CHAPTER - 1

INTRODUCTION
1.1.0 Prologue

The present research aims to study the effectiveness of Constructivist Approach to teaching Mathematics at middle school level. In this Chapter, the details of Constructivism as a theory of learning have been discussed. The Chapter also explains the rationale for selecting Mathematics as a school subject to assess the efficacy of Constructivism with reference to the points such as importance of Mathematics, the current status of Mathematics teaching at school level and the applications of prevalent learning theories for teaching Mathematics.

1.1.1 Importance of Mathematics

The place of Mathematics in educational institution seems clearly to be central one. Education Commission of India (1964-67) points out "one of the outstanding characteristics of scientific culture is quantification". Mathematics therefore assumes a prominent position in modern education.

Apart from its role in the growth of physical science, it is now playing an increasingly important part in the development of biological sciences too. The advent of automation and cybernetics in this century marks the beginning of new scientific, industrial revolution and makes it all more imperative to devote special attention to the study of Mathematics.

Taking cognizance of the above, Mathematics is included as a compulsory subject for the ten years of schooling.
Also, the National Policy on Education (1986) has emphasized the need and importance of mathematical education in our schools. It quotes: Mathematics should be visualized as the vehicle to train a child to think, reason, analyse and articulate logically. Apart from being a specific subject, it should be treated as concomitant to any subject involving analysis and reasoning.

As of today, the fast-paced growth of technology demands the people with sound understanding of Mathematics. And recognizing the importance of developing a better understanding of mathematical concepts, the Maharashtra State Board of Secondary and Higher Secondary Education has framed the following objectives of teaching Mathematics at the secondary level. (Handbook of Mathematics for Teachers: Std. 10, 1995, pp. 5).

Objectives

1. To help the pupil to develop logical thinking and problem-solving ability.

2. To develop the ability of the pupil to apply mathematical knowledge with a view to solve problems of real life situations.

3. To help the pupil identify inter-relationships between different parts of the problem and to draw conclusions through reasoning.

4. To help the students form the habit of expressing ideas briefly, precisely and concisely.
5. To help the students appreciate the role of Mathematics in scientific and technological development.

6. To equip the students, who may not opt for Mathematics as a subject for their studies, with basic mathematical tools and techniques necessary in the advancements of their branch of studies.

7. To equip those students, who may terminate their classroom education after Standard 10, with sufficient mathematical tools and techniques necessary in daily and practical life?

These objectives take into account the development of the student with regards to their cognitive, effective and psychomotor domains. Although, we have such long-term objectives for introducing mathematics at school level, the current state of learning of Mathematics at school level, the current state of learning of Mathematics on the part of students is far from satisfactory. The rate of failure in Mathematics is considerably higher than in other subjects and in general, Mathematics is a highly unpopular subject among the majority of students. One of the most responsible factors for such situation is the way Mathematics is taught in the schools.

1.1.2 The Current Status of Mathematics Teaching at School level

It will be interesting to know the situation of Mathematics in the schools outside India is not much different than that in India. Although it cannot be generalized, the following excerpt from a research based article throws some light on this topic.
In 1975, the National Advisory Committee on Mathematical Education (NACOME) commissioned a study of elementary school Mathematics instructions. (Wittrock, pp 852). The picture drawn from this survey is as follows (Conference Board of Mathematical Sciences, 1975).

“The median classroom is self-contained. The Mathematics period is about 40 minutes long and about half of this time is written work. A single text is used in whole-class instruction. The text is followed fairly closely, but students are likely to read at most one or two pages out of five pages of the textual materials other than problems. It seems likely that the text, at least as far as the students are concerned, is primarily a source of problem list. Teachers are essentially teaching the same way as they were taught in the schools. Almost none of the concepts, methods or big ideas of modern Mathematics programs have appeared in this median classroom (p.77)”

Additional evidence comes from three studies commissioned by the National Science Foundation. The following remarks from one of the National Science Foundation (NSF) case studies of Mathematics teaching are typical (Welch, 1978):

“In all Maths classes the researcher visited, the sequence of activities was the same. First answers were given for the previous day’s assignment. The more difficult problems were worked out by the teacher or a student at the chalkboard. A brief explanation, sometimes not at all, was given of the new material, the problems were assigned for the next day. The remainder of the class was devoted to working on the homework while the teacher
moved about the room answering questions. The most noticeable thing about Maths classes was the repetition of this routine (p. 6)."

There are three serious limitations of Mathematics as just characterized.

1. Mathematics is assumed to be a static bound discipline. The emphasis is on teaching the concepts and skills associated with aspects of this discipline. This traditional view of mathematics perceives that there is a lot to teach. This massive "record of knowledge, independent of its place as an outcome of inquiry and a resource in further inquiry, is taken to be knowledge". (Dewey, 1916, pp. 186-187). For schools, the consequences of this traditional view of Mathematics are that Mathematics is divorced from science and other disciplines and then separated into subjects such as arithmetic, algebra etc. The fragmentation of Mathematics, such as subject-----topics-----studies-----lessons-----facts and skills has divorced the subject from reality and from inquiry. Such essential characteristics of Mathematics as abstracting, inventing, proving and applying are often lost.

2. When the record of knowledge is mistakenly taken to be knowledge, the acquisition of information becomes an end in itself and the students spend their time absorbing what other people have done, rather than in having experiences of their own. Students are treated as pieces of 'registering apparatus'. Which store up information isolated from action and purpose. (Dewey,1916,p.147) Yet, current research indicates that acquired
knowledge is not simply a collection of concepts and procedural skills filed in long-term memory. Rather, the knowledge is structured by individuals in meaningful ways, which grow and change over time.

3. The role of teachers in the traditional classroom is managerial or procedural in that (Romberg, 1985): “their job is to assign lessons to their classes of students, start and stop the lessons according to some schedule, explain the rules and procedure of each lesson, judge the action of the students during the lesson and maintain order and control throughout (p.5)”.

In this traditional classroom, the teacher’s job is related neither to a conception of mathematical knowledge to be transmitted nor to an understanding of how learning occurs.

Although, the above article represents the state of Mathematics teaching in American schools, one may be tempted, to relate many of its points to the Indian Scenario. In addition, the Indian teachers and students have to face other socio-economic constraints such as over-strength of classrooms, poverty, illiteracy of parents, sex discrimination, lack of adequate resources etc. that further lead to the increasing rate of failure in Mathematics.

Also, the rigid curricula and administrative pressure discourage the teachers for trying out new methods of teaching and make the teaching-learning process meaningful. Moreover, hardly any efforts are taken to build the nexus between modern research in education and actual teaching
practice in schools. Eventually, the educational practice rarely gets influenced by the modern research and it remains far from being updated.

However, the researchers have tried out the prevalent theories of learning for Mathematics instruction at school level. The teaching methods based on these theories of learning have their own scope and limitations. A brief review regarding the same will be taken in the following module.

1.1.3 Theories of Teaching-Learning Mathematics : A Critical Approach

The Thorndike's theories and more recent behaviorists failed to account for the structure of discipline of Mathematics. Instruction based on behaviorist principles tended to fragment the curriculum into a number of isolated parts that could be learned through appropriate reinforcement. (Wittrock,86).

According to Gestalt principles instruction should be based on understanding, but that theory also provided little direct guidance regarding the design instruction to promote understanding.

In the 1960s, several theories of learning and development emerged that promised to provide a more direct link between learning theories and teaching Mathematics. The theories of David Ausubel (1968), Bruner(1960,66) and Gagne(1965) explicitly focused on structure of content to be learned. According to Ausubel, meaningful learning is more effective than learning by discovery whereas Jerome Bruner's ideas have had a particularly strong impact on discovery learning strategies. A number of
researchers have tried Ausubel's and Bruner's strategies for teaching mathematical concepts and thereby determining the areas in instructional practice where they can be used most effectively e.g. Chitriv (1983), conducted a study to evaluate differential effectiveness of Ausubel and Bruner strategies for acquisition of concepts in Mathematics. He found that Ausubel's strategy was superior to that of Bruner for enhancing concept transfer whilst Bruner's strategy was superior to Ausubel's for transfer of heuristics, discover new relationship, retain knowledge of concepts for short-term memory as well as long term memory. (Chitriv).

Robert Gagne provided the clearest specification of how Mathematics curriculum can be analyzed and researched. Gagne's task analysis provided a framework for systematically organizing a content domain into a hierarchy of principles, concepts and skills. Task analysis was used in the design of several elementary Mathematics projects, including Individually Prescribed Instruction (Findwall and Bolven, 1967) and developing Mathematical processes (Romberg, Harvey, Moser and Montgomery, 1974, 75, 76). However, rational task analysis by experts has evolved to empirical task analysis, which focuses on what children actually do when they solve Mathematical problems. (Wittrock, 74).

From a different perspective, Piaget (Piaget 1952, Piaget and Inhelder 1956, Piaget, Inhelder and Szeminska, 60) proposed a theory of development of the foundations of basic number, measurement and geometry concepts. Although Piaget was not explicitly concerned with problems of instruction and
did not directly studied the development of Mathematical concepts and skill that traditionally have been in the main stream of the Mathematics curriculum, the logical operations that he described seemed on face value to underly much of the basic Mathematics taught in the primary grades. Constructs such as conservation, transitivity and class, inclusion appeared to be pre-requisites for understanding most basic number and measurement concepts. A number of studies attempted to establish how Piagetian logical operations were related to the learning of basic Mathematical concepts e.g. Bala V. (1980) conducted a comparative study of the effects of modern and traditional Mathematics curricula on Piagetian concrete and formal logical thinking. He found that modern Mathematics facilitated Piagetian cognitive thinking to a greater degree than the traditional one at primary school level. Also, on Piagetian formal operational tasks both the modern and traditional groups were nearly equal in case of Std.VII but on Piaget's concrete logical tasks boys and girls of modern group of Std IV performed significantly better.

Although performance on Piagetian tasks have consistently been found to be correlated with arithmetic achievement, Piagetian logical operations have generally not proved helpful in explaining children's ability to learn most basic Mathematics concepts and skills. (Hiebert and Carpenter, 1982). According to Dubois (1979), Piaget's theory has some relevance for educational practice, but it is probably somewhat premature to adopt it as a prescription for the structure and sequencing of subjects to be covered in the school and the particular type of learning environment needed. Dubois, in the
same context, also suggests that one has to be cautious in adopting recommended educational practices that are purportedly developed from Piagetian base. (pp. 56).

Along with the attempts to put learning theories into educational practice, the researchers have tried out various teaching methods such as individualized instruction, lecture-discussion, expository, guided discovery and pure discovery, visual projection, programmed learning, analyticosynthetic Vs. tell and do, symbol picture logic programme, mastery learning, activities and experiments and so on. The researchers tried to find out the educational implications of these methods along with their limitations.

Giridhari Lal (1986) studied the effects of individualized and conventional learning for teaching Mathematics. He found that individualized instruction was more effective for Mathematics learning. Chitkara (1985) found lecture-discussion strategy better suited to below average ability extroverts and introverts as compared to high ability students. High ability extroverts and introverts were benefited by inductive discussion drill and auto-instruction group discussion in the said project.

Miyan M. (1982) found guided discovery method effective in developing originality as compared to tell and do as well as pure discovery method. But, interestingly, Bhalwankar A. (1985) arrived at the conclusion that for high intelligence group, expository method was effective than guided discovery on application objective whereas for low intelligence group, guided discovery was helpful on retention objective.
Gupta (1979), discovered that analytico-synthetic method was more effective than traditional (narration-explanation) method in terms of overall geometry achievement in class IX but for class VIII, they did not have any differential effect.

Several researchers developed programmed learning material and evaluated its effectiveness in terms of achievement and psychological correlates. (Pandey 1980, Seshadree 1980, Shah 1986, Inamdar 81, Sharma 81, Davies 82, Rao 83, Kothari 85). Sharma (81) found programmed instruction superior to conventional method in achievement and retention of Mathematical concepts taught during studies. But in one another study by Rao (1983), programmed instruction was found superior to conventional learning only in case of students with high general mental ability students studying in higher grade of privately managed schools. Also, programmed learning was found inferior to methods involving visual-projection, activity and experiments and equally good and sometimes superior in respect of different content area in Mathematics.

Mastery learning model (Bloom) had also gained a good deal of popularity among the researchers. Various studies supported the positive implications of mastery learning strategy in Mathematics education. Yadav (1984) found mastery learning strategy superior to traditional method in respect of Mathematics achievement, attitude towards Mathematics and improving self-concept. Sahastrabuddhe B. (1996) also supported the
efficacy of mastery learning model employed for teaching algebraic expressions in class VIII.

The above discussion may be precisely summarized by one of the major implications of Bhalwankar’s study (1985) that “one cannot be rigid in the use of teaching methods. All teaching methods are effective in certain situation and not so effective in other situations. Content and objectives determines the methods to be used”.

But more recently, it is not the teaching methods but what guided the current research is the perspective that children are not passive learners who simply absorb knowledge. They come to school with rich informal systems of Mathematics. They actively structure incoming systems of Mathematics. They actively structure incoming information and attempt to fit into their established cognitive framework. One of the basic assumptions underlying much current research is that children actively construct knowledge for themselves through interaction with the environment and reorganization of their own mental constructs. (Steffe, Von Glasersfeld, Richards and Cobb, 1983). Although instruction clearly affects what children learn, it does not determine it. And this approach has shifted the focus on search for the most appropriate teaching method to the study of cognitive construction through which the children undergo when they learn. This is the gist of Constructivist approach to learning.

The details of the Constructivism follow in the coming modules.
1.2.0 Constructivism

1.2.1 Emergence of the Concept

Constructivism is not a new concept. Some psychologists and educationists have based their theories of learning on the assumption that children come to the classroom with existing cognitive structures derived from their experiences. Probably Piaget was the best-known Constructivist who did a great deal of work on learning of Mathematics. However, Piaget talks more about cognitive development of a child through different age groups; he describes the stages of development characterized by typical learning behavior of a child. (e.g. principle of conservation) The teacher may refer to Piagetian ideas to formulate the strategies of teaching appropriate to age group of subjects. Constructivism has its roots in philosophy. The philosopher Giambatista Vico commented in a treatise (1710) "one only know something if one can explain it" (Yager, 1991). This idea matches with Constructivist thoughts. Immanual Kant further elaborated this idea by asserting that human beings are not passive recipients of information. Learners actively take knowledge, concept it to previously assimilated knowledge and make it theirs by constructing their own interpretation (Cheek, 1992). (Hanley Susan, as essay – "On Constructivism", 1994).

Constructivism is broadly classified into two positions viz.

1. Realist Constructivism
2. Radical Constructivism (Torstenflusen, Postlewaites, 1989)
1. **Realist Constructivism**

   It assumes that cognition is the process by which learners eventually construct mental structures that correspond to or match external structures located in the environment. It focuses on development of conceptual understanding and attempt to ensure that this understanding guides the performance of skills and procedures. In the course of learning process, students construct mental representations that accurately mirror the structure of the instructional materials in their environment. Realist Constructivism suggests a need to reconcile the characterization of knowing as the ability to participate in the intellectual practices of their society with the view that it involves construction of cognitive structures which mirror an environment that exist independently of human activity, culture and history.

2. **Radical Constructivism**

   It is influenced, by the theory of Piaget as interpreted and extended by Von Glaserfeld (1909). It believes that the learners construct sophisticated ways of knowing solely on the basis of their personal experiences as they attempt to achieve their goals by resolving situations that they find problematic.

   Radical Constructivism challenges realists’ hypothesis that true knowledge mirrors ontological reality. Realist constructivism locates knowledge at one pole of dualism – ontological reality and radical constructivism locates it at other pole-subjective experiences. Since 1987 researchers have used radical constructivism as a General orienting
framework within which to develop instructional strategies; frequently in collaboration with teachers. They believe that learning occurs as students develop effective ways to solve problems and involves reorganization of thinking to increasingly sophisticated levels. However, they need to elaborate their theoretical orientation so that it encompasses both collective activity and individual experiences.

**Moderate Constructivists Point of View**

Building powerful learning environments leads to an elaborate theory of learning in instructional settings, which also specifies the conditions that foster learning and hence to a renewed relationship between instructional psychology and instructional design. (Kessels and Plomp)

Learning is seen as a constructive act and the designer should provide for rich experiences by situating activities in authentic contexts and provide for exploration and sharing of multiple perspectives. The implication of this view for task analysis is that in some learning situations learning environment should not be limited to specific task elements and relationships.

From an extreme perspective, there is nothing that instructional designer can do to affect students' understanding and behaviour if knowledge is entirely constructed by students. If constructivists are right that students do not react in predictable ways to instruction and that what is taught has no factual, conceptual, rule-based on procedural foundations in the real world, it is pointless to design courses. However, not all constructivists take this radical position.
Wilson (1995) has described several ways in which traditional views of instructional design and contemporary views of Constructivism may both be applied to the design process. Human et. Al. (1989) had successfully implemented “small group, collaborative work, whole class discussions” approach to elementary school Mathematics on wide scale.

For many years, particularly under the influence of Piagetian interpretations of cognitive development, Constructivism was taken to mean that there should be no educational teaching instead, it was proposed that educators should arrange rich exploratory environments for children. In such environments, students would discover or invent knowledge for themselves. It is now known that arranging for students to construct their own knowledge is a far more complex matter filled with challenges that derive from the nature of expertise and learning (Renoic and Collins).

**Three general implications that follow from constructivism are**

1. Priority should be given to the development of meaning and understanding rather than the training of behavior.

2. Researchers and teachers should assume that students' actions are rational given the way that they currently make sense of things.

3. Students' errors and unanticipated responses should be viewed as occasions to learn about students understanding (Von Glaserfeld, 1989)
1.2.2 Constructivism in the Classroom


A high-school teacher was designing a project on finances for her students. Although she had taught this material several times in the past, she was not to integrate technology into the project. The teacher understood that students need time to explore the material so they can construct their own knowledge. She had read about Constructivist theory (i.e. students learn by taking an information from the world and constructing their own meaning from the experience as opposed to someone telling them bits of information) and had seen if modeled in her university courses.

However, when it came to implement this approach, she was reluctant to allow the students to be in-charge of their learning. She said, “I don't see that as teaching. The noise level was very loud and I was nervous when my principal walked in. What will he think about my teaching with all that noise? I just felt I was not doing my job. I know I should teach that way, but it is not my style.”

This may be a representative comment for the teachers who have at least once tried to integrate technology into educational practice. Although, teachers may have technical skills, they may not understand how Constructivism translates into effective classroom practice at least as demanding of teacher excellence as presentational instruction.
Traditionally, as teachers, we are taught to believe that learning takes place in a quiet and orderly setting. Activities in which students are taking an active role and sharing information with each other make for noisy classrooms. To an outsider, the classroom may appear to be in chaos. This does not mean students are not learning. Such activities are often more motivating and interesting to students because they are learner-focused and authentic encourage critical thinking and create knowledge, that is lasting, transferable and useful (Carr, Jonassen, Litzinger & Marra, 1998)

If approached in a constructivist manner, the teacher's job becomes one of facilitator or architect (Norton and Wiburg, 1998). Becoming a constructive teacher may prove a difficulty transformation since most instructors are prepared for teaching in the traditional, objectivist's manner. It "requires a paradigm shift" and "requires the willing abandonment of familiar perspectives and practices and the adoption of new ones." (Brooks and Brooks, 1993, p-25). Clearly, a lesson based on constructivism greatly differs from the traditional "teacher-as-lecturer" class type and denies the role of teacher as sole information given to passive students.

Although, not so much a theory of teaching as of learning, there are some behaviors teachers can emulate if they wish to follow a Constructivist paradigm. Hanley Susan represents a summary of some suggested characteristics of a Constructivist teacher (Brooks and Brooks, 1993) :

1. Become one of many resources that the student may learn from, not the primary source of information
2. Engage students in experiences that challenge previous conceptions in their existing knowledge.

3. Allow student responses to derive lessons and seek elaboration of student initial responses. Allow student some thinking time after posing questions.

4. Encourage the spirit of questioning by asking thoughtful, open-ended questions. Encourage thoughtful discussions among students.

5. Use cognitive terminology such as "classify", "analyze" and "create" when framing tasks.

6. Encourage and accept student autonomy and initiative. Be willing to let go off class from control.

7. Use raw data and primary sources, along with manipulative, interactive physical materials.

8. Don't separate knowing from the process of finding out.

9. Insist on clear expression from students. When students can communicate their understanding, then they have truly learned.

A teacher may structure lesson in the following format, which was condensed from current Constructivist literature and is not intended to be a rigid set of rules.

1. Engage student interest on a topic that has a broad concept. This may be accomplished by doing a demonstration presenting data or showing a short film.
2. Ask open-ended questions that probe the students’ preconceptions on the topic.

3. Present some information or data that does not fit with their existing understanding. Let the students take the bull by the horns.

4. Have students break into small groups to formulate their own hypotheses and experiments that will reconcile their previous understanding with the discrepant information.

5. During the small group interactions, the teacher's role is to circulate around the classroom to be a resource or to ask probing questions that aid the students in coming to an understanding of the principle being studied.

6. After sufficient time for experimentation, the small groups share their ideas and conclusions with the rest of the class, which will try to come to a consensus about what they learned.

Usually, the teachers worry that this type of classroom environment may be misinterpreted by others who see a Constructivist teacher not in control or not working hard. Eventually, the teachers focus on “appropriate behavior” from the students rather on learning process. The emphasis on “learning” results in long-term understanding of the material, while the emphasis on student conformance to discipline results in little recall of concepts over time (Katz, 1985)

In summary, Constructivist teaching offers a bold departure from traditional objectivist classroom strategies. The Constructivist approach
requires the teacher to relinquish his/her role as sole information-giver and instead to continually analyze his/her curriculum planning and instructional methodologies. Perhaps the best quality for a Constructivist teacher to have is the "instantaneous and intuitive vision of the pupils mind as it groups and fumble to grasp new idea. (Brooks & Brooks, 1993, p. 20). Clearly, the Constructivist Approach opens new avenues for learning as well as challenges for the teacher trying to implement it. (Hanley Susan, "On Constructivism", 1994).

1.2.3 Constructivism in Mathematics Education Research

Currently much research in Mathematics is guided by or consistent with a Constructivist perspective. Piaget was perhaps the best-known Constructivist. He did a great deal of empirical work with children and developed theoretical explanations including a description of the way knowledge construction occurs. Vygotsky developed a view that depends more on social interaction. Ernst Von Glasersfeld is known for his articulation and development of the ideas of Radical Constructivism.

In the Mathematics education community, Constructivism appears to have been very influential in legitimizing studies of students' mental processes such as how they learn to add or develop the concept of function. It has facilitated moving away from behaviorism, with its logical positivist viewpoint which tended to ignore the internal workings of the mind and thus effectively discouraged research on many mental questions. However, the emphasis gradually shifted to internal cognitive processes from mere
observable behaviors.

In popular usage, Constructivism is often used to refer to a teaching method or the advocacy of teaching method in which students construct (invent or discover) their own Mathematics. The following illustrations represent the general views about constructivism among the 'parents, teachers, peers etc. (Dede and Sprague, "Constructivism in Classroom, 1999).

**Illustration-1.** Certain parents dislike a — "teaching philosophy called constructivism that says children learn better if they construct something on their own- use a string to measure a circle and 'discover that the circumference is 3.14 times greater than the diameter". (June Kronholz, "Numbers Racket", The Wall Street Journal, Nov. 5, 1997).

**Illustration-2.** Constructivism apparently urges that the "students construct their own Mathematics". It is not clear where this will lead. Perhaps every student will construct his own algorithm for long division'. This doctrine holds that "students must somehow construct in their own minds all the basic notions of Mathematics". (Saunders Mac Lane, Letter to the editor, Focus, Feb. 1998).

This popular meaning of Constructivism is very different from the meaning in the Mathematics education research community. According to it, what is constructed (discovered) is Mathematics. E.g. that the ratio of the circumference of a circle to its diameter is independent of the circle's size. In contrast to this, according to Constructivism of Mathematics education
research, what is constructed is some kind of (personal) knowledge i.e. a structure in an individual mind which may not even be fully describable in words and which might or might not arise from discovery of Mathematics.

Furthermore, the Constructivism of the Mathematics education research does not refer to a particular teaching method, but rather provides a way of viewing learning, which can be used when analyzing many kinds of teaching.

'Constructivist Teaching' if it is used at all in the Mathematics education research community, is likely to be an umbrella term referring to teaching that is informed by constructivism i.e. that takes into consideration the idea that a student uses his/her prior knowledge in mentally constructing new knowledge.

Most popular meanings of Constructivism appear to be somewhat similar to that of 'discovery learning' which refers to a kind of teaching and learning based very roughly on the idea that student will learn well when they discover what is to be learned for themselves. Even in the 1960's when it was espoused by Harvard psychologist J. S. Bruner and others it was considered as an untested hypothesis. [L. S. Schulman and E. K. Krislar (Eds), Learning by Discovery: A Critical Appraisal, Rand McNally, 1966]. Currently, discovery learning is neither a major area of interest in Mathematics education research nor a driving principle in research based curriculum reform projects [Annie and John Selden (eds.), Research Samples Column].
The Constructivism greatly differs from other existing methods of teaching in its unique approach to study the learning process. The in facto details of Constructivist strategies and its implementation will be discussed in Chapter 3 and 4.

1.3.0 Rationale of the Study

As said earlier, Constructivism opens new avenues for the research in education and offers new challenges for the teachers to reform – the traditional methods of teaching. The teachers who believe that learning should be interesting and meaningful have to move past their concern that his/her role is of information dispenser and that of the students is of passive recipients. As suggested by Reigaluth (1992), they need to understand that their view of teaching is based on an educational model that has been around since the dawn of industrial age. By being writing to challenge that model through their own practice, the teachers can begin to educate other teachers and administrators to the power of student-centered learning enhanced by the appropriate use of technologies.

Influenced by constructivist ideas, the researchers decided to take up this approach to teaching Mathematics at middle school level. Researchers viewed Mathematics as the most appropriate subject for employing constructivist model because of the complex nature of this subject. On the part of teacher, it requires careful observations of internal workings of students' minds and analytical study of their thought processes. Also, the factors such as current status of Mathematics teaching (which is far from
satisfactory) and high rate of failure in Mathematics are attributable to the selection of this subject for the present study.

1.4.0 **Statement of the Problem**

To test the effectiveness of Constructivist Approach to teaching Mathematics at the middle school level.

1.5.0 **Operational definitions of the terms involved in the title**

i) Constructivist Approach: It means implementation of Constructivist Approach for teaching Mathematics to the students of experimental group of Std. VII of S.P.M. English School, Pune.

ii) Effectiveness: Difference in achievement of students taught by Constructivist approach and traditional method as measured by post-test.

iii) Mathematics: The entire syllabus of std. VII as prescribed by SSC Board, Pune of Maharashtra.

iv) Middle School level: Std. VII of SPM English School, Pune affiliated to SSC Board, Pune.

1.6.0 **Objectives of the study**

1. To compare effectiveness of Constructivist Approach and traditional method of teaching Mathematics to Std. VII students.

2. To evaluate the effectiveness of Constructivist Approach with respect to the objectives viz. knowledge, comprehension, application, process and skill.
3. To administer an opinionnaire to the students of experimental group to find out their opinion about Constructivist Approach of the teacher.

1.7.0 Hypothesis

There is no significant difference between the post-test scores of the students of control group and experimental group taught by traditional and Constructivist Approach respectively.

1.8.0 Limitations and scope

1. The study is restricted to Std. VII students of SPM English School, Pune. Total number of students: 47 + 47 = 94 (control and experimental group).

2. The study covers the entire syllabus of Mathematics for Std. VII prescribed by SSC Board, Pune.

3. The validity and reliability of the results have not been checked for larger number of students of different schools, for different media of instructions and for the subjects other than Mathematics.

1.9.0 Significance of the study

Conventionally, teacher is a sole information giver to the passive students. In Constructivist Approach, teacher has to become one of many resources that the student may learn from, and not the primary source of information.
In a Constructivist setting, knowledge is not objective. Mathematics and science are viewed as systems with models that describe how the world might be rather than how it is.

The role of teacher is to organize information around conceptual clusters of problems, questions and discrepant situations in order to engage the students’ interest. Ideas are presented holistically as broad concepts and then broken down into parts. The activities are student centered and students are encouraged to ask their own questions, carry out their own experiments and to make their own analogies and come to their own conclusions.

In summary, Constructivist Approach offers a bold departure from traditional classroom teaching. Surely, it will open new avenues for learning as well as new challenges for teachers trying to implement it.
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