CHAPTER - I

INTRODUCTION

1.0 OVERVIEW

The present study is a Normative Survey Research aimed to measure the achievement of the students of standard VIII in mathematics among Middle, High and Higher Secondary School in Dindigul District. The Stratified Random Sampling Technique was followed in the study. On the whole, 1241 Government Schools and 320 Aided Schools, 27 unaided schools are functioning in Dindigul District. There are totally 1588 schools, of which 1501 are in rural areas and only 87 schools are in urban areas. Government Schools consist of Panchayat union, Municipal, Adi-Dravidar and Kallar schools. Aided schools consist of minority and non-minority schools. Unaided schools function as self-financing Institutions without any monetary support from the Government. There are 30,351 students studying in these schools in standard VIII. By using the Stratified Random Sampling Technique, 3072 students and 167 teachers handling Mathematics for Standard VIII in 59 schools were selected as the sample for the study.

Two types of tools were used in the study. One is Achievement Test in Mathematics (ATM) developed by the Investigator. The other standardized tool on Teacher’s Morale developed by Anjani Metha (1977). After collecting the filled in questionnaires from the students and the teachers, the Investigator scored all the questionnaires. Master table was prepared by plotting the
Achievement Scores in Mathematics of the standard VIII students, Teacher’s Morale Scores of the teachers. Different statistical techniques were used in the study for finding out solutions to the problem. Mean and Standard Deviation were calculated to find out the significant difference between the two variables. The Investigator rejected or accepted the hypotheses based on the ‘t’ values. The study reveals that the Mean Achievement Scores in Mathematics is moderate in total among Middle Schools, it is comparatively higher in schools with the highest mean scores of Teacher Morale. It is surprising that Teachers Morale does not have any positive impact on students achievement in Middle and High Schools.

1.1 MATHEMATICS EDUCATION

India has a long History of teaching and learning Mathematics dating back to the Vedic Age (1500 to 200 BC). During the period AD 200 to 400, several works on Astronomy and Mathematics were composed, mainly based on indigenous knowledge. Most notable of this period was the contribution of Jaina Mathematicians. The Jaina texts prescribed arithmetic as one of the most essential requirements for children's first education. During the period of AD 400 to 1200, a new branch known as Ganita came into existence with three separate components namely, Arithmetic, Algebra and Geometry. But Mathematics received prominence as a separate subject only in the 12th century, as referred to in the Leelavathi of Bhaskaracharya. The situation with regard to Mathematics education remained unchanged after AD 1200 though there had
been epoch-making discoveries. In spite of political instability during the period up to the 18th century, the native system of education maintained its traditional structure up to the advent of British.

In Post-Independent India, great emphasis has been placed on Mathematics teaching and learning of Mathematics. The Education Commission (1964-66) recommended Mathematics as a compulsory subject for students at school level. The commission seemed to have been influenced by the international opinion at that particular time and favoured 'new Mathematics', which later pervaded secondary education. That was the era of Sets, and the Algebra of sets.

The Science of 'Mathematics Education' is still in its infancy in any curriculum, content and presentation of content are the two most important and inseparable components. The application of learning theories in content presentation is of very recent origin. Research evidence is inadequate to say anything definite as to which method is going to be the most effective for presentation of a particular type of content. However, methodology also involves the arrangement of the content in a hierarchical manner. The entire process is composed of complex psychological principles. The Education Commission points out that, 'In the teaching of Mathematics emphasis should be more on the understanding of basic principles than on the mechanical teaching of Mathematical computations'. Commenting on the then prevailing situation in schools, it observed, in the average school today instruction still conforms to a
mechanical routine, continues to be dominated by the old besetting evil of verbalism and therefore remains as dull and uninspiring as before’.

Mathematics has been recognized as one of the central strands of human intellectual activity. It has been a living and growing intellectual pursuit. It has its roots in everyday activities and forms the basic structure of our highly advanced technological developments. It comprises intricate and delicate structures which have a strong aesthetic appeal. It also offers opportunities for opening the mind to new intractable problem that offers the most intense of all intellectual pleasures. At the same time, it is reputed to be, and rightly so, the most hypothetical pleasures. It exhibits connections between things which can be visualized only through the human reason. “Mathematics is thought moving in the sphere of complete abstraction from any particular instance of what it is taking about.” - Whitehead, A.N.(1998)

1.2 GROWTH OF MATHEMATICS

Mathematics, like every thing else that man has created, exists to fulfil certain human needs and desires. More than 2,000 years before the beginning of the Christian era, both the Babylonian and the Egyptians were in possession of systematic methods of measuring space and time. They had the knowledge of rudimentary geometry and rudimentary astronomy. This rudimentary Mathematics was formulated to meet the practical needs of an agricultural population. Their geometry resulted from the measurements made necessary by problems of land surveying. Units of measurement, originally a stone or a vessel
of water for weight, eventually became uniform over considerable areas under names which are now almost forgotten. Undoubtedly, similar efforts occurred in early time in the southern part of Central Asia along the Indus and the Ganges rivers in Eastern Asia. Projects related to Engineering, Financing, Irrigation, Flood Control and Navigation required Mathematics. Again a suitable calendar had to be developed to serve agricultural needs. Zero was defined and this eventually led to positional notations for whole numbers and later to the same notation for fractions. The place of value system which eventually developed was a gift of this period. These achievements and many more of a similar nature are the triumph of the human spirit. They responded to the needs of human society, as it became more complex. Primitive men can hardly be said to have invented or discovered their arithmetic: they actually lived in it. The men who shaped the stones in erecting the Temples of Mathematics were widely scattered, a few in Egypt, a few in India and yet others in Babylon and China. These workmen confronted nature and worked in harmony with it. Their products, therefore, though scattered in time and space, partook the unity of nature.

Mathematics is something that the man has himself created to meet the cultural demands of time. Nearly every primitive tribe invented words to represent numbers. But it was only when ancient civilizations such as the Sumerian, et. al., developed trade, architecture, taxation and other civilized contracts that the number systems were developed. Thus Mathematics has grown into one of the most important cultural components of our society.
1.2.1 Pure and Applied Mathematics

The study of the history of Mathematics does not answer the question “What is Mathematics?” However it provides a valuable perspective to understand the nature of Mathematics. Mathematics has a cumulative growth from prehistoric times. This growth has been of two kinds: Extrinsic in the form of primary discoveries and Intrinsic development of the subject.

The primary discoveries have been those of essential basic ideas, most of them gained by trial and error. Primarily, they responded to human needs consistent with the body of knowledge already in existence before the emergence of the new ideas. They are true accretions. Secondly, in addition to the accretions motivated by human needs, the cumulative development of mathematics has been due to its inner growth.

As Nunn has said, “Mathematics truths always have two sides or aspects. With the one, they face and have contact with the world of outer realities lying in time and space, with the other they face and have contact with each other. Thus, the fact that equiangular triangles have proportional sides enables us to determine by drawing or by calculating the height of an unsalable mountain peak twenty miles away. This is the first or the outer aspect of that mathematical truth. On the other hand, we can deduce the truth itself with complete certainty form the assumed properties of congruent triangles. This is its second or inner aspect.”
1.2.2 Role of intuition and logic in mathematical thinking

Mathematics is creative and intuition is the first step towards creativity. The analytical approach is needed to validate the new discoveries of intuition in a rigorous manner.

According to the dictionary, intuition consists of the immediate apprehension, without the intervention of any reasoning process or knowledge or mental perception. Intuition is a mental act, a guess which gives a formulation or conclusion without going through a step by step analysis. An intuitive thinker arrives at an answer with very little awareness of how he has reached it. In learning Mathematics, the ability to visually dissect a pattern or a structure and guess a tentative generalization should be encouraged. When pupils are presented with the finished product which has been already formalized then their intuition suffers and they lose the opportunity to use an important tool in problem solving. No doubt, the intuition of pupils may not always be correct, the teacher should have an open mind to the mistakes pupil make. This is because intuition is the essence of any non-rigorous method of solving problems.

In Geometry, intuition helps to discover the proof of a result and the nature of Mathematical proof is the next important question to be considered. All proportions which mathematicians enunciate can be deduced one from the other by the rules of formal logic. This is one of the many methods of proving results in Geometry.
1.2.3 Language of mathematics

In teaching Mathematics, the teacher uses ordinary language to communicate mathematical concepts and to clarify thoughts. Language is a means of gradually internalizing experience to the point where actions can proceed in imagination without recourse to their physical repetition. For learning mathematical concepts children are initially engaged in activities with concrete materials, then encouraged to make audible descriptions and instruction- the concrete aids being withdrawn gradually until, finally, the concepts are internalized in verbal form. Thus language becomes a means of storing experience and facilitating problem-solving.

Effective learning of mathematical concepts does not result from mastery over activities alone. It depends on how far teachers are successful in developing language or other symbolic representations, building links with past experiences to formulate corresponding abstractions or laws. The transition from concrete to abstraction depends upon explanations written in mathematical terms. Today a physicist cannot pursue his or her studies without extensive use of mathematical language. Even subjects like Biology, Psychology, etc., which, to be descriptive, are increasingly using mathematical notations. Persons studying the form and structure of language have also applied Mathematics to explore it.

Roger Bacon (1999) said, “Mathematics is the gateway of the sciences. Neglect of Mathematics works injury of all knowledge, since he who ignored it
cannot view the other sciences or the things of the world. And what is worse, men who are thus ignorant are unable to perceive their own ignorance and so do not seek a remedy”. Mathematics, thus, may be seen as a tool or a means of communication.

Interesting studies of language difficulties experienced by children in Mathematics have been made. Some features of Mathematical language need special mention:

i. Mathematical language distinguishes between things and names of things. Number and numeric and fraction and fractional numbers are a few examples.

ii. Some common spoken words are used as technical terms and sometimes even in different contexts. For example, “variable” is used both as a noun and as an adjective; “root” is used as a root of an equation and as in square root, cube root, etc.,

iii. There are a variety of ways of calling a thing. For example, addition can be referred to as “find the sum”, “find the total”, “find the value”, “find the whole”, “how many in all?” etc.

iv. Mathematical solutions emphasize a specific arrangement of steps in the solution, i.e., an algorithm to develop accuracy of thought and precision in quantitative matters.

v. Like all other languages, the language of Mathematics has its own grammar. It has its own known, verbs, adjectives, etc.,
The main characteristics of mathematical language are simplicity, accuracy and precision in contrast to ordinary language which can be ambiguous, vague and emotive. Special care is needed in formulating definitions.

1.3 NEED AND IMPORTANCE OF MATHEMATICS IN SCHOOL CURRICULUM

Mathematics is an important component of school education. Its influence has been so fundamental and widespread that being numerate is becoming more important than being literate. The following values justify its position.

1.3.1 Social Aspects

- The routine activities of daily life demand a mastery of number facts and number processes. To read with understanding much of the materials in newspapers require considerable mathematical vocabulary. A few such terms are per cent, discount, commission, dividend, invoice, profit and loss, wholesale and retail, taxation, etc., As civilization is becoming more complex, many terms from the electronic media and computers are being added.

- Certain decisions require sufficient skill and understanding of quantitative relations. The ability to sense problems, to formulate them specifically and to solve them accurately requires systematic thinking.

- To understand many institutions and their management problem, a quantitative view point is necessary. It is illuminating to hear from an
economist, an architect, an engineer, an aviator, or a scientist what in Mathematics is helpful to them as workers.

- Many vocations need mathematical skills.
- Mathematics has helped in bringing together the countries of the world which are separated from each other physically.
- Mathematics has helped man in discovering the mysteries of nature and to overcome superstitions and ignorance.

1.3.2 Mathematical aspects

Mathematics teachers help us to analyze a situation, how to come to a decision, to check thinking and its results, to perceive relationships, to concentrate, to be accurate and to be systematic in our work habits.

Mathematics develops the ability to perform necessary computations with accuracy and reasonable speed. It also develops an understanding of the processes of measurement and of the skill needed in the use of instruments of precision.

Mathematics develops the ability to

a. make dependable estimates and approximations,

b. devise and use formulae, rules of procedure and methods of making comparisons,

c. represent designs and spatial relations by drawings and
d. Arrange numerical data systematically and to interpret information in graphic or tabular form.

1.3.3 Applications of Mathematics

The History of Mathematics is the story of the progress of the progress of civilizations and culture. “Mathematics is the mirror of the civilizations”. A country’s civilization and culture is reflected in the knowledge of Mathematics it possesses. Mathematics helps in the preservation, promotion and transmission of cultures. Various cultural arts like poetry, painting, drawing and sculpture utilize mathematical knowledge. Mathematics has aesthetic or pleasure value. Concepts like symmetry, order, similarity, form and size form the basis of all work of art and beauty. All poetry and music utilizes mathematics. Quizzes, Puzzles and Magic Squares are both entertaining and challenging to think ponder over. Hence the teaching of Mathematics is inevitable in our schools.

1.4 FACTORS AFFECTING CHANGE IN CURRICULUM

Educators are aware that changes have taken place in school Mathematics in the past two to three decades. These changes have brought about a near revolution in the content, method and instruction of Mathematics.

i. Reasons for the Change

The rapid advance of knowledge in Mathematics makes increasingly greater demand on an enlightened citizenship. There is a need for more effective articulation from one grade to the other i.e., from elementary to secondary
school. The recognition that the traditional mathematics programme, limited mainly to emphasis on computational skills and divided into traditional compartments viz. arithmetic, algebra and geometry is somewhat lacking in a few fascination and interesting aspects of Mathematics. The need for a better understanding of the structure of Mathematics and the mathematical process, its language and methods of proof are essential. The need for the utilization of more effective media for adapting Mathematics learning to the needs of different abilities is essential.

**ii. New Emphasis in Curriculum:**

The concern for the child as an individual and as a learner enabled the educators to question the grade placement of certain topics in elementary school mathematics. Topics in arithmetic believed to have little use in daily life were omitted. The term “arithmetic” was shifted to “elementary school mathematics’’ to indicate a change in emphasis to a more generalized language, formulation of laws and integrating algebraic processes in computational work. The drill method of teaching was replaced with methods emphasizing “meaning” and explaining the “whys” of the processes as related to computational procedures. Psychologists emphasized the relatedness of learning and explored the process of leading pertinent to the development of fundamental mathematical ideas. They found that there are levels, that is
a. Level of the concrete or the world of things;
b. The level of the semi concrete where the experiences are internalized and fit together:
c. The symbolic level where abstractions and generalizations are formulated;
d. The level of applications where the generalizations are tested and applied to situations.

This led them to conclude that certain topics should be introduced much earlier than was formerly believed.

Bruner’s hypothesis that any subject can be taught effectively in some intellectually honest form to any child at any stage of development led to an explosion of new methods based on discovery and problem-solving.

The study of geometry was expanded far beyond Euclid’s elements. The basis of transformations, vectors and coordinate geometry were included. In algebra, emphasis has now been given to equations by broadening the base to include ideas such as mathematical sentences, replacement set and solution set. Generalizations of the properties of the real number system and the introduction of the algebra of sets, groups etc., provided an expansion of mathematical ideas in both depth and breadth. Basic concepts in Mathematics such as functions, variables, relations etc., gained greater importance now days.
The use of computers has further enriched the content and practices in mathematics education in schools.

1.5 METHODS OF TEACHING MATHEMATICS

The teaching and learning of Mathematics have always been a major concern in education. Various Commissions and Committees have laid great emphasis on raising the quality of instruction in Mathematics. The National Policy of Education (1986) lays down the importance of Mathematics as a vehicle for developing creativity. Recent researches in the area of learning have led to a deeper understanding of “how pupils learn”. As a result, a broad range of new approaches to the teaching of Mathematics have been suggested to achieve optimal learning. The highly structured nature of Mathematics, its language and methods of proof have also attracted the attention of the psychologists and educationists. Consequently, the old methods of Mathematics teaching which relied heavily upon rote learning and drill have been replaced by the methods which rely upon discovery and problem solving approaches.

A few of the current trends in the methods and media used in Mathematics instruction are mentioned here. These include the basic features of more recent ideas which are the gift of educationists and psychologists. It is expected that teachers would try to fit them into their practical scheme of teaching.

It is difficult to weave pattern with ideas which are abstract. The elements of Mathematics and the role of intuition, logic, generalization and structure are
all difficult areas to delimit or explore. What then are proof structures or formats for organizing teaching-learning situations which a teacher can use? A few important lesson patterns are mentioned below.

1.5.1 Inductive Deductive Method of Teaching

Mathematics in the making is experimental and inductive. Induction is that form of reasoning in which a general law is derived from a study of particular objects or specific processes. The child can use measurement, manipulator or constructive activities, a pattern etc., to discover a relationship which he shall later formulate in symbolic form as a law or rule. The law, the rule or definition formulated by the child is the summation of all the particular or individual instances. In all induction the generalization that is evolved is regarded as a tentative conclusion.

In deduction the law is accepted and then applied to a number of specific examples. The child does not discover laws but develops skills in applying them. We proceed from the general to the particular or from the abstract to the concrete. In actual practice the combination of induction and deduction is practiced. The laws discovered by pupils inductively are further verified deductively through applications to new situations.

1.5.2 Analytic and Synthetic Method of Teaching

Most Mathematics originates in ideas and concepts associated with physical form and shape. It is then presented as a systematic abstract structure in
logic-deductive form. The ability to understand and work out a rigorous deductive structure using logic or reasoning is of great importance.

Analysis and Synthesis are the methods which use reasoning and arguments to discover relationships. Synthetic Euclidean geometry is a good model of a deductive structure and is favourable to the learning of reasoning and the development of precision of thought. In any proposition we have a hypothesis, which may be the information given in the proposition or a set of axioms, definitions, principles or relationships which have been proved earlier and a conclusion that is, the result to be proved or arrived at.

In analysis it is started from the conclusion and break it up into simpler arguments establishing connections with the relationships assumed in the hypothesis. If so doing, we find the missing logical connections and formulate a pattern for the proof. This pattern when retraced from hypothesis to conclusion, gives the synthetic proof.

1.5.3 Heuristic or Discovery Method of Teaching

The modern philosophy of Mathematics instruction lays emphasis upon meaning, understanding and application. This is in contrast to the “traditional” or “drill” theory. Children should see the meaning and feel the importance of what they are learning. Under the “drill” theory they are told the facts which they memorize through repeated practice. In “meaningful” learning, the child is a participant in finding the answer. He reasons it out. He discovers the
interrelationships by doing, experimenting and actively participating in
situations. The drill or practice is given only when an understanding has been
achieved. Various phrases such as “learning by doing”, “activity approach” or
“child-centered approach” etc. have been used to put greater emphasis on “child
as a learner” as against the content matter supposed to be sent.

The word “discovery” is not new. It has been in use under the title “the
heuristic method”. The word heuristic is derived from the Greek word “heurisko
which means “I find”. Schultz, in his book “The Teaching of Mathematics in
Secondary schools”, has listed the advantages and disadvantages of the
discovery method. Students think for themselves, acquire a real understanding of
the subject, take more interest and are willing to learn and a perception if
relationships are made possible. The method does not work well with all
teachers, it does not follow a text book, it is slow and requires better class
management techniques, etc., and these are some of the disadvantages. Recently
Jerome Bruner in his book “Process of Education” has defined discovery as “a
matter of rearranging or transforming evidence in such a way that one is enabled
to go beyond the evidence as assembled to new insights”.

According to Piaget (1997), new experiences are met by the child by
either assimilation or accommodation. If he has a available scheme with the new
experience ties in, he can assimilate it. If, on the other hand, the element of
novelty is too great for assimilation to take place, he will have to accommodate
the new situation by modifying existing and relevant schemata. It is through
such alteration of existing structures that new ones emerge and the child’s conceptual equipment grows.

Thus all discovery methods are invariably closely linked to practical work or problem situations which bring the child face to face with the inadequacy of existing schemata. Secondly, the teachers using the discovery method should guide and offer help to the child to develop a positive attitude and interpret controlled situations for the verification of their hypotheses to deduce new relations. The teacher’s role is one of support and encouragement. Some of the common method labeled as “project method”, “problem method”, “activity method”, “induction method” fall under the discovery approach.

1.6 TECHNIQUES IN TEACHING MATHEMATICS

Whatever method a Mathematics teacher may adopt for teaching the daily Mathematics lesson he tends to follow a fairly standard pattern. Each lesson builds upon the lesson previously taught. Hence, reinforcement by adequate practice or drill of previously learnt skills becomes an important task. Similarly, for gaining mastery of the new skills learnt, proper assignments/home work needs to be planned. As a rule, oral recitation and written work both form vital components of any lesson. Some of the techniques in teaching Mathematics are discussed here.
1.6.1 Drill and Practice

Drill is one of the most essential ways or methods of learning in Mathematics. The controlling purpose of all teaching activity is to reduce necessary learning habit. Gaining mastery requires acquisition of habits; hence drill plays an important role in acquiring mastery. By and large, practice lesson are of three types. The first category of lessons for mastery is of basic subject matter. These include subject matter which must be thoroughly mastered so that speed and accuracy is ensured on which future learning can be done.

The second category includes lessons for the mastery of procedures. In Mathematics one has to adhere to a systematic arrangement of steps, follow correct algorithms to scrutinize and check the correctness of each step, label appropriately parts in a diagram, sort out data, translate problems into symbolic form, practice short cuts etc.,

The third category consists of lessons which strive to develop the power of thinking and reasoning and to increase the concentration and interest of the learner. Such lessons include quizzes, puzzles and historical material which do not form part of a regular lesson.

Although a certain amount of formal drill is inevitable, preference should be given to functional or meaningful drill. Meaningful drill implies prior understanding of contents and its appropriate application. This drill is purposeful and is determined by need as well as by use.
1.6.2 Oral and Written Work

Typical mathematical situations which people encounter outside the school demand oral computation or involve a visual impression not completely described in words. A good deal of socio-economic information requires a quick response to a quantitative data. It is therefore desirable to develop a high rate of performance consistent with accuracy. Oral work helps each child work at the optimum rate which ensures maximum accuracy for him. In any lesson, both oral and written work should mingle freely. Oral work provides a rapid drill designed to habituate a fundamental process, a process, and a mode of thinking or a set of facts. It helps in completing more work in any given period. Generally material for oral work should not be read from a text book. Spontaneity in grasping the data and organization of thought in a limited time are important aspects to test the pupil’s responses.

However, when a teacher finds it necessary to inspect the work done by each child or to give children practice in independent work, written work becomes necessity. Throughout written work accuracy in computation, legibility of figures and symbols, speed consistent with accuracy, proper algorithm i.e. Logical and sequential arrangement of steps in the solution, neatness of work and correctness of results should be kept in mind. Written work can also be kept as a collective record which may help in assessing the pupil’s progress over a period.
1.6.3 Playway Technique

The most recent technique in the teaching of Mathematics is the playway technique or teaching through games. A game is a planned activity which the students undertake with the guidance of the teacher. Although only some concepts can be taught through games, the most important use of games like the quiz, the puzzle, the guessing game etc is the drill or oral practice of various mathematical concepts.

1.6.4 Assignment and Homework

Every Mathematics teacher assigns homework. The usual argument in favour of homework is that it provides additional practice and develops the habit of self-study and self-reliance. It is assumed that classroom time is only for teaching and not for practice. However, homework presents a number of problems - the study is unsupervised, it encourages the use of cheap notes and guides etc. Often the unsupervised homework develops undesirable study habits. Homework, which is an extension of supplementary to class work and which does not take away much of the free time of the child, is considered legitimate. Any homework assigned to pupils should be corrected and kept as a cumulative record in note books rather than on loose sheets of paper.

In recent years, the concept of homework is being replaced by differentiated assignments which are adjusted to the individual progress of each child and which encourage each one to do his own learning. Planning the
assignment represents one of the most important phase of teaching. It is that part of instructional activity which is devoted to

i. Organizing a task to be done and

ii. Fitting to the task an appropriate procedure for accomplishment. It assumes that the most effective learning is the product of self-imposed pupil activities.

A few principles governing a good assignment are listed here:

➢ The assignment should be clear and definite. It should be brief but fairly explanatory to enable each child to understand the task assigned.

➢ It should anticipate difficulties in the work to be done, and suggest ways to overcome them.

➢ It should connect the new lesson to past experiences and correlate the topic with all related subject matter.

➢ It should be interesting, motivating and thought provoking.

➢ The activities suggested for the assignment should be varied and adapted to the needs and interest of the students.

1.6.5 Unit Planning and Lesson Planning

An important aspect of teaching relates to planning and conducting daily lessons. While most teachers base their daily teaching on the subject matter presented in the prescribed in the text book there are many who extend the
subject matter to include vital experiences which have their source in the need or interest of the learner. The subject matter is organized into units to provide for as many types of functional activities as possible.

A unit is a long-range plan to direct the instructional plan. A unit takes care of the logical unity of the subject matter and the psychological considerations of the learner-his need, interests and ability to learn. There are many advantages in the unit organization of content:

i. The teacher directs the instruction programme and pupils carry it out with the cooperation of teachers and other pupils.

ii. Units cut across subject matter lines, thereby providing for a better correlation between different branches in Mathematics and with other subject areas. Thus, learning is more integrated rather than fragmented.

iii. A variety of activities provided for meeting individual differences in learning. Learning is not forced upon the child.

iv. Drill becomes functional and problem-solving skills more effective if developed in meaningful situations. Critical thinking is, thus stimulated.

A unit generally consists of three parts:

**a. The Purposes or Objectives:** Purposes are stated in terms of the understanding or the ability of the learners. The desired attitudes and appreciations which the teacher wants to see developed are also listed as outcomes.
b. Learning Experiences: The learning experiences or activities are such that they contribute to the growth of the child and help to move towards the stated purposes. Since learning is individual, it is desirable to suggest a wide variety of activities suitable for both group and individual work. These may be:

- **Preparatory** activities which orient and motivate pupils for purposeful activity or test preliminary abilities of pupils.
- **Developmental** activities which enable pupils to gain desired skills, abilities, attitudes and understandings. These activities involve discussion, problem solving experiences, construction and other forms of creative experiences and field trips.
- **Culminating** activities which will be a sort of non-conventional assignment, organizing exhibitions, preparing reports, individual record note books, short plays or a review test.

c. Evaluation: Evaluation includes plans to determine whether growth has taken place, how far it has gone and in what direction.

Lesson planning relates to the organization of a forty minutes period for teaching. Since Mathematics is a sequential subject, each day’s lesson is a foundation for understanding a subsequent lesson. A well-planned lesson gives a teacher a sense of security, keeps him on the right track, checks waste of time and ensures a smooth transition from one part of the subject matter to the next. It is advisable that the teacher draws up a schedule of lessons he plans to teach in
advance, preferably in the beginning of each week. The lesson plan should contain the following six parts:

1. Aims and objectives,
2. Background material or previous knowledge,
3. Introductory or motivational activities,
4. Developmental activities,
5. Summary and
6. Application.

1.6.6 Materials and Teaching Aids

For many teachers, the only means of communication with their pupils is through textbooks and blackboard work. The textbook has been the major source for providing explanatory material, directions for processes and procedures, a set of solved examples, diagrammatic representations of quantitative relationships, practice exercises and model test papers. A good textbook saves the time and labour of the teachers. It also makes unnecessary writing of exercises and problems dictated by the teacher. The usefulness of a textbook is increased if it includes suitable illustrations and diagrams. Too often difficulty arises because of the limitations of language or of readability in a textbook. A good textbook also provides exercises that call for oral rather than written responses. The mechanical requisites of paper, print size, format, and binding must measure up to approve standards in a good textbook. These days’ textbooks are
supplemented by work books and practice books which provide well distributed practice exercises arranged according to their difficulty level.

The most common aid of the teacher is the chalkboard. Almost all classrooms in the school contains one or more chalkboards. Class furniture is arranged so that the students usually sit facing the board. Pupils’ work can also be placed on the board and their errors can be easily corrected. Materials can be prepared at home on large sheets of paper which can be taped to the board. Colour is easily applied to the chalk board to emphasis key ideas. These days a wide variety of learning aids are included in teaching to clarify concepts, their applications and uses.

1.6.7 Laboratory Approach to Teaching of Mathematics

We are familiar with a laboratory as used in teaching science subjects. Recently, this idea has been extended to the teaching of Mathematics. One reason why learning Mathematics is considered difficult is the verbalistic quality of teaching. Verbalism is the use of words without emphasis on meaning and practice. It is not uncommon to find pupils who have learn various concepts, formulae and theorems without a proper understanding of their meaning and use. In a laboratory pupils learn by doing. They participate in experiments, manipulate materials and models, use different instruments and are thus able to give meaning to verbalism. Much of the Mathematics comes to life for the child in a laboratory situation. The laboratory provides an atmosphere in which problems are worked out in simulated life situations. Wall charts, models,
mathematical instruments, films, slides and video tapes and a lot of manipulative material should be provided in the laboratory. Various materials can be assembled from cheap and easily available things by the teachers and pupils.

In a laboratory situation,

1. Learning is child-centered, not teacher-dominated. The pupil carries out the activity. The teacher acts as a guide or helper.
2. The work is related to life situations and has significance for the teacher.
3. Among pupils more interest is created since they work in concreted situation rather than in the abstract.
4. Many community resources are utilized as the subject matter is organized into functional activities.

1.7 DESIRABLE CHARACTERISTICS OF A GOOD INSTRUCTIONAL PROGRAMME IN MATHEMATICS

The mathematical competencies of many of the present day students are certainly not as high as it could be expressed under optimum conditions. Problems caused by large classes, inadequate teacher preparedness, non-availability of good textbooks and other material aids, too much dependence on external examinations and unsatisfactory and outdated courses content still confront us. The spirit of innovation is lacking in our system. The traditional and conservative point of view has resisted any effort for change. There are a variety of new ideas and practices available for consideration. Any teacher of
Mathematics must make his own choice while organizing instruction. A few such ideas are outlined below:

a) Rote learning has been replaced by functional learning. It is also assumed that knowledge of basic or key ideas and their relationship helps children understand and appreciate Mathematics better than knowing isolated facts. An integral approach to teaching is preferred to teaching different branches as isolated from each other.

b) Pupils within a group differ widely in interests, experiences, abilities and rates of learning. To plan for effective and meaningful instruction, the teacher must discover the range of what is to be understood; and the skills of different pupils in his class. Creative work, community projects, construction activities and experiments that utilize the skills and mathematical abilities, challenged the thinking of the pupils and give them opportunities to discover at their own pace should be introduced.

c) Recently many topics, found to be outdated have been deleted. Many new topics are now being introduced. A few notable ones are sets, probability and statistics, inequalities and computer science. These have been included because, in the recent past, Mathematics has been widely in the social sciences, in the biological sciences, in business, and in industry. The gradation or placement of many topics and the treatment has been changed. The deductive approach has been extended to branches other than geometry.
In a few cases, such as Euclidean geometry, the subject matter has been condensed. There is an attempt to teach more Mathematics in less time.

1.8 FORMULATION OF OBJECTIVES

Aims and objectives are our guideposts. These are best expressed as desirable changes in what the learner actually does. Desirable changes in what the learner does not develop automatically is a by-product of the teaching of the subject matter. Each type of behaviour, including skills in the use of Mathematics, requires direct provision for its practice in active learning situations. The underlying premises in formulating the objectives of teaching Mathematics are:

i. The goals and objectives of teaching Mathematics must have a bearing on the objectives of general education as proposed in the National Policy of Education. These should also reflect the needs of society and strengthen the salient features of our culture.

ii. Mathematics education has been passing through a period of unprecedented change in content and methodology. The emerging trends and expanding frontiers of knowledge should form the basis for the formulation of objectives.

iii. The objectives should indicate both the desired behaviour and the type of situation in which it is to occur. It should be expressed in terms of desired pupil behaviour rather than of teacher behaviour. It should be also
specifically stated so that it is possible to infer some appropriate learning activity.

Generally speaking, the objectives are grouped under seven broad categories and they are,

- Knowledge
- Understanding
- Application
- Skill
- Appreciation and interests
- Attitudes
- Personality and character

In specifying the objectives in terms of the behavioural changes of the pupil, the following criteria may be kept in view:

a. The behavioral change should flow from the objective.

b. It should clarify what is implied by the objective.

c. It should indicate what exactly the pupils should do to attain the objective and what they are expected to do after the objective is attained by him.

d. It should be appropriate to the level of pupil’s development. For the purpose of guidance two appendices are provided;
National Goals and their implication for Mathematical Education.

A list of Objectives obtained from Different Syllabus and Other sources.

1.9 SELECTION OF CONTENT OR LEARNING MATERIAL

The objective of teaching Mathematics has two aspects such as content and behaviour. Therefore, some decisions about the subject matter are taken while formulating objectives. These form broad areas from which specific topics are selected after giving careful thought to the nature of the learner as well as the learning and the social needs. These broad areas are then arranged according to the “Spiral Plan”. The easier or simpler concepts are followed by more difficult concepts. Since Mathematics is treated as one indivisible whole in which the many skills and techniques composing it are tied together by a few basic ideas, it has been thought proper to organize the learning material under these ideas and then spread over all the school years.

A few ideas identified for “Mathematics for all”, i.e., general Mathematics are

i) Numbers and Operation

ii) Geometry

iii) Sets

iv) Function and Graphs

v) Measurement

vi) The Mathematical Sentence and

vii) Applications of Mathematics.
The content selected should reflect all the four significant aspects of mathematical learning—concepts or meanings, computational skills, problem-solving and attitudes as recognized in the formulation of the objectives. Applications as envisaged in the objectives should not be restricted to the traditional use of Mathematics in problems of personal finance, home, business and geometry but greater emphasis should be placed upon uses in technology, industry and new emerging areas in economics, management and computer science. The continuity and sequence of the learning material is mainly determined by the nature of the subjects. Since in Mathematics it is easy to find out (i) what needs to be reinforced in the course of learning which had begun in earlier courses, and (ii) what ought to be reinforced and treated further in depth at higher level of generality, the logical continuity in Mathematics facilities looking in both directions.

In actual practice, the subject matter is provided in the form of textbooks. Textbooks give the scope of each topic at a particular level. Some textbooks organize content into suitable units or sub-units taking into consideration the relationship between the various topics. The competencies for each unit are also listed. For organizing instruction the teacher should identify objectives for each unit, analyze the content for locating understanding, skill and attitudes and work out suitable activities of learning experience to give maximum opportunities to children to develop desired behaviour.
1.10 DESIGNING LEARNING EXPERIENCES

The achievement of objectives depends upon suitable and well-organized learning experiences which are presented to the pupil in order to produce effective learning. Learning experiences place great importance on the learner and the learner situation, instead of on the teacher and the content. A learning experience is thus a desired change in the mental make up of a child brought about through “activities leading to the discovery of connections, relationships and meaning which are significant in monitoring the conduct of the pupil”. The following suggestions should be kept in view while selecting and organizing learning experiences:

i. Learning experiences should be appropriate to the behavioural changes defined under the objectives. It is the experiences of the pupil that are important as it is through these that the child matures in his behaviour.

ii. Learning experience should be suitable for the content area or the topic. Mathematics by nature is sequential. As such there is continued and repeated expansion and fusion of all previously learnt ideas. This expansion is possible only when each experience is reinforced and used repeatedly.

iii. Learning experiences should be varied in order to be effective. Children differ in maturity, interests and abilities. To meet the requirements of
individual differences the learning experiences should be imaginative and easily adaptable to the interests of the pupil.

iv. The learning experiences may be planned for various purposes such as:

a. To explain a complex mathematical idea by making children do or think in parts.

b. To provide an opportunity to analyze and make a generalization.

c. To develop new vocabulary and to use known vocabulary.

d. To coordinate the idea of Mathematics and some other ideas, social or related to other branches of knowledge.

e. To provide experience in the process of problem-solving, i.e., planning a situation, gathering information, solving the problem and verifying the result.

f. To provide for applications of mathematical ideas and
g. To provide an insight into various methods of proof in Mathematics.

In an actual teaching plan learning experiences are effective when they are organized as a related whole.

1.11 ACHIEVEMENT IN MATHEMATICS

Achievement tests measure the accomplishments and the progress of the pupils. diagnoses the strength and weakness of the pupils in a subject or subjects measure the validity and reliability of instruction stimulate the pupils to study
open the way to remedial works measure the efficiency of the teacher, and his
efficiency can be best measured by the results of the test given in the difficult
subjects that he or his teaching can be used in the classification and sectioning of
pupils.

Here are some of the important points to be kept in mind by the teacher to
get the best achievement in Mathematics. Instruction of Mathematics should be
based on the readiness of pupils. Individualized instruction improves immediate
achievement, retention and transfer. Meaningful teaching improves retention,
transfer, and understanding. The Use of mathematical games increases
motivation. The Elementary school Pupils generally like Mathematics as do
teachers. Drill and Practice are necessary for computational accuracy. Concrete
materials should be used before proceeding to abstractions. The Drill should be
spaced and varied in type and amount. Periodic review improves retention.
Immediate review of Arithmetic test items increases achievement and retention.
Practices in promoting mental computation should be provided. Proficiency in
counting facilitates the 'learning of addition. The Teacher background is related
to pupil achievement.

The National Policy on Education (1986) has also considered the
importance of Mathematics in general education and suggests that 'Mathematics
should be visualized as the vehicle to train a child to think, reason, analyze and
to articulate logically. Apart from being a specific subject it should be treated as
concomitant to any subject involving analysis and reasoning. In the recent past
there have been tremendous developments in theories of learning and the science of teaching. Though Mathematics occupies a place of importance, the researches in this area have been scanty.

**International Commission on Education (1972)** has given its opinion for reforming examinations. It states, "Real evaluation of a pupil’s or student’s achievement should be based not on a single, summary examination, but on overall observation of his work throughout a course of his study. It should pay less attention to the volume of memorized knowledge and more to the development of his intellectual capacity, reasoning ability, critical judgment and proficiency in problem solving. One of the main purposes of evaluation at the primary stage is to help the pupils to improve their achievement in the basic skills and to develop the right habits and attitudes with reference to the objectives of primary Education.

1.12 RATIONALE FOR THE STUDY

Mathematics is defined as the Science of quantity and space. It is a systematic, organized and exact branch of Science. It helps people to give exact interpretations to various ideas and conclusions. It is a Science of logical reasoning and numerical problems. It deals with quantitative facts and relationships as well as problems involving space and form.

Standard VIII finds place in all Middle, High and Higher Secondary Schools. Each school has its own Infrastructure Facilities, Teacher Competence
and Teachers Morale. The performance of the children depends to a large extent on the overall efficiency of the school. These have been major variables which influence the achievement of the students to a great extent. As the Investigator is a Post Graduate in Mathematics, he was motivated to know to what extent these variables influence the achievement of the students in Mathematics. Hence he was motivated to take up the study “A COMPARATIVE STUDY ON THE ACHIEVEMENT IN MATHEMATICS AMONG THE STUDENTS OF STANDARD VIII OF MIDDLE, HIGH AND HIGHER SECONDARY SCHOOLS IN DINDIGUL DISTRICT”.

1.13 CHAPTERISATION

The thesis contains five chapters as follows:

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Description</th>
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<tbody>
<tr>
<td>Chapter I</td>
<td>Introduction of the study deals with the Growth of Mathematics, Need and importance of Mathematics, Methods and techniques of teaching Mathematics and Achievement in Mathematics. It ends with Rationale for the Study and the Chapterization of the thesis.</td>
</tr>
<tr>
<td>Chapter II</td>
<td>Review of related literature concentrates on the studies related to Achievement in Mathematics and Teacher Morale done in India and Abroad.</td>
</tr>
<tr>
<td>Chapter III</td>
<td>Methodology of the Study provides the information regarding the Design of the study, Selection and size of the Sample, Sampling Technique, Tool development, Data Collection, Statistical Technique used for the data analysis, Delimitations of the study.</td>
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### Chapter IV
Data Analysis deals with the results of the data with respect to the variables such as Sex, Locality, Community, Parent’s Education and Parent’s Occupation of the students of the Middle, High and Higher Secondary Schools.

### Chapter V
Summary and Findings deals with the Findings, Discussions and Conclusion of the study, Recommendations for the further study based on the present study in detail.

### Bibliography
Bibliography Provides list of Books, Dissertations, Journals and Articles on Educational Researches which helped the Investigator in the process of the study.

The ensuing chapter deals with the Review of Related Literature.