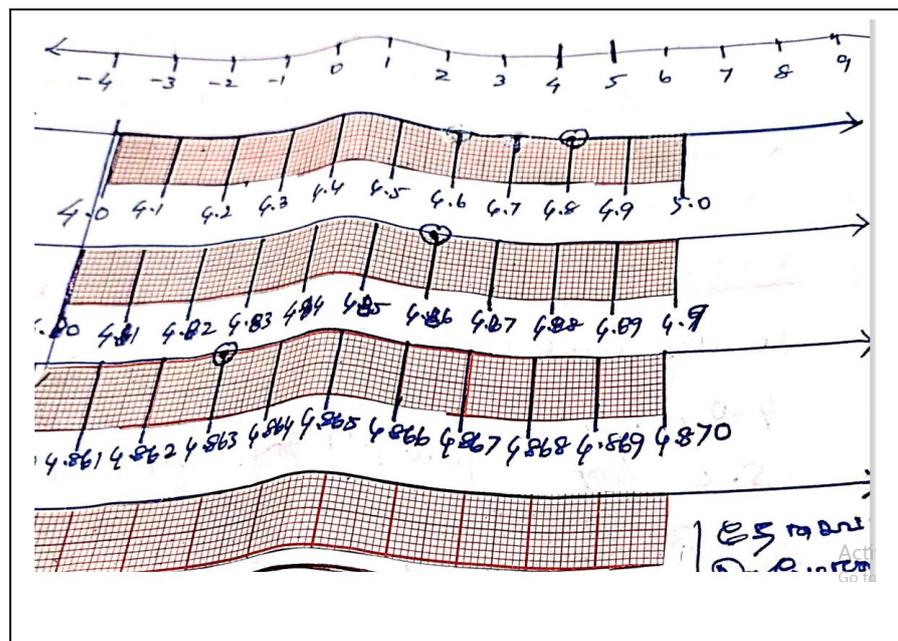
Materials required: Graph sheet, Pencil, eraser

Procedure: To represent 5.987 on the number line

- Students must know 5.987 lies between 5 and 9



- Divide space between 5 and 6 into 10 equal parts such as 5.0, 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7, 5.8, 5.9 & 6.0
- Mark 5.9
- Divide space between 5.9 and 6 into 10 equal parts such as 5.90, 5.91, 5.92, 5.93, 5.94, 5.95, 5.96, 5.97, 5.98, 5.99 & 6.0
- Mark 5.98
- Divide space between 5.98 and 5.99 into 10 equal parts such as 5.980, 5.981, 5.982, 5.983, 5.984, 5.985, 5.986, 5.987, 5.988, 5.989 & 6.000
- Mark 5.987



Interpretation:

Can you imagine the decimal points on the number line?

Conclusion: Students learnt to visualize the real numbers on the number line.

Thinking corner: Try to represent some other numbers on the number line.

Activity:2

Materials required: Graph sheet, Pencil, eraser

Procedure: To represent 4.863 on the number line

Step1: In a graph sheet draw 4 squares of size 10cmx10cm

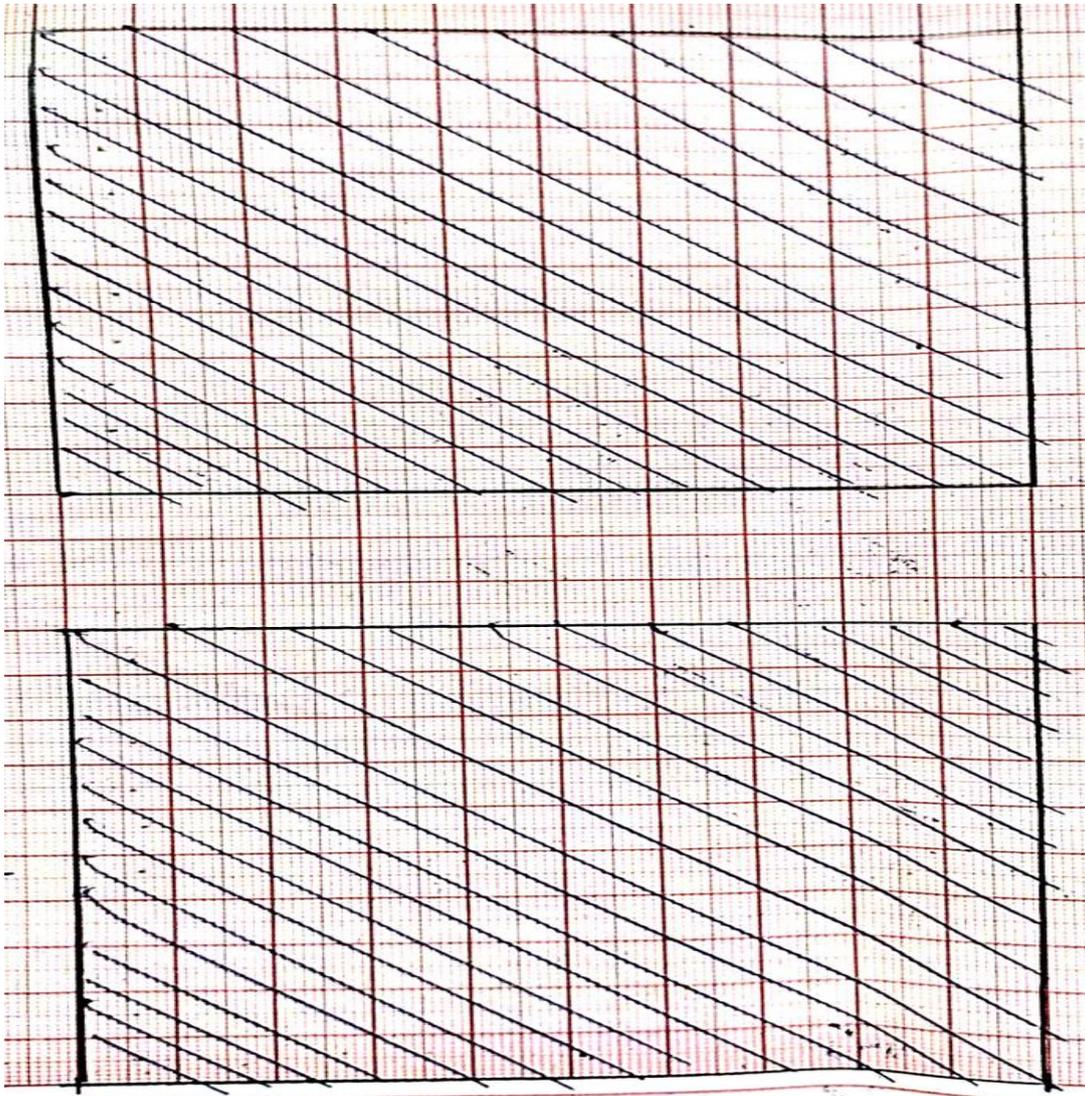
Step2: Divide 10cmx10cm square in to 10 equal parts. Colour 8 parts. Then we get 4.8

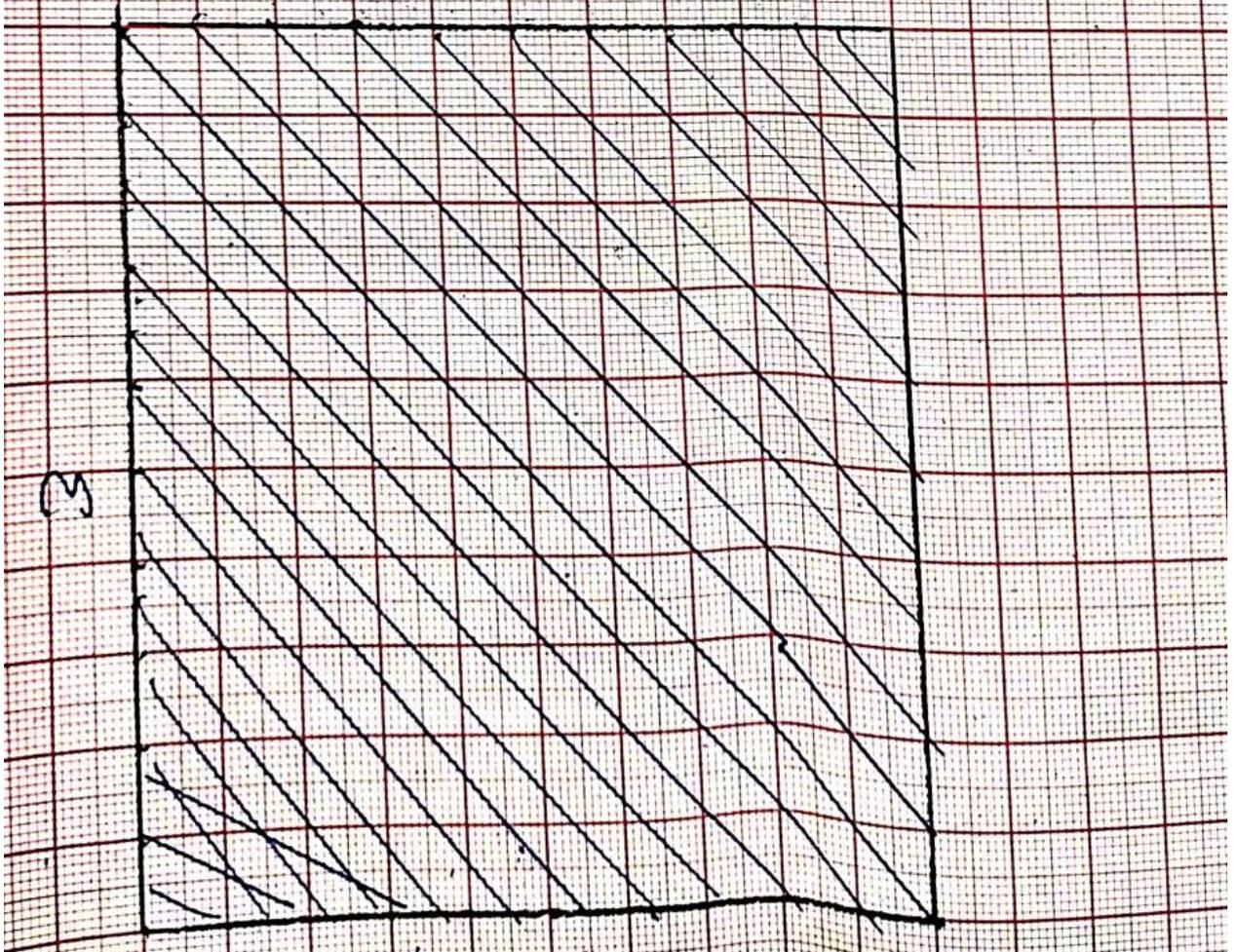
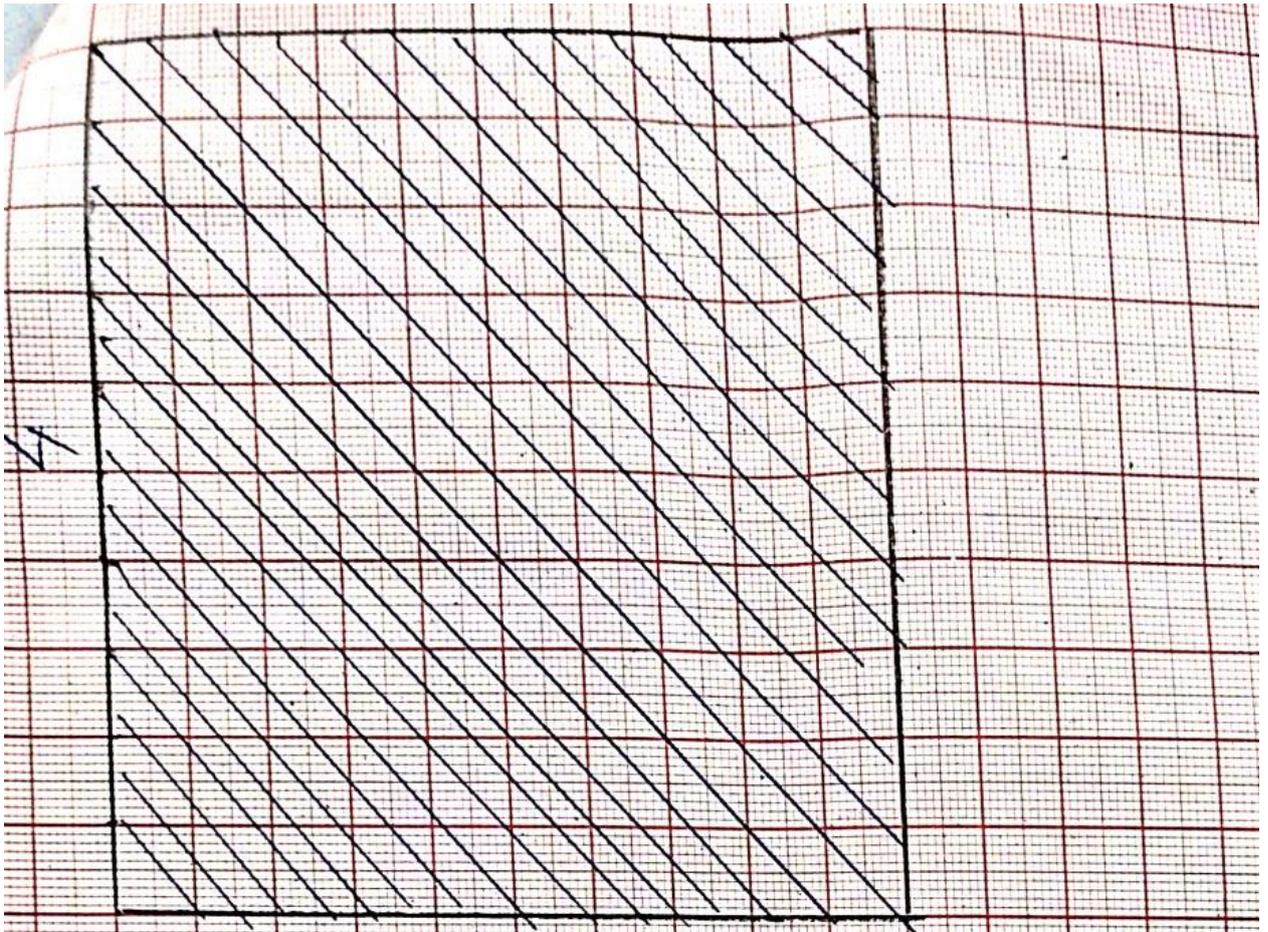
Step3: Divide another 10cmx10cm square in to 100 equal parts. Colour 86 parts. Then we get 4.86

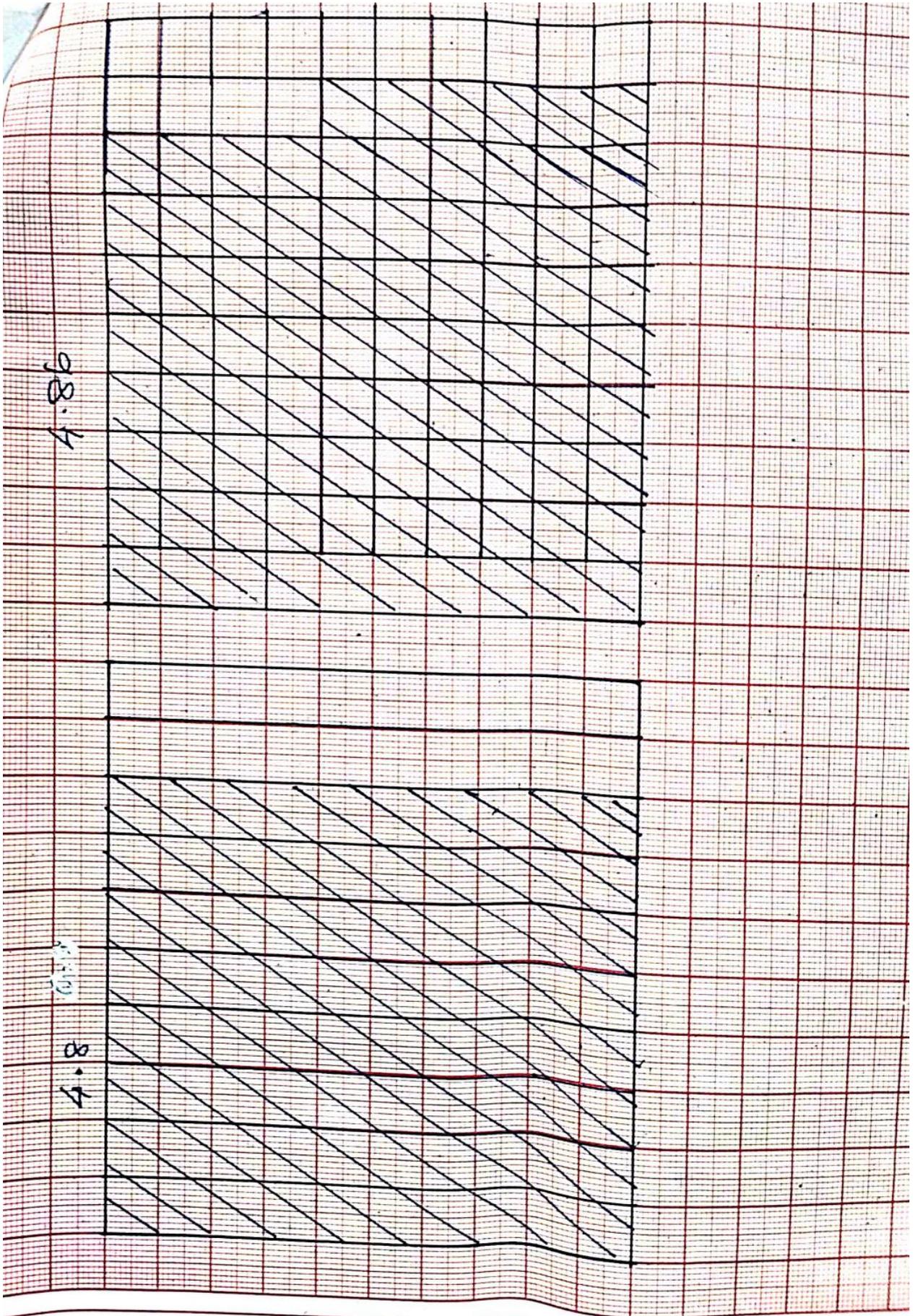
Step4: Divide another 10cmx10cm square in to 1000 equal parts. Colour 863 parts. Then we get 4.863

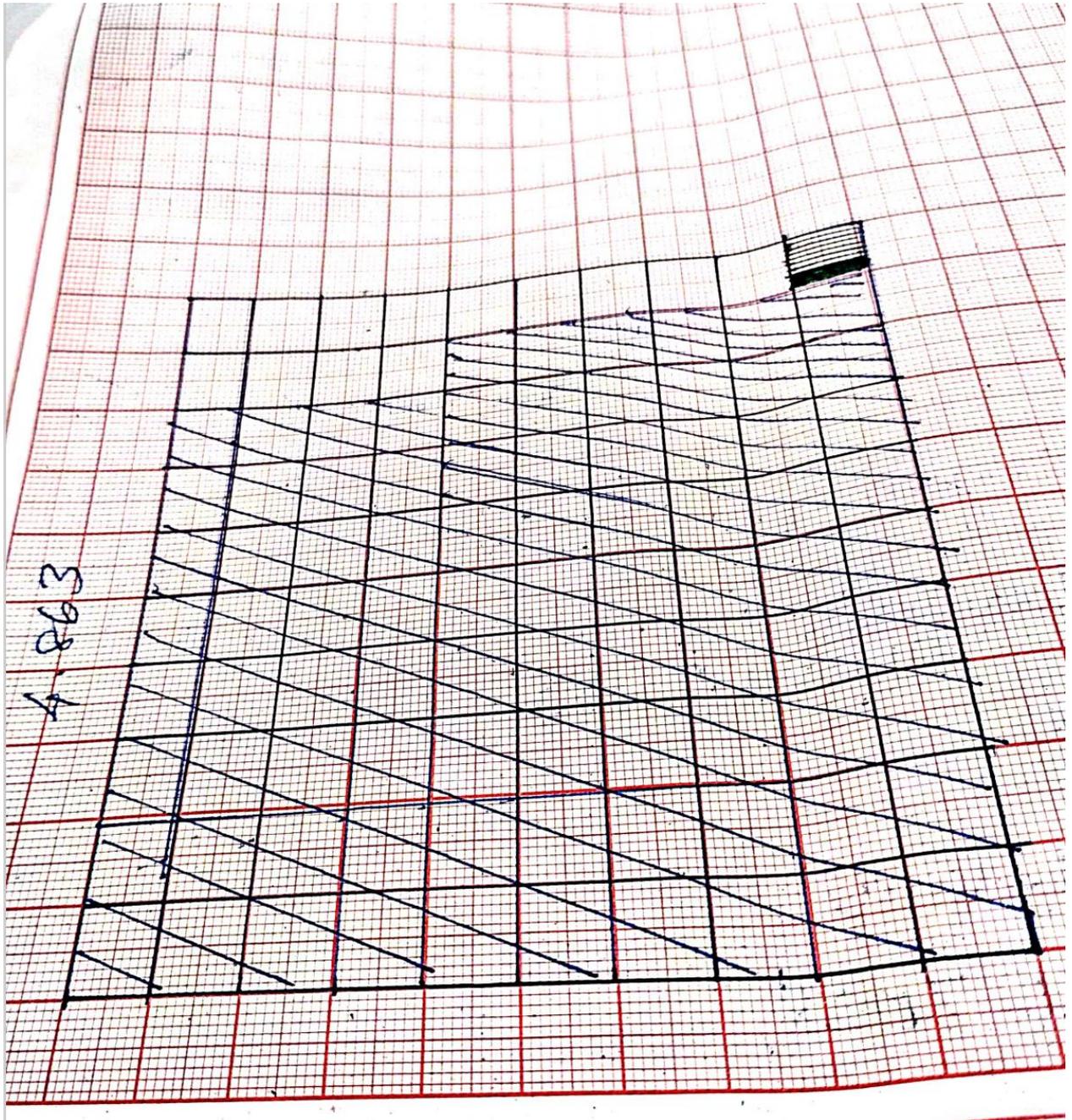
Square1&2

Square3&4









ACTIVITY3

LO: To understand the scientific notation

Aim: To understand the scientific notation

Prior knowledge:

To express rational and irrational numbers in decimal form

Materials required: Scale, Pencil, Paper & pen

Procedure:

- Draw a line and fix a decimal point in center.
- On the left of the decimal point is called integral part (whole part) whereas the right side of the decimal point is called decimal part.
- On the left side of the decimal part each unit is considered as 10 and its exponents.
- On the right side of the decimal part each unit is considered as 1/10 and its exponents.
- Now take a number and fit it on the line.
- According to the integral or decimal number, move the decimal point. So that there is only one non-zero digit to the left or right respectively.
- Choose the exponential number after or before decimal point according to the integral and decimal number respectively and write its multiple which is in the form

$$N = a \times 10^n$$

Where $1 \leq a < 10$, n is an integer

ACTIVITY:2

Materials required: Chart & Marker

Procedure:

- The way of expressing a big or small number in short way is called scientific notation.
- Consider this number 14700000
- Shift the decimal point one digit to left and to compensate it multiply the number by 10. Ex: 1470000.0x10 or 1470000x10¹
- Repeat the process till there is only one non-Zero digit to left. Each time shift the decimal to left, multiply the number by 10 or increase the power of 10 by one (10¹)
- This process does not change the value of number but its easy to read/write

14700000.0	or	14700000
1470000.0x10	or	1470000x10 ¹
147000.0x10x10	or	147000x10 ²
14700.0x10x10 x10	or	14700x10 ³
1470.0x10x10 x10x10	or	1470x10 ⁴

$147.0 \times 10 \times 10 \times 10 \times 10 \times 10$	or	147×10^5
$14.7 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10$	or	14.700000×10^6
$1.47 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10$	or	1.4700000×10^7

$$14700000 = 1.47 \times 10^7$$

- Consider this number 0.00000147
- Shift the decimal point one digit to right and to compensate it multiply the number by 1/10
0.00000147
00.0000147x1/10 or oo. oooo147x10⁻¹
- Repeat the process continuously till there is only one non-Zero digit to left.
- Each time shift the decimal point to right and multiply the number with 1/10 or decrease the power of 10 by one(10⁻¹) 0.00000147

$0.00000147 \times 1/10$	or	14700000
1470000.0×10	or	1470000×10^1
$147000.0 \times 10 \times 10$	or	147000×10^2
$14700.0 \times 10 \times 10 \times 10$	or	14700×10^3
$1470.0 \times 10 \times 10 \times 10 \times 10$	or	1470×10^4
$147.0 \times 10 \times 10 \times 10 \times 10 \times 10$	or	147×10^5
$14.7 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10$	or	14.700000×10^6
$1.47 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10$	or	1.4700000×10^7

$$0.00000147 = 1.47 \times 10^{-6}$$

Conduct this as group activity by giving them more examples.

Conclusion: It makes big number(for ex: 841000 000 000 000) or small number (for ex: 0.000 000 000 0841) easy to read and handle.

ACTIVITY:3

LO: To understand the scientific notation

Aim: To understand the application of the scientific notation in word problems

Prior knowledge:

- To express rational and irrational numbers in decimal form
- To write numbers in exponential form.
- To understand the scientific notation.

Materials required: Picture of solar system

Procedure:

Step1: Represent the following numbers in the scientific notation and compare the answers and discuss with your peer group.

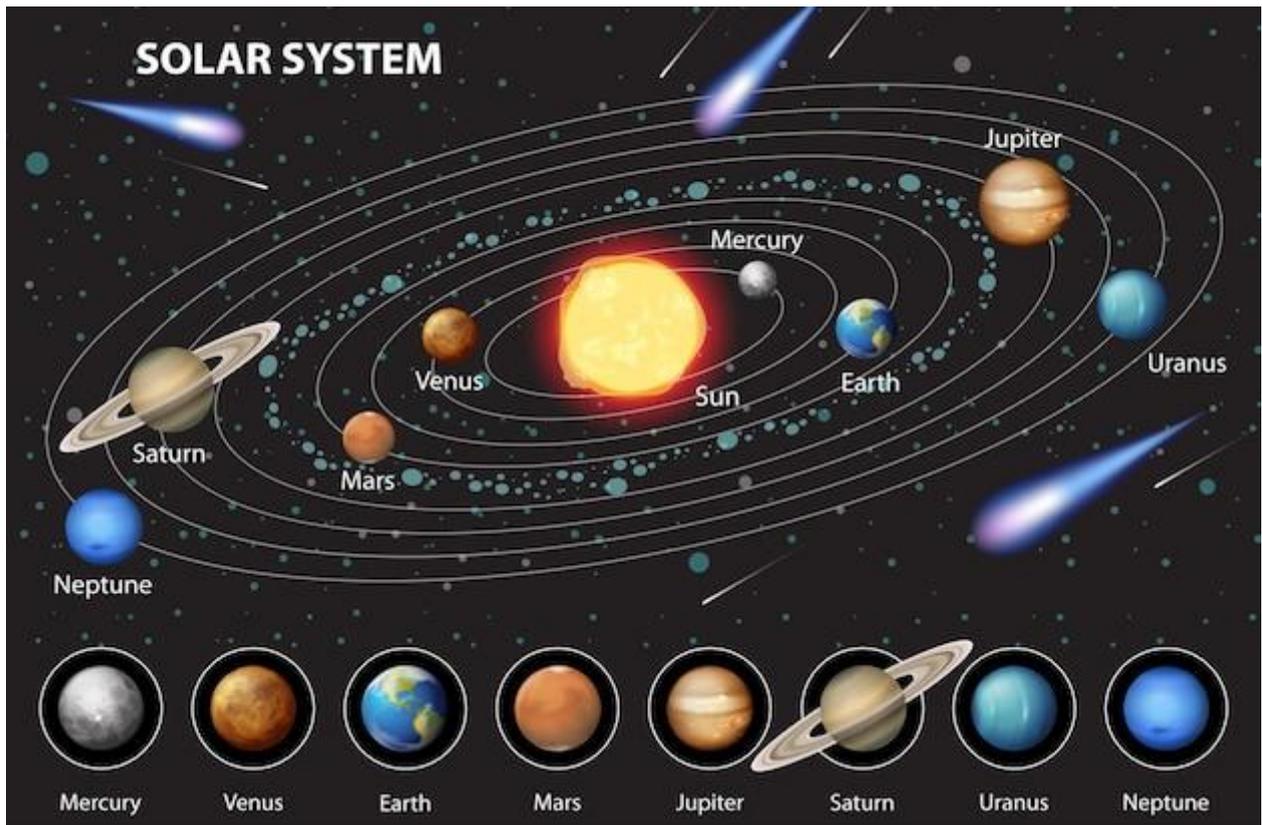
1) $456\,000\,000 = 4.56 \times 10^8$

2) $000\,000\,0456 = 4.56 \times 10^{-8}$

Step2: The table shows the directions surveyed areas for cancer awareness. How much area did the north and south surveyed together?

Direction	Area
East	1.94×10^8
North	3.28×10^8
South	8.65×10^6
West	9.75×10^6

Step3: The diagram below shows the planets of our solar system. Use it to help to answer the exercise below.



Pluto is considered to be a “dwarf planet” in our solar system. Pluto is about 3.6745×10^9 miles from the sun. Mercury is about 3.5984×10^7 miles from the sun. About how many times farther from the sun is Pluto than Mercury?

Conclusion: In this activity the students learn the application of scientific notation in word problem.

LO: Able to draw graph for a given linear equation

Aim: To know the solution from the given linear equations using graphical representation

Prior knowledge:

- Marking X-axis, Y-axis co-ordinates and origin in graph sheet.
- Plotting points in Cartesian co-ordinate plane.
- Joining the points of every equation using scale.

Materials required: Folding graph sheets in large size, Marker pen, A4 size graph sheet, scale, pencil

Activity1 Group activity)

Aim: To solve the linear equation for finding unique solution

Problem: Two cars are 100 miles apart. If they drive towards each other they will meet in 1 hour. If they drive in the same direction they will meet in 2 hours. Find their speed by using graphical method.

X	-100	0	100
Y	200	100	0
Y	200	100	0

Procedure:

Step:1 

Opposite direction $X+Y = 100$  (1)

Same direction $X- Y = 50$  (2)

Step:2

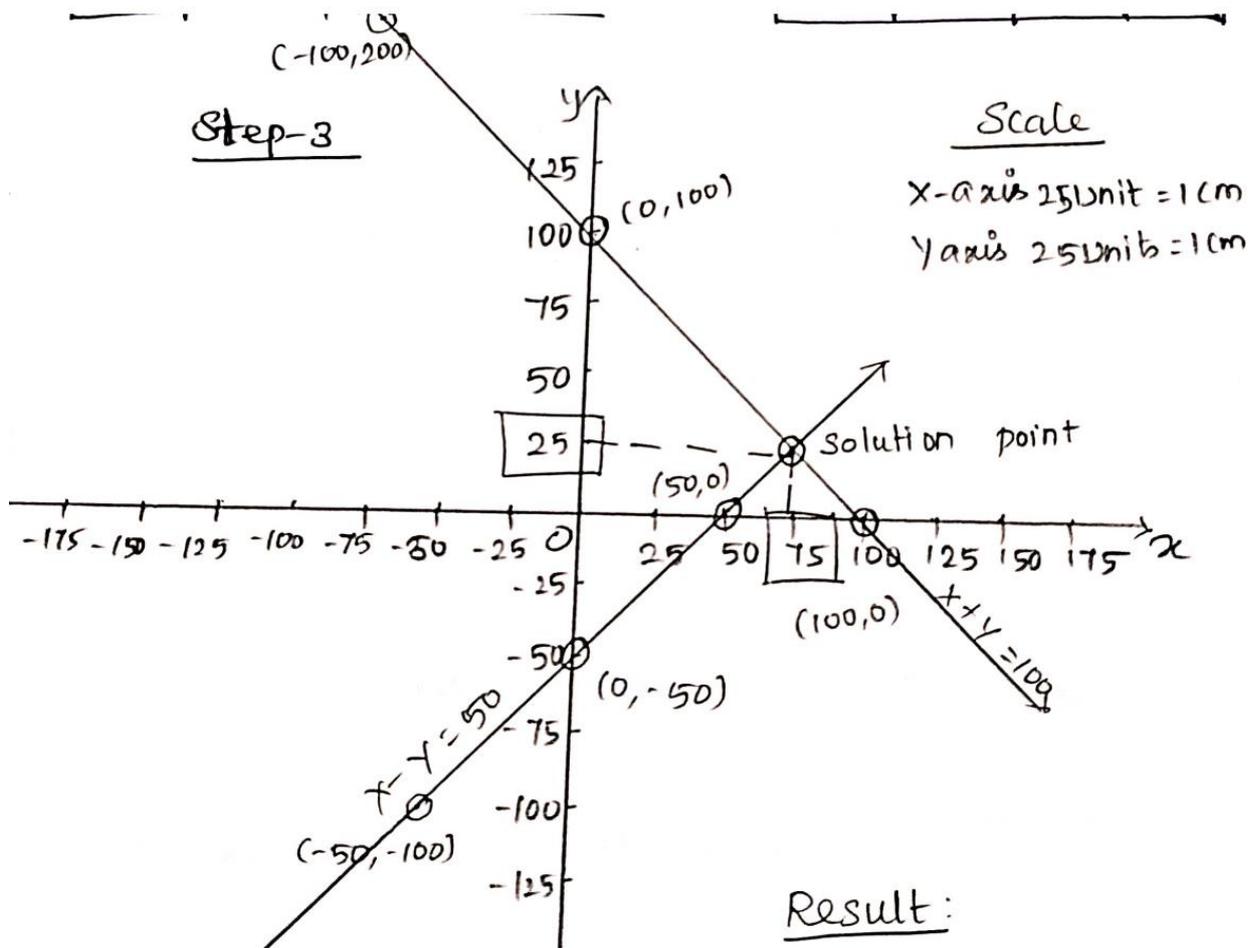
Table-1 $X+Y = 100$

$$Y = 100-X$$

Table-2 $X-Y = 50$

$$Y = X- 50$$

X	-50	0	50
Y	-100	-50	0



Solution:

- Both the lines intersect only at one point.
- So, it has unique solution.

Result:

$X+Y = 100$ & $X - Y = 50$

The solution is $X = 75$ $Y = 25$

Practice problems:

1. $x-y=0$ & $y + 3 = 0$
2. $x - 2y = 0$ & $x-4 = 0$

Activity2 (Small Group activity)

Aim: To solve the linear equations for finding many solutions using graph

Problem: Use graphical method to solve the following system of equations $3x+2y= 4$ & $9x+6y= 12$

Procedure:

Step:1 $3x + 2y = 4$ ----- (1)

$9x + 6y = 12$ -----(2)

$3x = 4 - 2y$

$9x = 12 - 6y$

$x = 4 - 2y/3$

$x = 12 - 6y$

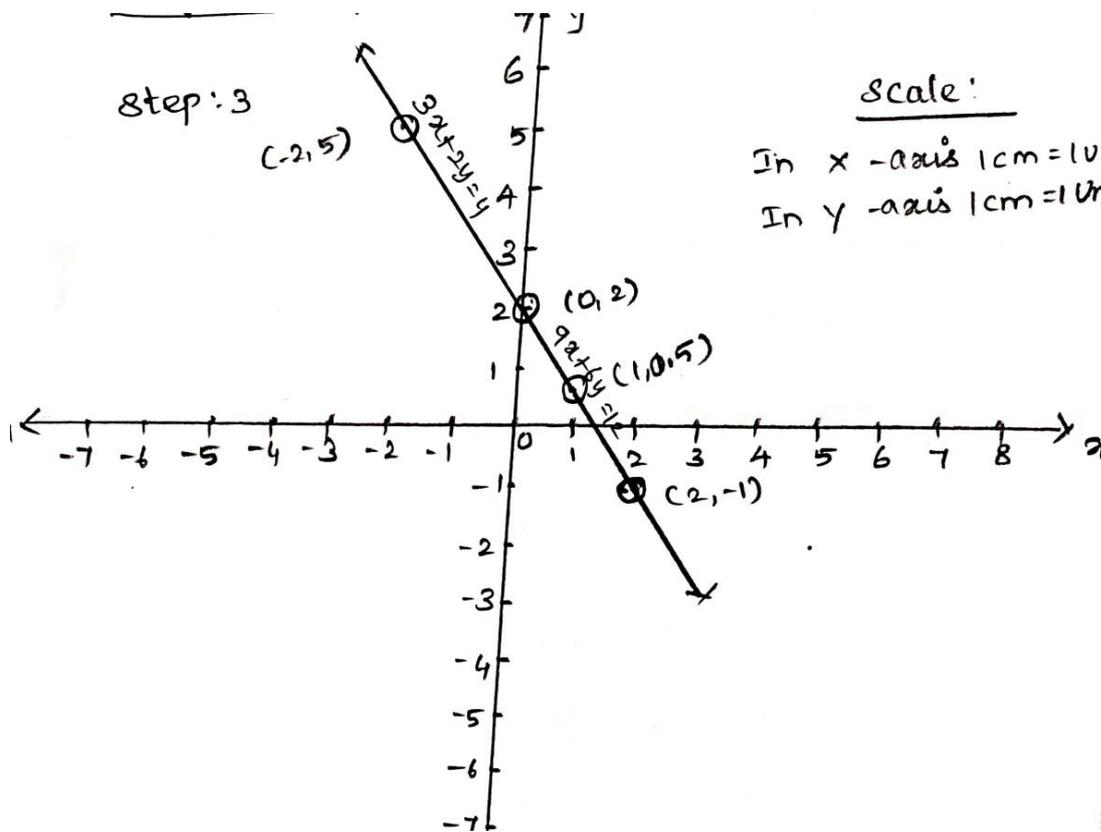
Step:2

Table:1

X	0	1	2	-2
Y	2	0.5	-1	5

Table-2

X	0	1	2	-2
Y	2	0.5	-1	5



Solution:

- All the points from table 1&2 are common
- Both the lines are coinciding
- So it has infinite many solutions

Result:

$3x+2y = 4$ & $9x+ 6y = 12$ has infinitely many solutions, because the lines are coinciding.

ACTIVITY3 (SMALL GROUP ACTIVITY)

Aim: To solve the linear equations for finding no solutions using graph

Problem: Use graphical method to solve the following system of equations $x/2 + y/4 = 1$ & $x/2 + y/4 = 2$

Procedure:

Step:1

$$x/2 + y/4 = 1$$

$$2x+ y = 4$$

$$x/2$$

$$x/2 + y/4 = 2$$

$$2x + y = 8$$

Step:2

Step:2

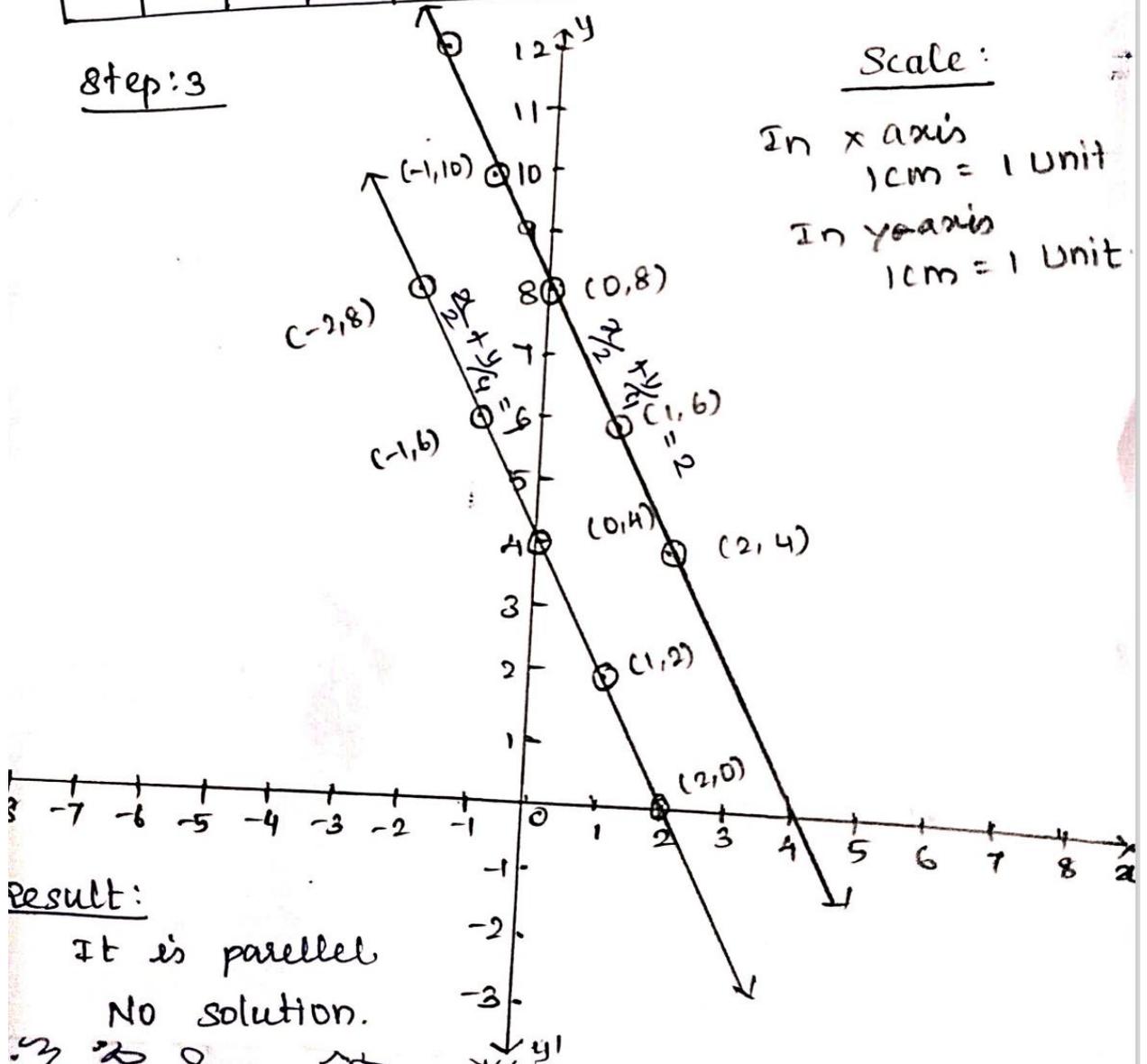
TABLE-1

X	0	1	-1	2	-2
Y	4	2	6	0	8

TABLE-2

X	0	1	-1	2	-2
Y	8	+6	10	+4	12

Step:3



Solution:

- Both lines are parallel
- It has no solution

Result: It is parallel. It has no solution

LO: To understand the properties of quadrilaterals and use them in problem solving.

Aim: To understand the properties of quadrilaterals

Prior knowledge: Straight line, triangle and quadrilateral

ACTIVITY:1(GROUP ACTIVITY)

Materials required:

Quadrilaterals-drawn in chart, paper folding& models

3 sided and 5 sided shapes

Procedure:

Step:1

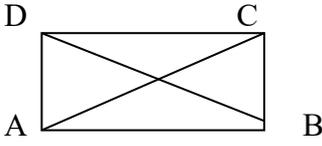
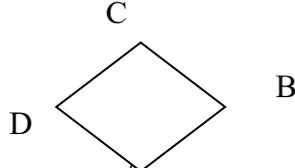
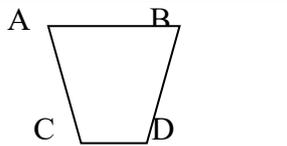
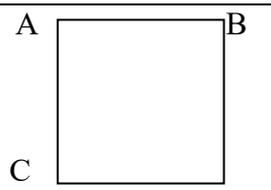
Students are asked to find out the 4-sided shapes which are in the group of 3 sided 4 sided and 5 sided shapes.

Step: 2

Take out the 4-sided shape and group it. Let us call this group of shapes us quadrilateral group or quadrilateral family.

Step: 3

Now measure the sides and angles of each quadrilateral and tablet it as given below.

Shape	Length of Sides	Angles	Properties Based on sides & Based on angles
	AB= BC= CD= DA= AC= DB=	$\angle A =$ $\angle B =$ $\angle C =$ $\angle D =$	
	AB= BC= CD= DA=	$\angle A =$ $\angle B =$ $\angle C =$ $\angle D =$	
	AB= BC= CD= DA=	$\angle A =$ $\angle B =$ $\angle C =$ $\angle D =$	
	AB= BC= CD= DA=	$\angle A =$ $\angle B =$ $\angle C =$ $\angle D =$	

Interpretation:

Conclusion:

Students learnt the similarities and differences on different geometrical shapes in quadrilateral family.

students learnt road signals, map reading, route map location findings etc..

Thinking corner:

Do you think the above shapes only in quadrilateral family?

ACTIVITY 2

Aim:

Introducing parallelogram and its properties

Prior knowledge:

- Measuring angles using protractor
- Knowledge of polygons, triangle & quadrilateral
- Knowledge of ordered pairs and plotting the points in the graph sheet

Materials required:

Graph sheet, rectangular box, protractor, ruler etc.,

Procedure:

Step:1

Take any two points and make four ordered pairs without repetition.

Step :2

Now plot the four ordered pairs in a graph sheet. join the points. we get a rectangle. **Step :3**

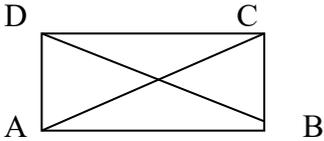
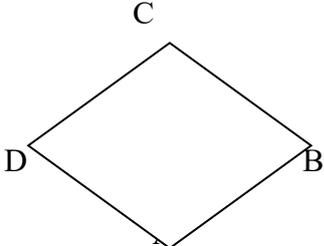
Measure the 4 sides, 4 angles and 2 diagonals and table it. conclude the properties of rectangle.

Step :4

Now move the rectangle either of the side (left or right) we get parallelogram.

Step :5

Now measure the four sides, 4 angles one two diagonals. Tabulate the values.

Shape	Length of Sides	Angles	Length of diagonals
	AB= BC= CD= DA= AC= DB=	$\angle A =$ $\angle B =$ $\angle C =$ $\angle D =$	
	AB= BC= CD= DA=	$\angle A =$ $\angle B =$ $\angle C =$ $\angle D =$	

Properties of parallelogram:

- Opposite sides are parallel and equal.
- Opposite angles are equal and sum of any two adjacent angles are 180°
- Diagonals bisect each other

Conclusion:

students learn about parallelogram and its properties through learning by doing.

ACTIVITY 3 (INDIVIDUAL) EVALUATION

Aim: Evaluating the understanding of properties of parallelogram.

Prior knowledge:

- Properties of parallelogram
- Measuring angles and sides
- Straight angle and sum of angles of triangle
- Adjacent angles and opposite angles

Materials required: Matching board ,Velcro strips, protractor, ruler and flash cards

Procedure:

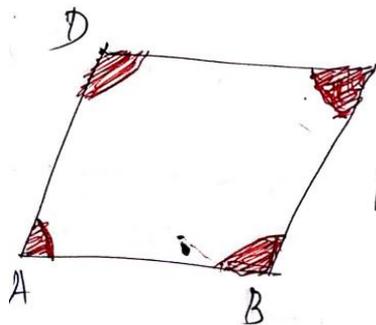
Step:1

Matching board (magnetic)

Measuring	Matching
1) AB, BC, CD, DA	Opposite angles are equal
2) $\angle A, \angle B, \angle C, \angle D$	Diagonals bisect each other
3) $\angle A + \angle B, \angle B + \angle C, \angle C + \angle D, \angle D + \angle A$	Opposite sides are equal.
4) OA, OB, OC, OD	sum of any two adjacent angles are 180°

Step: 2,

Using wellgroove strips



$\angle A = \angle C$ } opposite angles
 $\angle B = \angle D$ } are equal.
 $\angle A + \angle B = \angle B + \angle C = \angle C + \angle D = \angle D + \angle A$
 $=$  straight angle = 180°

Similarly other activities can be conducted to reinforce the learning using protractor ruler and flash cards.

Conclusion:

Students learn about properties of parallelogram concretely. Evaluation helps them to attain learning outcome.

LO: To understand the mid-point formula and use it in problem solving

ACTIVITY:1(INDIVIDUAL ACTIVITY)

Aim: To understand the midpoint formula and use it to solve the problems.

Prior knowledge:

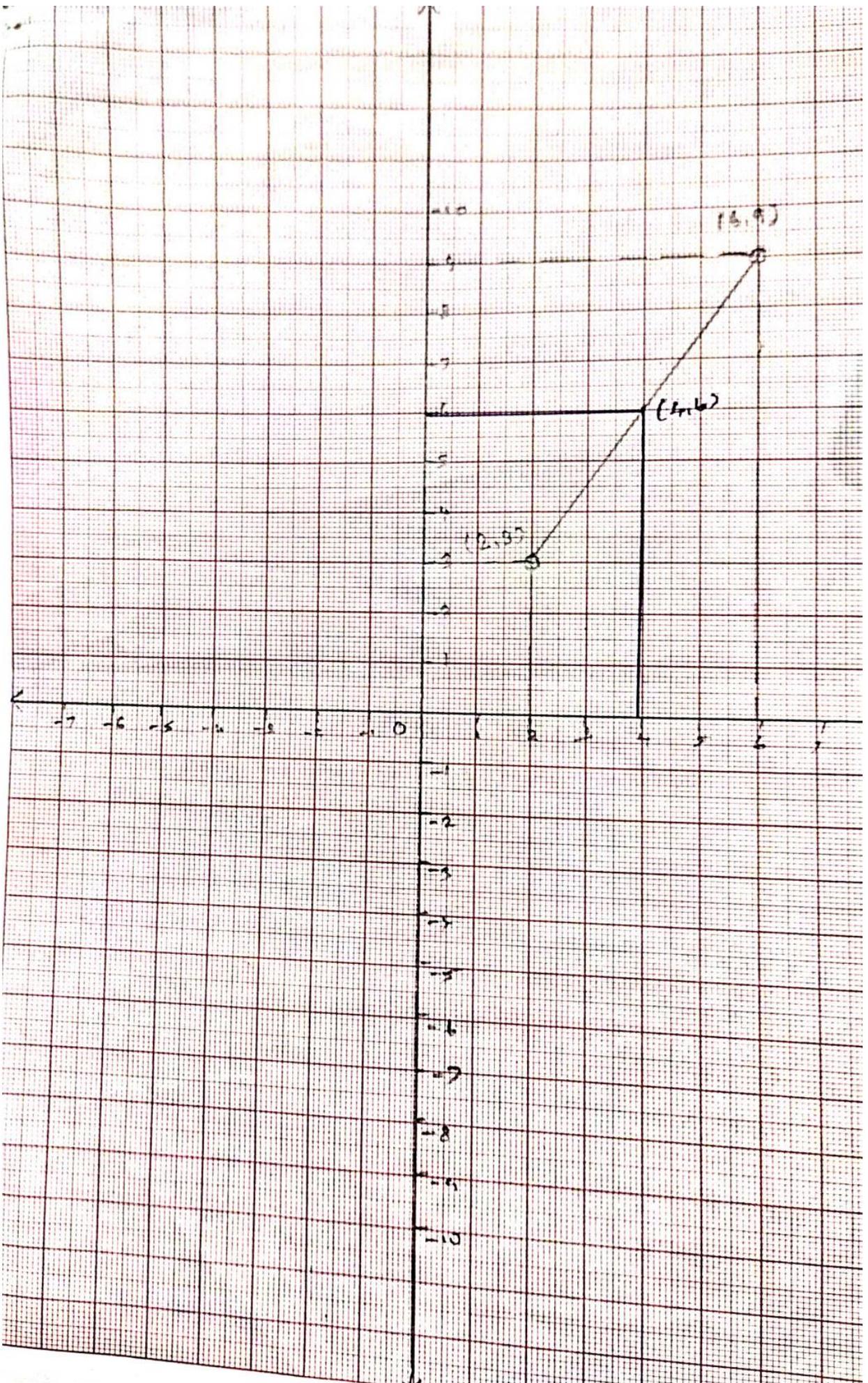
- X axis and Y axis
- Plotting the points
- Dividing four quadrants
- Drawing lines

Materials required: Graph sheet, pencil, scale, eraser etc.,

Procedure:

Let us take two points (2,3) and (6,9)

- To plot (2,3) in the Cartesian plane draw a vertical line at $x=2$ and horizontal line at $y=3$.
- To plot (6,9) and draw a vertical line at $x=6$ and horizontal line at $y=6$.
- Join the points (2,3) and (6,9)
- Draw a vertical line and horizontal line between them, which meets at (4,6) is the midpoint (M) of line segment (2,3) and (6,9)
- X-co-ordinate of M is $(x_1+x_2)/2$
Y-co-ordinate of M is $(y_1+y_2)/2$
Midpoint $M=(x_1+x_2/2, y_1+y_2/2)$



Conclusion:

From this activity we conclude that the midpoint of line joining the two points (2,3) and (6,9) is (4,6)

ACTIVITY: 2(INDIVIDUAL ACTIVITY)

Aim: To understand the midpoint formula and use it to solve the problems.

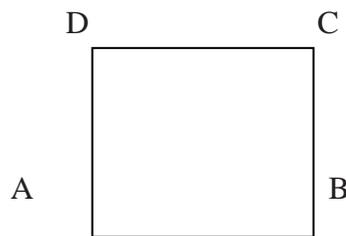
Prior knowledge:

- Concept of midpoint formula
- Concept of right-angle property
- Distance formula

Materials required: Paper, Scissor, Colour sheets, scale, eraser etc.,

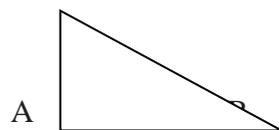
Procedure:

Step:1 Take a paper and made it into Square. Name it as ABCD.



Step:2

Join A and D by folding it which shows the right-angled triangle $\triangle ABC$ at A



Step:3

To find the midpoint of BC by folding the paper which is at O.

Step:4

Measuring the length of OA, OB, OC by coincides BA, CA which equals $OA = OB = OC$

Conclusion:

From this we conclude that midpoint of hypotenuse is equidistance from all the vertices.

ACTIVITY: 3 (INDIVIDUAL ACTIVITY)

Aim: To understand the midpoint formula and use it to find the centroid of triangle.

Prior knowledge:

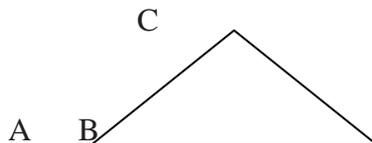
- Concept of median
- Properties of triangle
- Midpoint of line segment

Materials required: Paper, Scissor, pencil, eraser etc.,

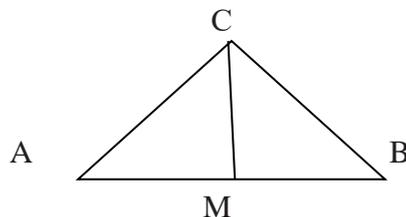
Procedure:

Step:1 Make a line segment on a paper by folding it and name it as AB

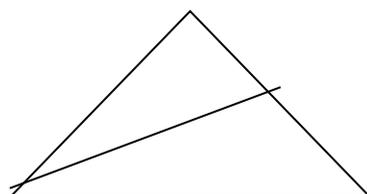
Step:2 Fold the line segment AB such that A falls on B. Mark the point of intersection M which is the midpoint of AB.



Step:3 A falls on B makes M as point of intersection



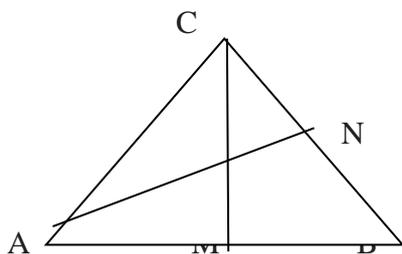
Step:4 B falls on C makes N as point of intersection



Step:5

Draw the medians AN and CM. Let them meet at G.

The point G is the centroid of triangle ABC.

**Conclusion:**

From this activity we conclude that the point of concurrence of medians of a triangle is centroid of triangle G.

LO: To understand the usage of trigonometric tables**Aim:**

- To find trigonometric ratios (0° - 90°)
- To solve the related problems

Prior knowledge: Pythagoras theorem, algebra concept

Materials required: Chart, Sketch, pencil, paper, scale, eraser, pictures of trees, mountains, building etc.,

Activity: 1

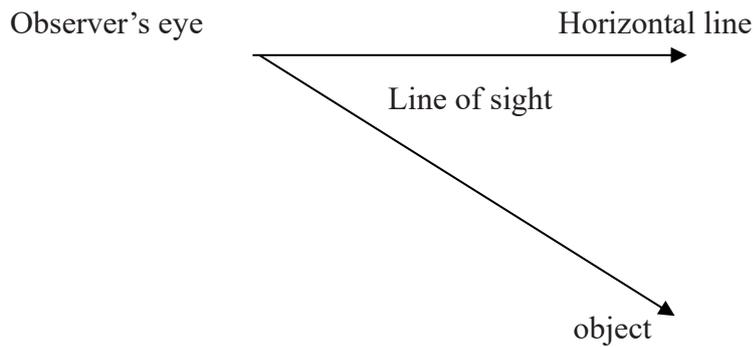
Aim: To know angle elevation, angle of depression

Procedure:

Angle of elevation: The angle of elevation is an angle that is formed between the horizontal line and the line of sight. If the line is upward from that horizontal line, then the angle formed is an angle of elevation.

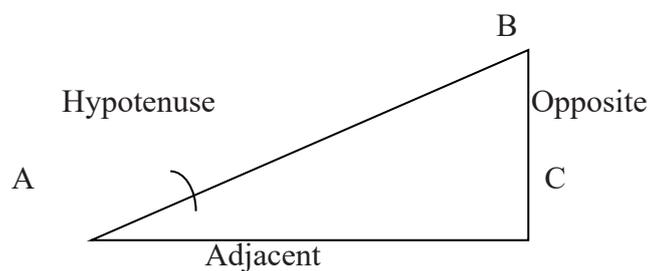
Angle of depression:

The observer is standing at height and the object is kept below the line of sight of the observer. If the object is kept the below eye level of the observer, then the angle formed between the horizontal line and the observers line of sight is called the angle of depression.



Line of sight	Angle formed
Above the horizontal line	Angle of elevation
Below the horizontal line	Angle of depression

Trigonometric Ratios: The ratios of the sides of a right triangle are called trigonometric ratios. Three common trigonometric ratios are the sin, cos and tan. These are defined for the acute angle.



$$\sin \theta = \frac{\text{opposite side}}{\text{Hypotenuse}}$$

$$\cos \theta = \frac{\text{Adjacent side}}{\text{Hypotenuse}}$$

$$\tan \theta = \frac{\text{opposite side}}{\text{Adjacent side}}$$

In these definitions the terms opposite, adjacent and Hypotenuse refer to the length of the sides.

SOH-CAH-TOA

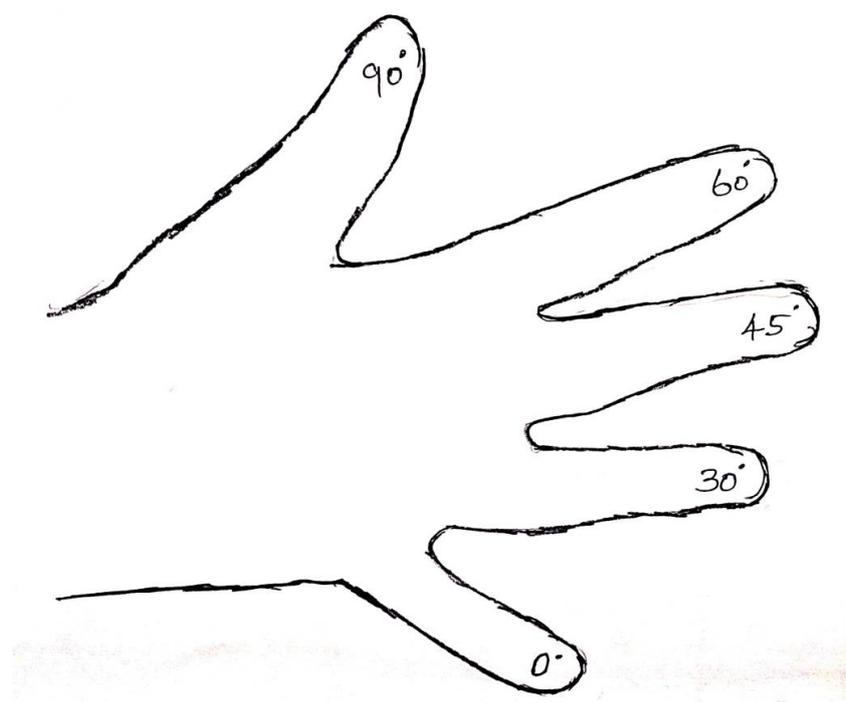
An easy way to remember trigonometric ratios.

The word SOH-CAH-TOA help us to remember the definitions of sin, cos and tan.

Acronym part	Verbal description	Mathematical definition
SOH	Sin is opposite over hypotenuse	$\sin \theta = \frac{\text{opposite side}}{\text{Hypotenuse}}$
CAH	Cos is adjacent over hypotenuse	$\cos \theta = \frac{\text{Adjacent side}}{\text{Hypotenuse}}$
TOA	tan is opposite over adjacent	$\tan \theta = \frac{\text{opposite side}}{\text{Adjacent side}}$

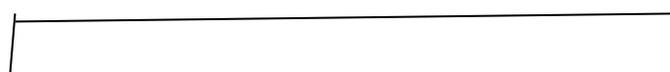
For example, to recall the definition of sine refer SOH. Sine starts with letter S. The letter O and H help us to remember that sine is opposite over hypotenuse.

Trigonometry Hand Trick



$$\sin \theta = \frac{\text{Number of fingers below the bent finger}}{2}$$

$$\cos \theta = \frac{\sqrt{\text{Number of fingers above the bent finger}}}{2}$$



Example: Find $\sin 60^\circ$

Step: 1 Bend the pointer finger

Step: 2 count the number of fingers below the bent finger

Step: 3 Use the formula for $\sin \Theta$

$$\sin 60^\circ = \sqrt{3}/2$$

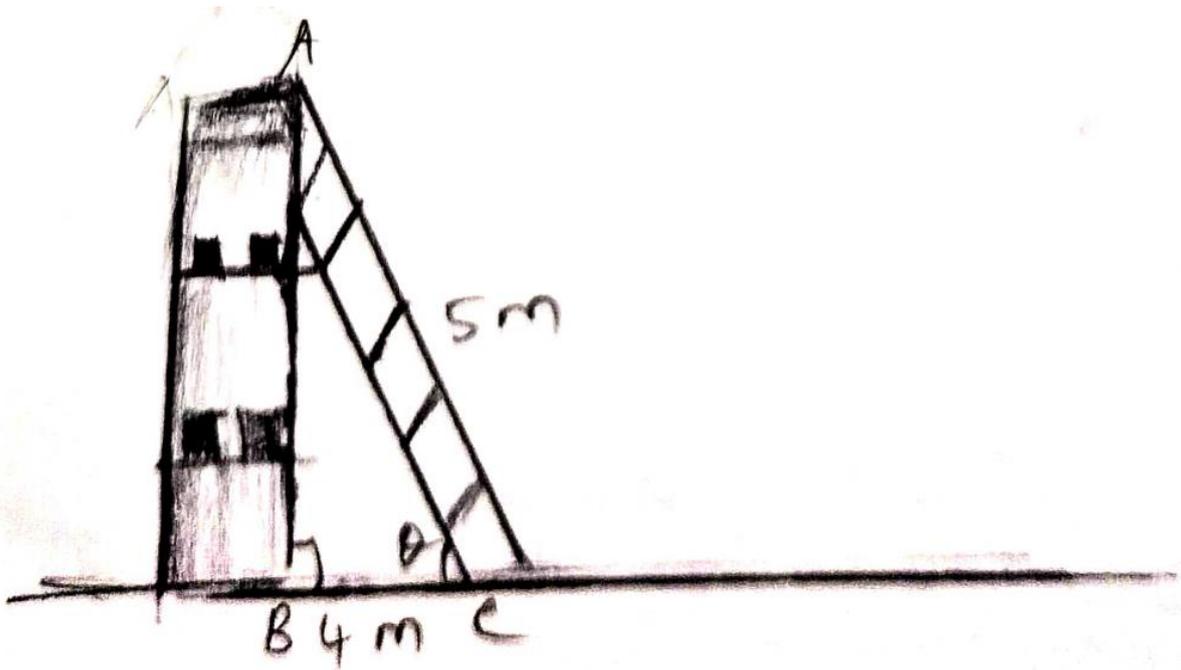
The same way for all values of \sin and \cos can be calculated.

θ	0°	30°	45°	60°	90°
$\sin \theta$	0	$\frac{1}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{\sqrt{3}}{2}$	1
$\cos \theta$	1	$\frac{\sqrt{3}}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{1}{2}$	0
$\tan \theta$	0	$\frac{1}{\sqrt{3}}$	1	$\sqrt{3}$	not defined
$\operatorname{cosec} \theta$	not defined	2	$\sqrt{2}$	$\frac{2}{\sqrt{3}}$	1
$\sec \theta$	1	$\frac{2}{\sqrt{3}}$	$\sqrt{2}$	2	not defined
$\cot \theta$	not defined	$\sqrt{3}$	1	$\frac{1}{\sqrt{3}}$	0

ACTIVITY 2

Trigonometric tables

Find the angle made by a ladder of length 5m with the ground, if one of its ends is 4m away from the wall and the other end is on the wall.



$\cos \theta = \text{Adjacent side} / \text{Hypotenuse}$

$$\cos \theta = 4\text{m} / 5\text{m} = 0.8\text{m}$$

Use natural cosines table

$$0.8007 = \cos 36^{\circ} 48'$$

$$0.0007 = + \quad 4'$$

$$0.8000 = \cos 36^{\circ} 52'$$

Note: $1^{\circ} = 60'$ (60 minutes)

$$1' = 60'' \text{ (60 seconds)}$$

Real life application of trigonometry

- Trigonometry concepts can be used to measure the height of a building or measure the height of a building or mountains
- It is used in flight engineering
- It is used in astronomy to calculate the distance between stars and planets

APPENDIX-3
WORK SHEET
SET LANGUAGE

*42 kcal Energy
*1.61g protein
*0.17g fat
*4.9mg vit c
*78mg sodium
*9.56g carbs



Beetroot



Sweet potato

*162 kcal calories
*3.9g fiber
*37g Carbs
*3.6g protein
*0.1g fat

*15kcal calories
*2.2g protein
*2.3g Carbs
*0.2g fat
*0.7g fiber



Mushroom



Green Peas

- * 118 calories
- * 21.1g Carbs
- * 8.3g fiber
- * 8.3g protein
- * 2mg sodium
- * 0.4g fat
- * 2.9g Sugar

- * 340mg potassium
- * 4g protein
- * 4047. Vitamin C
- * 1%. Calcium
- * 6%. Magnesium



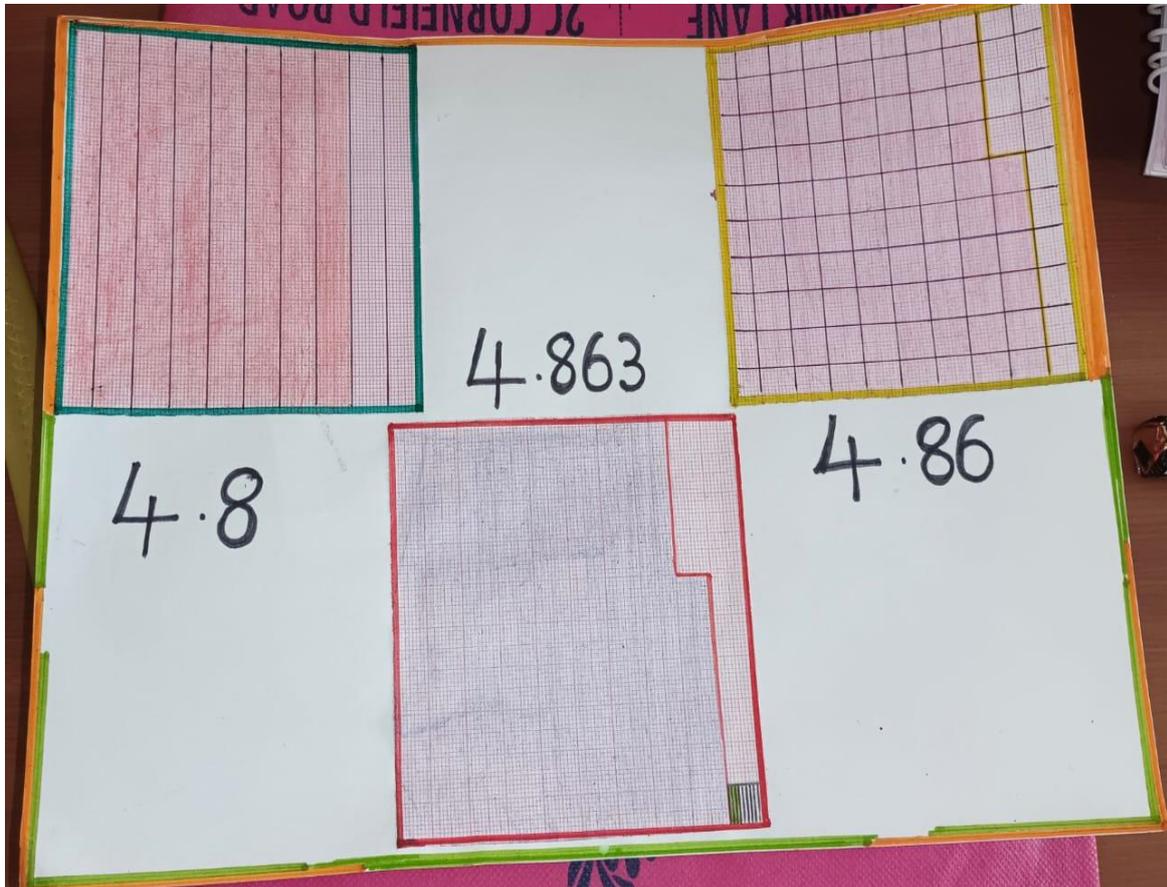
Capsicum

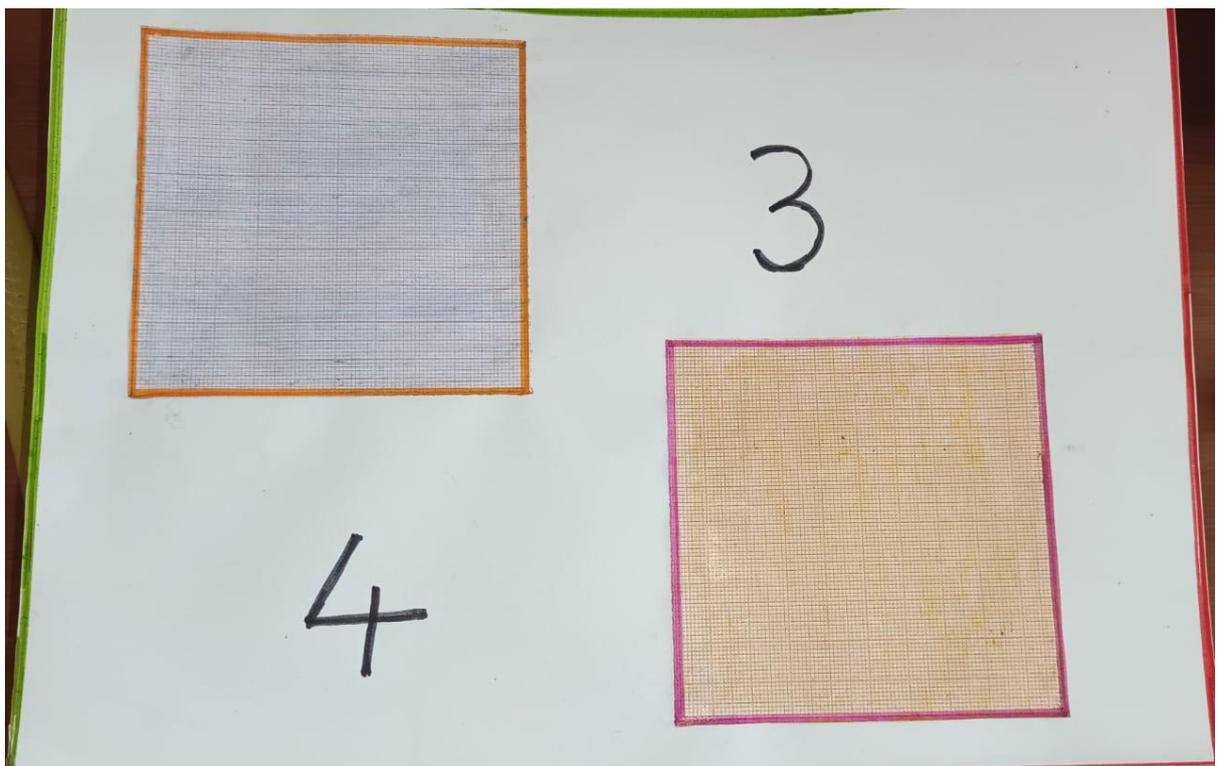
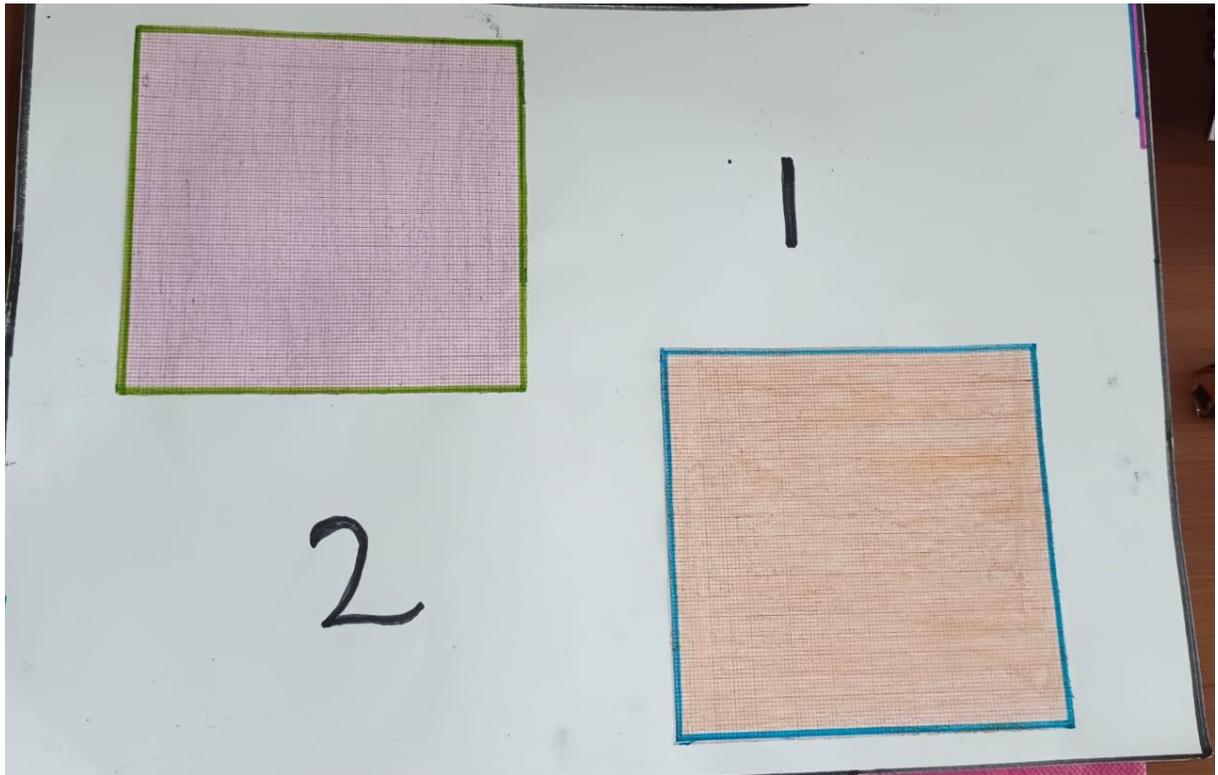


Bitter Guard

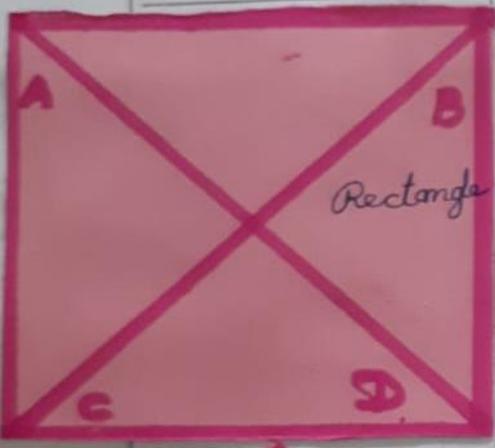
- * 3.6g protein
- * 927. Vitamin C
- * 602mg potassium
- * 13mg sodium
- * 47. Calcium

REAL NUMBERS





GEOMETRY

<u>Properties of Quadrilaterals</u>			
Shape	Length of Sides	Angles	Properties Name Based on sides & Based on angles
 <p style="text-align: center;">Rectangle</p>	$AB = 6.5 \text{ cm}$ $BC = 6 \text{ cm}$ $CD = 6 \text{ cm}$ $DA = 6.5 \text{ cm}$ $AC = 6.2 \text{ cm}$ $DB = 6.2 \text{ cm}$	$\angle A = 90^\circ$ $\angle B = 90^\circ$ $\angle C = 90^\circ$ $\angle D = 90^\circ$	<u>Sides</u> .. Opposite sides are parallel. <u>Angles</u> .. Opposite angles are equal and sum of any two adjacent angles is 180°
 <p style="text-align: center;">Rhombus</p>	$AB = 3.5 \text{ cm}$ $BC = 3.5 \text{ cm}$ $CD = 3.5 \text{ cm}$ $DA = 3.5 \text{ cm}$	$\angle A = 80^\circ$ $\angle B = 50^\circ$ $\angle C = 80^\circ$ $\angle D = 50^\circ$	<u>Sides</u> .. All sides are equal and opposite sides are parallel. <u>Angles</u> .. Opposite angles are equal and sum of any adjacent angle is 180°

TRIGONOMETRY

Trigonometric ratio	0°	30°	45°	60°	90°
Sin θ	0	$\frac{1}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{\sqrt{3}}{2}$	1
Cos θ	1	$\frac{\sqrt{3}}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{1}{2}$	0
Tan θ	0	$\frac{1}{\sqrt{3}}$	1	$\sqrt{3}$	not defined
Cosec θ	not defined	2	$\sqrt{2}$	$\frac{2}{\sqrt{3}}$	1
Sec θ	1	$\frac{2}{\sqrt{3}}$	$\sqrt{2}$	2	not defined
Cot θ	not defined	$\sqrt{3}$	1	$\frac{1}{\sqrt{3}}$	0

Sines	Cosines
Sin 0° $\frac{\sqrt{0}}{2} = 0$	Cos 0° $\frac{\sqrt{4}}{2} = \frac{2}{2} = 1$
Sin 30° $\frac{\sqrt{1}}{2} = \frac{1}{2}$	Cos 30° $\frac{\sqrt{3}}{2}$
Sin 45° $\frac{\sqrt{2}}{2} = \frac{\sqrt{2}}{\sqrt{2} \times \sqrt{2}} = \frac{1}{\sqrt{2}}$	Cos 45° $\frac{1}{\sqrt{2}}$
Sin 60° $\frac{\sqrt{3}}{2}$	Cos 60° $\frac{1}{2}$
Sin 90° $\frac{\sqrt{4}}{2} = \frac{2}{2} = 1$	Cos 90° $\frac{\sqrt{0}}{2} = 0$

$$\sin \theta = \frac{\sqrt{\text{Number of fingers below the bent finger}}}{2}$$

$$\cos \theta = \frac{\sqrt{\text{Number of fingers above the bent finger}}}{2}$$



Sin 0° $\frac{\sqrt{0}}{2}$	Cos 0° $\frac{\sqrt{4}}{2} = \frac{2}{2} = 1$
Sin 30° $\frac{\sqrt{1}}{2} = \frac{1}{2}$	Cos 30° $\frac{\sqrt{3}}{2}$
Sin 45° $\frac{\sqrt{2}}{2} = \frac{\sqrt{2}}{\sqrt{2} \times \sqrt{2}} = \frac{1}{\sqrt{2}}$	Cos 45° $\frac{\sqrt{2}}{2} = \frac{\sqrt{2}}{\sqrt{2} \times \sqrt{2}} = \frac{1}{\sqrt{2}}$
Sin 60° $\frac{\sqrt{3}}{2}$	Cos 60° $\frac{1}{2}$
Sin 90° $\frac{\sqrt{4}}{2} = \frac{2}{2} = 1$	Cos 90° $\frac{\sqrt{0}}{2} = 0$

APPENDIX-4
PHOTO GALLERY



GROUP WORK



DEMO CLASS BY STUDENT



**VISIT BY RESEARCHER
&
CO-RESEARCHER**





POST TEST





STUDENTS ENGAGED WITH ACTIVITY



**GROUP WORK
VISITED BY RESEARCHER**

APPENDIX-5

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