CHAPTER – 1

INTRODUCTION

Origin of the Problem:

A significant number of students find it difficult to learn mathematics. Mathematics is a special subject symbol occupies a very important role in it. The nature of mathematics makes difficult for the students to learn. Success or failure in a mathematics course has a strong influence on students' choice of major and whether they graduate and qualify for meaningful jobs.

Mathematics is abstract subject. The reasoning in mathematics possesses a number of characteristics, namely, characteristics of accuracy, verification of results, certainty of results, similarity to reasoning in life, originality. All these characteristics automatically become a part and parcel of a child when he learns mathematics. Mathematics is a symbolic language. Students find it difficult to understand mathematics because of symbols and abstractness.

Patel in her study specifies that one of the reasons for the selection of commerce stream was that students felt science stream to be difficult, as it requires a lot of hard work to be put in. The study also stated that few of the students who earlier took up science stream later on got shifted to commerce stream, as they could not cope up with Physics and Mathematics. Ours and previous few generations have failed to produce good mathematics teachers at school level in adequately large numbers. If a boy or girl is taught by a bad mathematics teacher he will be worse off than not being taught it at all. The corpus of this enormous knowledge
that man built over the last few centuries will be too burdensome to carry into future on the shoulders of ill-equipped school Mathematics teachers.

Currently, Science stream is divided into group A with Mathematics and group B without Mathematics. As 21st century progresses there will be two kinds of people - mathematically abled and mathematically disabled or disadvantaged. The latter takes orders from the former. Our country requires technically skilled manpower and in order to meet this objective mathematics plays an important part.

In order to overcome the difficulties faced by the students, teacher should adopt different methodology in teaching of mathematics like drill method, using different audiovisual aids, computer aided instruction, mathematical club etc. There is no denying fact that a well articulated method of teaching of mathematics is the need of the hour. To inculcate interests among students, teachers need to evolve imaginative method. “Methods of teaching maths should be modernized stressing the investigatory approach and understanding the basic principles” Loudermilk(1979). It can foster the sustainable human development.

Thus, as teachers seek to improve their teaching effectiveness by improving their instructional practices, they should carefully consider the teaching context, giving special consideration to the type of students they teach. The researcher was herself a teacher of mathematics and felt that student’s achievement in the subject of mathematics was low. Giving students dozens and dozens of problems to solve does not help them to understand mathematics therefore she felt that it was essential to develop some methodology for mathematics in order to optimize improvements in quality. Hence when given an opportunity she decided to choose the topic of her choice i.e. ‘Evolving methodology of mathematics teaching at intermediate level and its validation effectiveness.”
**Statement of the problem:**
Problem of the study has been stated, “Evolving Methodology of Mathematics Teaching at Intermediate Level and Its Validation Effectiveness”.

**Objectives of the study:**
The present study has the following main objectives. It has been given in the succeeding lines:
(1) To identify an effective methodology of mathematics teaching at intermediate level
(2) To compare the academic achievement of students taught through evolved method and traditional method.

**Hypothesis:**
\(H_0\) : There is no significant difference in the academic achievement of students taught through identified traditional method and evolved method.

**Theoretical Basis of the study:**
Recent years have seen increased research on methodology of teaching as an essential aspect of effective teaching and learning (Bryant and Driscoll, 1998; McMillan, Myran and Workman, 2002; Stiggins, 2002). It is becoming more and more evident that an effective methodology of teaching is an integral component of the teaching and learning process (Gipps, 1990; Black and Wiliam, 1998). It is regarded that effective mathematics teaching requires understanding what students know and need to know. Ampiah, Hart, Nkhata and Nyirenda (2003) contend that a teacher needs to know what children are able to do or not if he/she is to...
Research has revealed that most students perceive mathematics as a difficult subject, which has no meaning in real life (Countryman, 1992; Sobel & Maletsky, 1999; Van de Walle, 2001). This perception begins to develop at the elementary school where students find the subject very abstract and heavily relying on algorithm, which the students fail to understand. This trend continues up to middle, high school and college. By the time students get to high school they have lost interest in mathematics and they cannot explain some of the operations (Countryman, 1992). According to Countryman (1992), the rules and procedures for school mathematics make little or no sense to many students. They memorize examples, they follow instructions, they do their homework, and they take tests, but they cannot say what their answers mean.

Most research studies in both education and cognitive psychology has reported weaknesses in the way mathematics is taught. The most serious weakness is the psychological assumption about how mathematics is learned, which is based on the “stimulus-response” theory (Althouse, 1994; Cathcart, Pothier, Vance & Bezuk, 2001; Sheffield & Cruikshank, 2000). The “stimulus-response” theory states that learning occurs when a “bond” is established between some stimulus and a person’s response to it (Cathcart, Pothier, Vance & Bezuk, 2001). Cathcart et al. (2001) went further to say that, in the above scenario, drill becomes a major component in the instructional process because the more often a correct response is made to stimulus, the more established the bond becomes. Under this theory children are given lengthy and often complex problems, particularly computations with the belief that the exercises will strengthen the mind. Schools and teachers need to realize that great philosophers, psychologists, scientists, mathematicians and many others created
knowledge through investigation and experimentation (Baroody & Coslick, 1998; Phillips, 2000). They understood cause and effect through curiosity and investigation. They were free to study nature and phenomenon, as they existed.

Today, learning mathematics seems to suggest repeating operations that were already done by other people and examinations that seek to fulfill the same pattern (Brooks & Brooks, 1999). The constructivist view is different from the positivist view and, therefore, calls for different teaching approaches (Baroody & Coslick, 1998; Cathcart, et al., 2001; von Glasersfeld, 1995). The constructivist view takes the position that children construct their own understanding of mathematical ideas by means of mental activities or through interaction with the physical world (Cathcart, et al., 2001). The assertion that children should construct their own mathematical knowledge is not to suggest that mathematics teachers should sit back and wait for this to happen. Rather, teachers must create the learning environment for students and then actively monitor the students through various classroom assessment methods as they engage in an investigation. The other role of the teacher should be to provide the students with experiences that will enable them to establish links and relationships. Teachers can only do this if they are able to monitor the learning process and are able to know what sort of support the learners need at a particular point. The main hypothesis of constructivism is that knowledge is not passively received from an outside source but is actively constructed by the individual learner (Brooks and Brooks, 1999; von Glasersfeld, 1995). Within this hypothesis lies the crucial role of the teacher. Today many psychologists and educators believe that children construct their own knowledge as they interact with their environment (Brooks and Brooks, 1999; Cathcart, et al., 2001; Hatfield, Edwards, Bitter & Morrow, 2000; von Glasersfeld, 1995).
Unfortunately, classrooms do not seem to reflect this thinking. Some teachers still continue to teach in the way perhaps they themselves were taught because human beings naturally look back and claim that the past offered the best. If children construct knowledge rather than passively receive it, they must be offered the opportunities to act on their environment, physically and mentally, to use methods of learning that are meaningful to them, and to become aware of and solve their own problems (Althouse, 1994). Althouse is in agreement with Baroody and Coslick (1998) who suggest that teaching mathematics is essentially a process of translating mathematics into a form children can comprehend. Teaching mathematics is providing experiences that will enable children to discover relationships and construct meaning. Students should be assisted to see the importance of mathematics not by rote learning but by investigating and relating to real-life situations. Giving students dozens and dozens of problems to solve does not help them to understand mathematics, if anything it frustrates them even more. The more they do things they cannot understand or explain, the more they get frustrated.

As a teacher herself, the researcher felt that there was nothing more frustrating than spending several weeks on a topic, only to give an assessment and discover that her students have made no gains in their knowledge about that topic. Therefore, she then decided to undertake a study related to developing teaching methodology of mathematics at intermediate level. Hence when she got an opportunity to undertake a research study in education, she opted to work on the topic of her choice i.e. “Evolving methodology of mathematics teaching at intermediate level and its validation.”
**Concept of teaching:**

Gage (1987) defined teaching “as any interpersonal influence aimed at changing the ways in which other persons can or will behave.”

From this definition, it is clear that teaching involves more than one person and the behavioural influence of one person changes the behaviour of others. But it does not specify the persons involved in teaching. A similar stand has been taken by Hough and Duncan (1970). According to them, “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”. In their definition Hough and Duncan has stressed the involvement of more than one person in the teaching act and given teaching the status of a professional, rational and humane activity. Teaching has also been seen by them as a creative and imaginative activity instead of a sheer mechanistic way of influencing human behaviour. However, their definition does not specify the persons involved in the teaching that is the teacher and the students.

Flanders (1970) says, “The act of teaching leads to reciprocal contacts between the teacher and the pupils and the interchange itself is called teaching.” From this definition, it is clear that teaching is an activity which involves the teacher and the pupils and the interchange between them is not one-way but two ways or reciprocal. Thus, this definition specifies the persons involved in the act of teaching a factor that was not present in the preceding definitions, but it does not talk about the situation where teaching takes place and the kind of activities which are performed in teaching. These aspects are affected in the definition given by Carter V. Good. In the *Dictionary of Education* Good (1959) has given the narrow and the broad meaning of teaching. According to the
narrow meaning, teaching refers to the act to instructing in educational institutions. Under the broad meaning, teaching implies the management by an instructor of the teaching learning situation including (a) direct interaction between teacher and learner, (b) the preactive decision making process of planning, designing, preparing the materials for the teaching-learning conditions, and (c) post-active redirection (evaluation, redesign and dissemination).

From Good’s definition, three major factors emerged: first, that teaching is an instructional activity which takes place in educational institutions; second, that it is a managerial activity which is concerned with organization of teaching learning situations; and third, that it is an interactive process between the teacher and the student which involves preactive decision making activities like planning, designing, preparing the materials for the teaching-learning situations and post-active redirections. Thus, Good, recognised two important aspects of teaching; teaching is a process which has a number of activities and it involves a particular situation in which teaching takes place.

Teaching as a process has also been highlighted in the definition of teaching given by Joyce and Weil (1980). According to them “teaching is a process by which teacher and students create a shared environment including sets of values and beliefs (agreement about what is improvement) which in turn colour their view of reality.

This definition adds a new dimension to teaching, apart from its recognition of teaching as a process. It stresses the importance of teaching-learning environment which is created out of the interaction between the teacher and the students. But teaching as a process is not clear from the definition. A process always has a series of activities which are in a logical sequence. It is important to know whether teaching is process or not. A study of the four phases of teaching given by Hough
and Duncan (1970) makes it clear that teaching is a process which has a series of activities which takes place logically and sequentially. According to them, teaching comprises four phases-a curriculum planning phase, and instruction phase, a measuring phase and an evaluating phase. It is in curriculum planning phase that goals of education are formulated; the content/curriculum is selected and organised, based on the goals of education and the objectives of instruction are specified. In the second phase, content/curriculum is transacted through the act of instruction and strategies are designed and used to help students to learn. The third phase is the measuring of learning outcomes in which measurement devices are created or selected to measure learning outcomes. Data collected from the measurement are organised and analysed. Finally, evaluation based on the measurement data, is done, human judgement is given regarding the appropriateness of objectives and effectiveness of instruction and validity and reliability of measurement devices and tools to test learning.

A look at the teaching activities described by Hough and Duncan in four phases of teaching makes it clear, that teaching is process of a series of activities which takes place in a logical sequence. Thus, teaching can be viewed both as an act in a wholistic sense because a number of activities make teaching a global act. It is viewed as a process because activities in teaching occur in a logical sequence. From the previous discussion, it is clear that teaching in a classroom does not takes place in a vacuum. It involves certain components which makes teaching takes place in a classroom. These components are the human, material and the skill based components.
Concept of Effective teaching:

It is safe to say that everyone, every parent, grandparent, young person and citizen in our country would like to have the assurance that all our children are being taught and prepared for college, for future work and for life in the Twenty-First Century. In order to achieve this, we need to ensure that those who teach our children incorporate the qualities of effective teaching in their professional lives. In essence, we need every teacher in our schools to be an effective teacher.

Effective teaching is a set of behaviours that teachers incorporate into their daily professional practice. These involve a deep understanding of the subject matter, learning theory and student differences, planning, classroom instructional strategies, knowing individual student’s assessment of student understanding and proficiency with learning outcomes. They also include a teacher’s ability to reflect, collaborate with colleagues and continue ongoing professional development.

Concept of Effective teacher:

Research offered a plethora of definitions of an effective teacher. Clark (1993, p. 10) wrote that, “Obviously, the definition involves someone who can increase student knowledge, but it goes beyond this in defining an effective teacher.” Vogt (1984) defined effective teaching to the ability to provide instruction to different students of different abilities while incorporating instructional objectives and assessing the effective learning mode of the students. Collins (1990), while working with the Teacher Assessment Project established five criteria for an effective teacher:

(a) is committed to students and learning.
(b) knows the subject matter.
(c) is responsible for managing students.
(d) can think systematically about their own practice, and
(e) is a member of the learning community (Clark, p. 11).

One distinguishing quality that effective teachers seem to have is, that in all their approaches to planning, designing and implementing instruction and assessment, their focus is on “student learning” to inform their own teaching. Effective teachers know who their students are. They know their students’ learning styles, their strengths and their deficits as learners. They are masters of their subject matter…but more importantly, effective teachers are always focused on their students’ learning.

**A Model of Teachers’ Thought and Action:**

It is beneficial to look at teacher’s thought processes (Figure 1) as it could increase our understanding of how and why the process of teaching looks and works as it does. Teacher thought processes complements the larger body of research on teaching effectiveness: this is because how teachers think, act and react determine effective teaching (Clark and Peterson, 1986). Teachers’ actions and their observable effects are important as what is inside the teachers’ head is translated here. Therefore, this model depicts two important domains that involves the teaching process. Each domain is represented by a circle. The first domain is the teachers’ thought processes comprising teachers’ interactive thoughts and decisions, teacher planning (preactive and postactive thoughts) and teachers’ theories and beliefs. Teachers’ thought processes occur “inside teachers’ heads” and therefore they are unobservable and they are **measurable**. The second domain contains teachers’ actions and their observable effects comprising teachers’ classroom behaviour, students’ classroom behaviour and student achievement. The phenomena involved
in the teacher action domain are more *easily measured* and are more easily subjected to empirical research methods than are the phenomena involved in the teacher thought domain. Thus, the variables for this particular research contained in both domains. The relationship between teacher classroom behaviour, student classroom behaviour and student achievement are reciprocal and therefore it is represented as cyclical or circular. This is because teacher behaviour affects student behaviour, which in turn affects student behaviour and ultimately student achievement. Alternatively, students’ achievement may cause teachers to behave differently toward the student, which then affects student behaviour and subsequent student achievement. Teacher’s interactive thoughts and decisions and their preactive thoughts and decisions are important because they determine teachers’ interactive teaching. Teachers think differently during interactive teaching compared to their thinking while not interacting with students. Teacher planning includes the thought processes that teachers engaged in prior to and after classroom interaction. Teachers’ theories and beliefs represents the rich store of background knowledge teachers have that affects their planning and their interactive thoughts and decisions.
Criteria of Teacher Effectiveness:
Teacher effectiveness as a concept has no meaning apart from the criterion measures or operational definitions of success as a teacher. The concept of criterion of teacher effectiveness can have educational or social values of some kind. By teacher’s effectiveness is usually meant the teacher’s effect on the realization of some values.

Concept of teaching techniques:
A teaching technique is that a teacher uses in support of his methodology of teaching to help students accomplish mastery in the classroom. Some teaching techniques involve ways to differentiate instruction so that everyone in the classroom can learn the material, while others involve
different types of activities that motivate students with different interests or who have different learning styles. The days of the lecture are in the past because the trend in education is to facilitate student exploration and mastery. There are many techniques that help teachers accomplish this. Some of the more popular teaching techniques in the 21st century involve technology. Instead of settling for the traditional slideshow that one gets from PowerPoint, many teachers are adding even more flair to their curricula by using the added motion and media capacity of websites that boost presentation capacity further. Other instructional techniques have been around for years because they simply work. Some of them are illustration with example, explanation, description, discussion, narration, experimentation, demonstration, deduction, diagrammatic presentation, are some of the examples of teaching techniques.

Method of teaching-a historical perspective:

Ancient education

About 3000 BC, with the advent of writing, education became more conscious or self-reflecting, with specialized occupations such as scribe and astronomer requiring particular skills and knowledge. Philosophy in ancient Greece led to questions of educational method entering national discourse.

In his literary work *The Republic*, Plato described a system of instruction that he felt would lead to an ideal state. In his dialogues, Plato described the Socratic method, a form of inquiry and debate intended to stimulate critical thinking and illuminate ideas.
It has been the intent of many educators since, such as the Roman educator Quintilian, to find specific, interesting ways to encourage students to use their intelligence and to help them to learn.

**Medieval education**

Comenius, in Bohemia, wanted all children to learn. In his *The World in Pictures*, he created an illustrated textbook of things children would be familiar with in everyday life and used it to teach children. Rabelais described how the student Gargantua learned about the world, and what is in it.

Much later, Jean-Jacques Rousseau in his *Emile*, presented methodology to teach children the elements of science and other subjects. During Napoleonic warfare, the teaching methodology of Johann Heinrich Pestalozzi of Switzerland enabled refugee children, of a class believed to be unteachable, to learn. He described this in his account of an educational experiment at Stanz. He felt the key to have children learn is for them to be loved.

**19th century - compulsory education**

The Prussian education system was a system of mandatory education dating to the early 19th century. Parts of the Prussian education system have served as models for the education systems in a number of other countries, including Japan and the United States. The Prussian model required classroom management skills to be incorporated into the teaching process.
20th century

Newer teaching methods may incorporate television, radio, computer, and other modern devices. Some educators believe that the use of technology, while facilitating learning to some degree, is not a substitute for educational methods that encourage critical thinking and a desire to learn. Inquiry learning is another modern teaching method.

Concept of Traditional Method of Teaching:

This is a well-known fact that our education system still relies on traditional methods of teaching. It involves the usage of chalk and talk and lecture. Here the teacher plays the main role therefore we also call them as the teacher centered method of teaching. Traditional teaching method is described as being teacher-oriented, in a lecture style and is inflexible. Lessons are usually taught by the teacher introducing skills using a blackboard accompanied by a verbal explanation or lecture. Traditional teacher-centered methods focused on rote learning and memorization must be abandoned in favor of student-centered and task-based approaches to learning. However, many parents and conservative citizens are concerned with the maintenance of objective educational standards based on testing, which favors a more traditional approach.

Concept of Questioning and its Types:

A learner is by nature a questioner. A question is a linguistic expression used to make a request for information, or the request made using such an expression. The information requested is provided in the form of an answer. If there is a drive in an individual to increase knowledge, skills or understanding it is driven by doubt, curiosity, wonderment, incomprehension, puzzlement, uncertainty, recognition of a need, or
curiosity. This drive is then focused through questions that the learner formulates and actively seeks to find answers to. They may be simple questions that seek clear facts, or complex questions that probe deep into concepts, beliefs and understandings. The question may provide an answer that solves the learning need or may lead to further questions as knowledge and understanding grows. It is obvious though, that however simple or complex an issue is, a good clear relevant question will be of far greater use to the learner than a question that is vague, poorly defined or irrelevant.

Types of questions asked during the lesson has further five dimensions namely factual, probing, higher order, student’s initiated and problem solving.

The factual dimension of the types of questions deals with the questions that are simple, straight forward based on the recall or recognition. The second one i.e. probing questioning means clarifying, increasing critical awareness, refocusing, prompting, redirecting to another student. Higher order questioning means evaluation, inferences, comparison or application. Student’s initiated questioning means where a student initiates a talk by asking question, clarifying doubt or posing some problem to the teacher. In problem solving question the teacher simply poses the mathematical problems to the students.

**Significance of the study:**
As teachers seek to improve their teaching effectiveness by changing their instructional practices, they should carefully consider the fact that all this is impossible without understanding what happens in the classroom. The study in hand is a stepping stone in the field of classroom interaction related researches.
The real problems of the education, lies in the classroom not outside it. Mathematics teaching is different from other subjects, due to the abstract nature involved in it. For an effective and efficient teaching in mathematics, it is essential to develop some methodology for mathematics in order to optimize improvements in quality. Present study would motivate more and more research scholars to undertake this type of studies to get a first-hand knowledge of what is going on in the classroom and how improvement can be brought in teaching and learning at this level. Specifically, the study sought to understand the methods and tools teachers use to teach their students. The researcher studied closely how effectively the student teacher interaction was being carried out in the classroom by focusing on the strategies and tools the teachers used to teach the learners. In addition, the present study also motivated the research scholars in looking into the class room problems not from outside but by actually peeping into the classroom problems from inside.

**Delimitation of the study:**

Delimitation is a term; its meaning in research refers a boundary or a limit. Delimitation brings precision and minimizes confusion at every step of the research. In succeeding lines the researcher has mentioned the delimitations of her study.

1. The study was delimited to C.B.S.E affiliated senior secondary schools situated in the Faridabad district of Haryana.
2. The study was delimited to intermediate class only.
3. The study was delimited to mathematics lessons taught by effective teachers to intermediate classes.
4. The study was delimited to conic sections.
5. The study was delimited to observation method of data collection.
6. The study was delimited to survey method of research.
7. The study was delimited to purposive sampling technique.