CHAPTER I

INTRODUCTION:

1.0.0 PROLOGUE:

The problem for present investigation is, "A study of effects of expository and guided discovery methods of teaching mathematics on the achievements of the students of different levels of intelligence". Since the present investigation is related to teaching of mathematics, the definitions of teaching and their implications for research studies and definitions of strategies and patterns of teaching have been discussed in detail. These definitions are followed by nature of variables involved in teaching, and therefrom types of research studies are discussed in brief. The chapter ends with objectives, assumptions, scope and limitations of the study.

1.1.0 TEACHING, DEFINITIONS AND THEIR IMPLICATIONS:

A set of human behaviours is infinite. Similarly a set of teaching behaviours which is a subset of human behaviours is also an infinite one. For every element belonging to the first set, there exists a corresponding element in the other set. In short these two sets are equivalent. Then the question arises; what is the distinguishing characteristic common to both these two sets of behaviour? The distinguishing characteristic is intention. Teaching behaviour(s) is intentional; its basic intention is somebody learns something or, more precisely in mathematical language,
'P learns X', where P stands for student, X for learning outcomes measured in terms of knowledge, feelings and attitudes and others (product variables).

Since intentions can be as simple as knowing the name of the object and as complex as development of the character of the student. The complexity of the teaching behaviours varies directly according to the complexity of the intentions. It is said that the subtlety of human nature is far more complex than the subtlety of human reasoning. It is therefore, also very difficult, if not impossible, to bring human behaviours under the domain of human reasoning, so is the case with teaching behaviours.

The heritage of teaching, teaching behaviours, and teaching methods is very rich and as ancient as the heritage of human race. Since the time of Socrates, Plato, Aristotle etcetera the persons working in different fields have been trying to describe the teaching-learning process. Broudy (1963, p.2) has rightly pointed out that the real history of teaching method would, if properly written, be a history of education, and the real history of education would be hard to distinguish from the history of the human race.

There is a long standing controversy in education - whether teaching is an art or a science? Hightet (1955, p.398) views teaching as an art and not a science. If teaching is an art then it has to be developed like any other art. But on the contrary if it is not an art, then it should be
possible to develop the skill of teaching among those who want to become teachers. However, one thing is certain that, as teaching is a practical activity, it has a structure. But it is a particularly rich and complex structure. For understanding the structure and the phenomenon of teaching it must be analyzed in a systematic way. Many great personalities from the diversified fields have tried to define teaching in the light of their own perspectives.

Many philosophers, developmental psychologists, learning theorists, curriculum developers have put forth a number of definitions of teaching. In order therefore, to study these definitions one can subgroup these definitions according to their stress on the source of reality, the focus of attention, on the nature of learning outcomes and learners' environment. Based on these considerations, the set of definitions of teaching has the following subsets:

1) **Definitions based on learning environment**:

The first subset is formed by the definitions given by learning theorists like Thorndike, Skinner and others. The emphasis of these definitions is on the learning environment and the teacher is expected to create the necessary situations conducive to learning. Some of these definitions are:

Thorndike (1913, p. ): Teaching is the arrangement of situations which leads to desirable bonds and makes them satisfying.
Gagne (1978, p.23): Instructing means arranging the conditions of learning that are external to the learner. These conditions need to be constructed in a stage by stage manner, taking due account at each stage of the just previously acquired capabilities of the learner, the requirements for retention of these capabilities, and the specific situation needed for the next stage of learning.

Skinner (1966, pp.64-65): Teaching is the arrangement of contingencies of reinforcement under which students learn. They learn without teaching in their natural environments, but teachers arrange special contingencies which expedite learning, hastening the appearance of behaviour which would otherwise be acquired slowly or making sure of the appearance of behaviour which might otherwise never occur.

ii) Definitions whose stress is on teaching acts:

The second subset deals with the information processing, with a stress on the acts of the teacher in order to bring about change in the learner. Ryans, Gage, Smith and others who have been working in the field of teaching put forth these definitions.

Ryans (1965, p. ): The functioning of the teacher system is described as teacher information processing, information forwarding, and information control.
Gage (1963, p.96): By teaching we mean any interpersonal influence aimed at changing the ways in which other persons can or will behave. The influence has to impinge on the other person through his perceptual and cognitive processes.

Hough and Duncan (1970, p.2): Teaching is an activity - a unique professional, rational and humane activity in which one creatively and imaginatively uses himself and his knowledge to promote the learning and welfare of others.

Mitra (1972, p.22): Teaching is a series of acts carried out by a teacher and guided by formulation of the teaching task in a formalized instructional situation.

iii) Definitions whose stress is on process of interaction:

Persons like Flanders, Amidon and Hunter, after analysing classroom teaching with the help of different category systems, have put forth definitions of teaching which belong to this subset. According to them teaching is a process of interaction between teacher and student.

Hughes (1963, p.27): Teaching is interaction. Here interaction means the partners or objects in a situation act upon each other. Therefore, teaching cannot be separated from the learner.

Amidon and Hunter (1966, p.1): Teaching is ... an interaction process, primarily involving classroom talk, which takes place between teacher and pupils and occurs during certain definable activities.
Flanders (1970, p.1): The act of teaching leads to reciprocal contacts between teacher and the pupils; and the interchange itself is called teaching.

Bidwell (1973, p.414): Teaching may be defined as a series of interactions between someone in the role of teacher, and someone in the role of the learner, with the explicit goal of changing one or more of the learner's cognitive states (what he knows or believes, or his skill in performing cognitive tasks) or affective states (his attitudes, values or motives). In its aims teaching is coterminous with socialization; it is distinctive in the social definition of the interpersonal relationships that it involves.

iv) Definition in mathematical form:

Henderson (1963, p.1007): Teaching can be conceived as the ternary relation: X teaches Y to Z. Expressed in the notation of relational theory this becomes (XY)TZ or more generally T (X, Y, Z).

As popularly conceived, the domain of 'X' is the set of persons who act as teachers, the domain of 'Y' is the set of knowledge, beliefs or skills selected by the teacher; and the domain of 'Z' is the set of individuals - humans and other animals capable of modifying their behaviour as a result of experience - who are taught by the teacher. This definition is more comprehensive and takes into account all facets of teaching-learning process. Moreover, this definition offers a direction in developing and analyzing research on teaching.
v) **Implications of these definitions:**

If one analyzes the definitions stated earlier, one finds the following aspects revealed in one or the other definition:

(a) modification of environment conducive to learning;
(b) a process of interaction which is the core of teaching process;
(c) interaction process directed towards predetermined goal;
(d) interaction process inclusive of verbal and nonverbal activities of the teacher and the students.

Taking into consideration these aspects, teaching can be redefined as:

an interactive process between the teacher and the pupil in a classroom situation with predetermined goals or objectives to be achieved.

Burns (1980, p.793) has pointed out that researchers have usually employed outcome measures at the end of the instruction to quantify learning while ignoring changes that occur during learning. But it is the process of change from ignorance to competence, which should be the major focus of instructional psychology.

Therefore, evaluating the effectiveness of the two or more teaching strategies, outcomes at the end of instruction (i.e. intermediate product variables) as well as, outcomes during the interaction process itself should be taken into
account. If one takes into consideration these criteria for judging the effectiveness of teaching, one must try to develop some criteria for judging the effectiveness of teaching during the interaction process itself. For the development of such criteria a careful analysis of the interaction process is essential. These criteria can be developed on the basis of students' responses during the interaction process (i.e. immediate product variables). Pupils' initiation ratio, rate at which learning is taking place, corrective feedback, and motivational statement ratios can be considered for the development of such criteria.

Therefore, for the present and future studies on teaching, the definition of teaching can be restated as:

Teaching is an interactive process between teacher and the pupil in classroom situation with predetermined objectives to be achieved, and its effect can be measured in terms of both immediate and intermediate product variables.

1.2.0 TEACHING STRATEGIES-METHODS- PATTERNS:

Teaching behaviours occur in a particular sequence to help the student to learn. If the investigator is interested in finding out the relationship between a particular sequence and the achievement of the students, then that particular sequence should be repeated for several times and its validity should be established on the basis of empirical support. These sequences are classified into various meaningful categories such as strategies, methods, patterns and others.
i) Teaching Strategies:

Smith et al. (1967, p.3) consider that a strategy is a way of looking at activities involved in classroom discourse. It refers to a set of verbal actions that serves to attain certain results and to guard against others. There are two dimensions of a strategy, namely, the treatment and the control dimensions. The treatment dimension concerns with the type and sequence of operations that the teacher and the pupils jointly enter in setting forth and structuring information in such a way as to disclose the content that is to be learned. The control dimension deals with operations on the content.

Smith and Maux (1970, p.3) refer to strategy as a pattern of acts that serve to attain certain outcomes and to guard against certain others. The pattern of acts need not refer to only a 'set of verbal behaviours' as given by Smith et al (1967).

Hough and Duncan (1970, p.164) define strategy 'as a pattern of substantive, managerial, or silent behaviour used to facilitate students' attainment of an objective'. Further, it is composed of a series of moves, where move is defined as a single event that starts with the initiation of a behaviour and ends with its transition to another behaviour. But strategies do not involve all types of teaching behaviours. They are often used with tactics. A tactic is defined as a pattern of appraisal behaviours used to support primary instructional pattern, i.e. strategy. For example, teacher
asking a question followed by a move to student's response, and student's response followed by a move to another question forms a strategy. This strategy is supported by appraisal behaviours such as confirmation and corrective feedback.

Though Gerhard (1971, p. 21) uses the word 'teaching strategies', yet no definition of the term is provided. According to him, 'traditionally teaching strategies have been classified as a series of methods ranging from the lecture, discussion, and recitation to the multimethod, the project and the self discovery, and the self selection approach. Provided with these methods, the question arises as to how we use them to promote process and how they fit within the behavioural approach?'. This statement indicates that a teaching strategy can be considered to be similar to a teaching method.

Frankel (1973, p. 176) considers teaching strategies exclusive of pupils' learning activities. Teaching strategies refer to the operations a teacher performs in order to involve students in activities and represent things which students do, or action in which they are engaged. This idea of teaching strategy involves only teacher behaviours and not pupil behaviours.

The term strategy has been also used by Flanders (1970, p. ). Though not clearly defined, it seems that, a strategy is the way in which the teacher handles a classroom situation in order to facilitate learning.
Johnson and Rising (1971, p.143) explain strategy thus: 'The strategy for teaching a mathematical concept is the procedure, the algorithm, used to deal with the content'. The strategy selected depends upon the topic, the class, the objectives and the procedures known to the teacher. New strategies have a therapeutic effect on the teacher. The new approach makes the teacher's role little more exciting and offers him a bit more challenge. Strategies for teaching determine the overall classroom presentation and the materials to be used.

Henderson (1963, p.1007) after analyzing the recorded tapes of the verbal behaviors of mathematics teachers in the classroom, defined discovery teaching as a particular pattern or strategy of teacher moves. Four basic moves were identified: (i) the statement of the principle, (ii) the clarification of the principle, (iii) the justification of the principle, and (iv) the application of the principle.

If the initial move of the teacher is the statement of the principle or referring of a student to a principle in textbook followed by clarification and application or justification moves, the sequence of moves is defined as an expository strategy; however, if the 'statement' move is not the initial move, but appears if at all, near the conclusion of a sequence, the sequence is then called as a guided discovery strategy.
ii) Teaching Methods:

Dictionary of Education, Good (1973, p.363) defines Method as an established or systematic order for performing any act or information.

The relationship established by an educational institution with a group of participants, for the purpose of systematically diffusing knowledge among them.

These two definitions of the term clearly indicate two important aspects of the method: (a) systematic organization, (b) imparting knowledge - the focus of act.

Henderson (1963, p.1007): a pattern, that is a set of common properties that a set of behaviour manifests, will be called a method.

According to Broudy (1963, p.2), method refers to the formal structure of sequence of acts, commonly denoted by instruction.

Different teaching methods can be classified into two broad classes:

i) Expository: Rule-Example, Didactic, Tell and do method.

iii) Patterns of Teaching:

An event is the shortest possible act that a trained observer can identify and record. Often during classroom interaction, the same sequence of events occurs again and again, and such a sequence is called a 'pattern'. A pattern is thus defined as, 'a short chain of events that can be identified, occurs frequently enough to be of interest, and can be given a label (or name) since this often facilitates thinking'. Flanders (1970, p.4).

For example, lecture pattern, discussion pattern, question-answer pattern.

iv) Strategies, Methods and Patterns - Their Interrelationships:

Various terms, as mentioned in 1.2 (i) to 1.2 (iii) have been used by different researchers to focus upon certain sequences of teaching behaviours that form a part of classroom processes. A clear distinction need to be made before undertaking a study in this area. All these three deal primarily with sequences of teaching behaviours differing in their complexity. For the purpose of the present study a differentiation between these three has been made on the following basis.

Strategies are more general in nature and deal with approaches such as expository, discovery, inductive, and deductive. These are based on the logical analysis of the content. But whatever are the steps/moves of the strategies, these may not be readily applicable in a particular lesson because of the
constraints of content, pupil, time, resources available. Therefore, the teacher has to adapt/modify these strategies to suit the particular situation. Then these strategies are converted into methods of teaching i.e. Expository method, and Guided discovery method. While implementing expository strategy in the classroom, sometimes it may be difficult to offer the justification of the principle/move for one reason or the other; if this strategy is implemented then it will be an expository method. Therefore, selection of the method is always preceded by a selection of the strategy. In short, the method deals with a sequence of presentation of content in the classroom.

When a particular strategy/method is implemented in an actual classroom, by interaction with different types of pupils, it is translated into different teaching patterns. Therefore, teaching patterns are observable forms of a particular teaching strategy or a method. Therefore, when strategies interact with content, these are translated into different methods. One can use one or more strategies in one method only (e.g. deductive discovery method). When method interacts with pupils in the classroom setting, it gives rise to different teaching patterns. One can use the discovery strategy/method with different teaching patterns such as lecture, discussion.

The relationship between strategies/methods/patterns can be represented diagramatically as follows:
1.3.0 RESEARCH ON TEACHING:

As a primary arena for learning, the classroom-teaching learning process and its effects have long been the object of the research studies. Persons from diversified fields such as philosophy, psychology, sociology, and education have been undertaking studies in the area of teaching. These studies started with indirect assessment of classroom variables, but with the gradually improving techniques of systematic observation, many recent studies of classroom learning have sought the advantages of direct assessment of behaviours of teacher and pupils, the most fruitful being the consideration of verbal responses.

Gage (1963, p.97): We define research on teaching, as research in which at least one variable consists of a behaviour or characteristic of teachers.

1) Variables involved in research on teaching:

As pointed out that teaching is very very complex humane activity, it involves number of variables and interaction
between these variables. But for the sake of studying teaching learning phenomena, these variables are grouped into four different subgroups by Dunkin and Biddle (197). The definitions of these variables are given below:

(a) Presage variables: Presage variables concern the characteristics of the teachers that may be examined for their effects on teaching process. The variables like teacher formative experiences, teacher training experiences and teacher properties are included in this category.

(b) Context variables: Context variables concern the conditions to which the teacher must adjust characteristics of the environment. The variables like pupil formative experiences, pupil properties, school and community contexts, classroom contexts etcetera are included in this category.

(c) Process variables: Process variables concern with the actual activities of the classroom teaching. Observable behaviours of teachers and pupils are included in this category.

(d) Product variables: Product variables concern the outcomes of teaching. The variables like subject matter learning, attitude towards subject are included in this category.

Studies of research on teaching can be classified into different classes depending upon the nature of variables and its relationship with other variables involved in the study.

As earlier defined, teaching can be conceived as a ternary relation $T(X, Y, Z)$ from which one can abstract many relationships: (a) If $X = Z$ in the relation, then the person
is characterized as self taught or self educated. (b) A second kind of study focusses on the binary relation YSZ. This kind of research is known as curricular research. (c) The third kind of research focusses on the binary relation XRZ. This is called as methods research. Research of this kind focusses on the relation between the methods of teacher (person, text, or machine) employs and those behaviours of a student which under various hypotheses are related to methods. There are three general approaches to undertake this type of research.

(i) teaching is a necessary condition for a certain kind of student behaviours. If X then Z, $X \rightarrow Z$

(ii) teaching is a sufficient condition for a certain kind of student behaviours. If Z then X, $Z \rightarrow X$

(iii) teaching is both necessary and sufficient condition for certain kind of student behaviours. $X \text{ if and only if } Z$. $X \leftrightarrow Z$. This is an exciting kind of research but difficult too at the same time.

Since the present investigation is related to methods research, this type is discussed in detail.

ii) Methods research :

Methods research can be classified into two categories depending upon the number of methods of teaching involved as a variable in the study.

(a) only one method,

(b) comparison of two or more methods.
(a) Single Method Research:

The first type of study is not a comparison of methods of teaching say mathematics but an argument in favour of one particular method. These types of studies advocate a particular method for social utility or applicability to real life situations or development of certain kinds of characteristics in the students.

Beberman (1958) in the University of Illinois School Mathematics research project, observed that the methods (inductive discovery and deductive discovery) produced significant interest in mathematics, power in mathematical thinking and versatility in applying mathematics to new problems.

Bruner (1971, p. ) is also strong advocate of discovery method. According to him, 'It is only through the exercise of problem solving and effort of discovery that one learns the working heuristics of discovery, and the more one has practice, the more likely is one to generalize what one has learned into a style of problem-solving or inquiry that serves any kind of task.'

These types of inferences are possible only through this type of research on teaching.

(b) Comparison of two or more methods:

Most of the studies on methods are comparative in nature. A comparison is made between relative achievements of two or more experimental groups. Some studies compare the 'traditional' with 'inductive or deductive' method of teaching.
mathematics. A well known and age-old controversy is, comparison between effects of expository-discovery methods of teaching mathematics.

In short the investigator tries to find out certain behaviours of students which can reasonably be considered related to the method employed. In this type of research the investigator is interested in finding out a method which is a sufficient condition for the manifestation of certain behaviours by the students.

But different reviewers of research on teaching Wilder (1954), Gage (1963), Rosenshine (1970), Travers (1973), Dunkin and Biddle (1974) generally hold the view that change in pupil's behaviour seemed largely unaffected by style of teaching. Therefore, Wallen and Travers (1963, p.494) concluded that "The era of research comparing one teaching method with another method is coming to an end."

Wittrock (1966, p.37) opined that "Individual differences may require several approaches," and stated that "with variety of subject matter and students encountered in schools, it is surely futile to expect one method of learning to be consistently superior or inferior to other plausible procedures."

In other words, to evaluate the effectiveness of different teaching methods with reference to different content matter requires data on their consequences for different types of pupils. Therefore, researchers should study the differences in what is taught and the pupils to whom it is taught.
But the researcher is of the opinion that research should study the differences in how the content is taught and the pupils to whom it is taught and for what purposes it is taught. With these types of studies one would be able to make the statements like: for content material Y, taught by teacher Q to pupil Z, the best strategy is X. Therefore, with this logic at the back, the present investigation has been undertaken.

1.4.0 STATEMENT OF THE PROBLEM:

The problem for present investigation was taken as under:

A STUDY OF THE EFFECTS OF EXPOSITORY AND GUIDED DISCOVERY METHODS OF TEACHING MATHEMATICS ON ACHIEVEMENTS OF STUDENTS OF DIFFERENT LEVELS OF INTELLIGENCE.

1.5.0 SIGNIFICANCE OF THE PROBLEM:

Any meaningful piece of research can acquire rationale in the way it attempts to fulfil the desiderata of educational situation, and adds to the existing fund of knowledge in the particular area of research, or the way it propose to help in systematising the current theory and practice of education.

The systematization of knowledge through research helps progress. Progress is evolutionary process which mainly comes through good quality of education imparted to new generation. This is especially true in case of technological
progress for which trained personnel are required. This training is given to the individuals through different educational courses. Technological progress depends upon the development in science and mathematics. Therefore, students having strong background in both science and mathematics are required. In the words of Kothari Commission (1964-66) "The destiny of India is being shaped in her classrooms." This brings out the importance of classroom teaching for the national development. Dunkin and Biddle (1974, p.vii) remarked that "Teaching is the heartland of the research effort that should govern education". Hence, it is needless to point out the importance of classroom teaching for the progress of any country. Through teaching only knowledge is transmitted from one generation to another generation. Other outcomes such as skills, attitudes need to be developed through teaching also. The effective outcomes depend upon type of students, teachers, and facilities available in educational institution. Although these factors as 'inputs' are important, the way in which the students are being taught is also equally important. This determines the importance of teaching methods in order to bring about the desired outcomes of education. Due to invention of many mechanical gadgets such as video-cassette recorders, teaching machines, and computer a number of researchers are undertaking studies in the area of teaching in general and teaching of mathematics in particular.

There is an age-old controversy in the area of teaching of mathematics, namely, expository-discovery controversy. There are number of research studies abroad about this controversy, but the researcher could find only one Indian
study in this controversy. These studies are reviewed in Chapter II.

But the results of these studies are inconclusive and sometimes even contradictory. The comparison of effectiveness of two methods is based on the fallacy: there is probably certain kind of teaching which is really better than all other kinds. The present investigation was undertaken by the researcher taking into consideration the inadequacy of the earlier studies. The following points would clarify the significance of the present study.

Cronbach (1966, p. 2) commenting upon the nature of studies on discovery-didactic methods of teaching mathematics wrote, "Didactic teaching can and should develop meaning out of concrete experience and lay bare mathematical structure behind an algorithm. Only comparing that kind of didactic teaching with discovery methods tell us anything of value today." If at all the researcher wants to compare discovery and expository methods then he must compare good expository method with good discovery method only. In short researcher should give a fair treatment to expository method also. In the present investigation, the researcher used practically the same type of learning experiences in both the treatments and also controlled the factors such as, teacher, duration of the treatment, practice problems, class assignments, home work, pupils' participation and objective based criterion test.
Ausubel (1971, p.84) while examining the inconsistencies in the results related to expository and discovery dilemma said, "Learning by discovery has its proper place among repertoire of accepted techniques available to teachers, for certain purposes. Under certain conditions it has defensible rationale and undoubted advantages. Hence the issue is not whether it should be or should not be used in classroom, but rather for what purposes and under what conditions."

Therefore, the effectiveness of the method should not be judged on the basis of total achievement only. In the present study, achievement of the students after the treatment was measured in terms of knowledge, comprehension and application objectives. But in the study of effects of teaching, it is also equally important that, to what extent students have retained, what is taught to them. Therefore, in the present study, retention has been measured in terms of knowledge, comprehension and application objectives.

Joyce and Weil (1972, p. x) have rightly pointed out "Principles of teaching are not conceived as static tenets but as dynamically interactive with social and cognitive purpose with learning theory underlying procedures with available support technology and with personal and intellectual characteristics of the learning groups."

Wright (1960, p.70) suggested the following problem areas for further investigation:

1) The variation of teacher behaviours while teaching the same topic to several groups of pupils.
ii) The effect of various broad areas of subject matter and methods on patterns of behaviour in the mathematics classroom.

As the present study was confined to cognitive aspect of teaching, therefore, the researcher restricted his study to the cognitive interaction in the classroom. The researcher studied the dynamics of teaching by studying the interaction process/pattern associated with two treatments and variation in the interaction pattern due to change in pupils' characteristics i.e. intelligence. This is also an important aspect of the study.

Bloom (1976, p.52) found that, intelligence measures account for about 25 percent of the variance while achievement measures account for 50 to 64 percent of variance on subsequent achievement measures. These two important covariates were controlled in the experiment. Intelligence was controlled experimentally by using 2 x 3 factorial design, with intelligence as blocking variable. Cognitive entry behaviours were controlled by using statistical technique 'ANOCOVA'.

In short, the present investigation was carried on four dimensions of the variables involved in the teaching-learning process.

i) presage-product. Relationship between method and the achievement of the student;

ii) presage-process. Relationship between method and a pattern;
iii) context-process. Relationship between students' characteristic and the pattern of the method;

iv) process-product. Relationship between process variables and achievement of the student.

Keeping in view these four dimensions of the study, the objectives of the study were:

1.6.0 OBJECTIVES OF THE STUDY:

Since research on teaching involves four types of variables as Presage, Process, Product, and Context variables, the research studies on teaching can be classified on the basis of the relationship the investigator wants to explore among these variables. The researcher also classified the objectives of the study on the basis of classification of these relationships as under:

i) Objectives related to Presage-Product:

(a) To study the differential effect of guided discovery and expository methods of teaching mathematics on the achievements of the students;

(b) To compare the effects of guided discovery and expository methods of teaching mathematics on the achievements of students of different levels of intelligence, measured in terms of knowledge, comprehension and application objectives;

(c) To study the differential effects of guided discovery and expository methods of teaching mathematics on the retention of the students;
To compare the effect of guided discovery and expository methods of teaching mathematics on the retention measured in terms of knowledge, comprehension, and application objectives with respect to students of different levels of intelligence;

ii) **Objective related to Presage-Process**: To study and compare interaction pattern associated with guided discovery and expository methods of teaching mathematics.

iii) **Objective related to Context-Process**: To study the variation in interaction patterns due to change in levels of intelligence of the students with respect to guided discovery and expository methods of teaching mathematics.

iv) **Objective-related to Process-Product**: To establish the relationship between interaction patterns associated with guided discovery and expository method and achievement of students.

### 1.7.0 Definition of the Terms Used:

i) **Expository method**: If initial move of the teacher is the statement of the principle or generalization (followed by clarification, justification of the rule, and application of rule) the sequence of move is known as expository method.
ii) **Guided discovery method** : If the statement of the principle or generalization is not the initial move, but appears, if at all, near the conclusion of a sequence, the sequence is then called as guided discovery method.

iii) **Intelligence test** : Raven's Standard Progressive Matrices Test used to measure the general mental ability of the students.

iv) **High intelligence group** : The students who secured percentile ranks P75 or more on the intelligence test.

v) **Middle intelligence group** : The students who secured percentile ranks between P25 and P75 on intelligence test.

vi) **Low intelligence group** : The students who secured percentile ranks P25 or less on intelligence test.

vii) **Students** : Students who were studying in VII Grade from the two schools selected for the study during the year 1981-82.

viii) **Achievement of students** : The scores obtained on the test comprising of knowledge, comprehension and application objective items based on the content 'volume'.

ix) **Knowledge objective** : Those behaviours or test situations which emphasize the remembering, either by recognition or recall, of ideas, material, or phenomena.

x) **Comprehension objectives** : Those objectives, behaviours or responses which represent an understanding of the literal message contained in communication.
xi) **Application objective**: Use of principles correctly in a given appropriate situation in which no mode of solution is specified.

1.8.0 **ASSUMPTIONS OF THE STUDY**:

Every scientific investigation is based upon certain assumptions. These assumptions are simply judgements or propositions which are accepted or taken for granted. These can be derived axiomatically or based directly on previously admitted empirical evidence. Some assumptions are not capable of immediate confirmation in any manner; but are accepted because these are necessary for investigating phenomena in the area of the theory. Assumptions help the investigators in developing hypotheses worth to be investigated. The present investigation was related to teaching of mathematics, and since teaching is very complex activity, the researcher completed the study with the following assumptions based on either empirical evidence or taken for granted.

Flanders (1970, p.19) stated that, "Teacher behaviour patterns and procedures for analyzing these patterns could be taught, simultaneously practised and then tried out in classroom." Ryans (1969, p.19) also formulated assumption that, "Teacher behaviour is characterized by some degree of consistency."

This brings about the feasibility of teacher training and its transferability in classroom setting. With the help of training teacher behaviour can be improved, modified, and controlled. The researcher derived the following assumptions:
A1: Teacher can be programmed to a great extent.

Hough and Duncan (1970, p. 6) enumerated certain critical assumptions about teaching and teachers. Out of these critical assumptions, one is, "The act of teaching is a complex process that is influenced by a field of forces which teachers can be only in part aware." Ryans (1969, p. 16) also developed the assumption as "Teacher behaviour is a function of situational factors and characteristics of the teacher." While teaching to different types of students there are number of forces acting on teacher behaviour in classroom. Teachers' intent, formative experiences, training experiences, and student responses and their characteristics. Since in the present study only one teacher was involved to control the interteacher variability in teaching, therefore, the following assumptions were drawn.

A2: Teacher behaviours are partially controlled by student responses and to a large extent by method of teaching.

A3: There exists intra-teacher variations in teaching.

A4: There exists relationship between method and interaction pattern of teaching.

Torney et al. (1977, p. 48) after reviewing the research studies related to expository-discovery learning concluded that, "The argument about teaching methods has most often been phrased in terms of which teaching strategy discovery or expository, is to be preferred. Attempts to resolve the issue
have been largely non-productive because, in so far stating
the issue, attention has been directed away from more
pertinent questions asking in which situations and with
respect to which pupil characteristics will the use of
discovery methods result in particular educational goals
being achieved." This clearly indicates that the effectiveness
of any method depends upon pupil characteristics and goals
to be achieved. This leads to the following assumption.

A5 : There exists an interaction between method
and student characteristics, and it varies
with student characteristics.

A6 : There exists variation in interaction pattern
due to change in pupil characteristics.

Bloom (1976, p.69) after reviewing both macrolevel
and microlevel studies with respect to school learning
concluded that what happens to the learner at one point in
his learning career has consequences, positive or negative,
for subsequent stages in his learning career. This leads to
the following assumption :

A7 : Pre-requisite or cognitive entry behaviour
is essential for the subsequent school
learning.

Bloom (1976, p.15) stated that generalized characteristics
of the learner - such as intelligence and aptitudes -
are highly resistant to modification, while characteristics
such as the specific pre-requisites and motivation for a learning task are modifiable to a greater degree at most stages in the individual's history. The following assumptions are extracted by the researcher:

$A_8$: Cognitive characteristics can be modified by a short treatment.

$A_9$: Intelligence, aptitudes generalized characteristics are stable (or resistant to modification easily) to a large extent therefore, these can be controlled experimentally.

For statistical analysis certain assumptions are to be fulfilled by the data. These assumptions can be tested. Testing of these assumptions itself becomes independent study. Secondly in educational research it is not necessary to test these basic assumptions. Therefore, the researcher taken for granted the following two assumptions for the study.

$A_{10}$: Intelligence and achievement in mathematics are normally distributed.

$A_{11}$: There is linear correlation between scores of prior and later achievement of students.

1.9.0 SCOPE AND LIMITATIONS OF THE STUDY:

i) This study was limited to girl students selected from two schools from Pune City.

ii) Most of the students were from middle, upper classes of the society.
iii) This study was limited to only one unit i.e. 'volume' selected from the syllabus of VII grade mathematics.

iv) High, middle, and low intelligence groups were taught by only one teacher one period every day for nine days by expository and guided discovery methods. The sequence of teaching to these three different groups was not the same throughout 9 days. The sequence of teaching followed in expository method was not the same as sequence followed in guided discovery method.

v) The total teaching time for each treatment was limited to 9 school periods only.

vi) The number of students in each sub-group was limited to sixteen only.

vii) The study is limited to achievement of students in cognitive domain only.

viii) The conclusions of the study are limited to the teacher who has presage variables intelligence P95, teacher attitude score 260, percentage of marks at degree 55%, and percentage marks at B.Ed. 70.6%, percentage of marks M.Ed. 68%.

In the light of the points mentioned above in this chapter, the research studies related to expository-discovery controversy would be reviewed in the next chapter with special reference to the teaching of mathematics. This will help in the designing and implementation of the study.