CHAPTER I

CONCEPTUAL FRAMEWORK OF THE STUDY

I.1. Education

“Education is a liberating force and in our age, it is also a democrating force, cutting across the barriers of caste and class, smoothing out inequalities imposed by birth and other circumstances” - Indira Gandhi

As said by Indira Gandhi, Education plays the most important role in enhancing status of human beings. Education is a powerful tool which can bring about a radical transformation in society. Education is the dynamic side of one’s life.

The word education is derived from the Latin word ‘Educere’ which means ‘bring up’ or ‘develop’. So the function of education, thus, is to bring up or to develop children. The most popular meaning of the term education identifies with the process of instruction and training that takes place in an educational institution. Besides gaining knowledge and information, education also develops and promotes values, logical thinking and creativity. Education also helps an individuals to develop adjustment to the environment and have the control over it. It develops social and community responsibility in learning.

I.1.a. Nature of Education

Education is a tri-polar process where teacher, taught and social environment act and react with one another. It is a life-long process. It is a process of individual development. It is both theoretical and practical. It is science as well as art. It is an instrument which is used to attain better life. Education is essentially a process of growth and development which goes on throughout life. Education is the modification of behavior.
I.1.b. Different Views on Education

There are different views of education such as natural, nurtural and dynamic. Natural view considers education as the bringing out the inborn potentialities. Nurtural view considers leading an individual to the comfortable life. Dynamic view deals with the dissemination that includes transmission, preservation and enrichment of knowledge. The term “Knowledge” here refers to understanding of various concepts as a result of teaching and learning process. Mathematics is one such concept.

I.2. Mathematics

Mathematics is a science of calculation, a science of space and numbers and a science of measurement, magnitude and direction. In fact, the meaning of the word mathematics is ‘the science in which calculations are prime”. In this way, on the basis of these assumptions of mathematics, one can say that mathematics is the science of numbers, word, sign, etc, with which one can know about magnitude, direction and space.

I.2.a. Definitions of Mathematics

Mathematics is derived from Greek words ‘Manthanein’ which means ‘learning’ and ‘Techne’ which means ‘an art of technique’. Therefore, mathematics means the art of learning related to disciplines or faculties. The dictionary meaning of mathematics is that it is either the science of number and space or the science of measurement, quantity and magnitude. Mathematics is, thus, defined as the science of quantity, measurement and spatial relations. It is a systematized and organized branch of science. It deals with quantitative facts, relationships as well as with problems involving space and form.
According to J.B. Shaw, “Mathematics is engaged, in fact, in the profound study of art and the expression of beauty”.

According to Lindsay, “Mathematics is the language of physical sciences and certainly no more marvelous language was created by the mind”.

According to Aristotle “Mathematics is the study of quantity”.

According to Gauss “Mathematics is the queen of sciences”.

Websters’ New world Dictionary (1973) defines mathematics as the “science dealing with quantities, forms, etc and their relationships by the use of numbers and symbols”.

1.2.b. Characteristics of Mathematics

Mathematics has certain unique features which one could hardly find in other disciplines. The following are the important characteristics of Mathematics.

1.2.b.(i). Precision and Accuracy: Mathematics is known as an ‘exact’ science because of its precision. It is perhaps only subject which can claim certainly of results. In mathematics, the results are either right or wrong, accepted or rejected. There is no midway possible between right or wrong. Mathematics can decide whether or not its conclusions are right. Mathematicians can verify the validity of the results and convince others of its validity with consistency and objectivity. This holds not only for the expert, but also for anyone who uses mathematics at any level.

Even when there is a new emphasis on approximation, mathematical results can have any degree of accuracy required. Although precision and accuracy are distinctly different as criteria for the measures of approximation, they can be most
effectively discussed when contrasted with each other. The most effective measures of both precision and accuracy are in terms of the errors (positive or negative) involved. The precision of a measure or a computation is evaluated in terms of the apparent error. The accuracy of a measure or a computation is evaluated in terms of the relative error or percent of error made.

I.2.b.(ii).Logical sequence: Mathematics also possesses the characteristic namely logical sequence. The study of mathematics begins with few well-known uncomplicated definitions and postulates, and proceeds step by step to quite elaborate steps. It would be difficult to find a subject, in which the better gradation is possible, in which work can be adapted to the needs of the pupil at each stage, than in mathematics. Mathematics learning always proceeds from simple to complex and from concrete to abstract.

It is a subject in which the dependence on the earlier knowledge is particularly great. Algebra depends on arithmetic, the calculus depends on algebra, dynamics depends on the calculus and analytical geometry depends on algebra and elementary geometry and so on. Even within these topics, the same dependence is found.

I.2.b.(iii).Symbolism: Symbolism can be stated in a concise form as \( a+b = b+a \), and \( axb = bxa; a,b \in \mathbb{R} \). Almost all mathematical statements, relations and operations are expressed using mathematical symbols such as \(+, -, x, \%,<, >, =, \leq, \sqrt{\Sigma}, \) and so on. It is highly impossible to prepare a comprehensive list of all the mathematical symbols.

I.2.b.(iv).Abstraction: Mathematics is abstract in the sense that mathematics does not deal with actual objects in much the same way as physics. But, in fact,
mathematical questions, as a rule, cannot be settled by direct appeal to experiment. For example, Euclid’s lines are supposed to have no width, and his points to size. No such objects can be found in the psychical world. Euclid’s geometry describes an imaginary world which resembles the actual world sufficiently for it is a useful study for surveyors, carpenters and engineers.

Infinity is something that one can never experience and yet it is a central concept of mathematics. Our whole thinking is based on the assumption that there is infinitely many numbers, so that counting need never stop; that there are infinitely many fractions between 0 and 1, that there are many points on the circumference of circle, etc. Infinity, then, is not a concept corresponding to any objects that are seen or likely to see. It is abstract concept.

I.2.b.(v).Structure : In English dictionaries, one may discover that, generally speaking, a structure denotes ‘the formation, arrangement, and articulation of parts in anything built up by nature or art’. It seems reasonable to assume then that a mathematical structure should be some sort of arrangement, formation, or result of putting together of parts.

I.2.c.Importance of Mathematics

Mathematics is an important subject in school curriculum. It is more closely related to our daily life as compared to other subjects. Except the mother tongue, there is no other subject, more closely related to the daily life as Mathematics. Mathematics is considered as father of science. In present days, mathematics has been given an important place in school curriculum. In order to give an important place in curriculum, a particular subject must possess the following views.
➢ Utility of particular subject in daily life.

➢ Helpful in the development of mental discipline.

➢ Mathematics, thus, has the quality to be given important in school curriculum.

I.2.d. Aim of Teaching Mathematics

➢ To enable the child to understand the use of numbers and quantities related to their daily life.

➢ To enable the child to solve mathematical problems of daily life.

➢ To create a suitable type of discipline in the mind of the child.

➢ To familiarize child with the latest mathematical knowledge to fulfill the existing needs of the society.

➢ To give the knowledge about the broad objective of teaching mathematics such as knowledge, understanding, application, etc.

➢ To develop, in the child, fundamental skills and process of mathematics.

➢ To develop, in the child, a sense of appreciation of cultural arts.

➢ To prepare the child for elementary as well as higher education in science, engineering, and so on.

➢ To develop the habit of concentration, self-confidence, self-reliance and discovery.

➢ To develop, in the child, the mental powers like thinking, reasoning, and so on.

➢ To develop scientific and realistic attitude towards life.

➢ To give practical knowledge of mathematics to face the day-to-day problems.

➢ To prepare the child for technical professions such as those of accountants, auditors, bankers, surveyors, cashiers, scientists, architects and mathematics teachers.
➢ To bring an all-round and harmonious development of the personality of the child.

➢ To develop the sense of appreciation of mathematical knowledge and contribution of mathematicians.

➢ To develop the skill to use the modern mathematical device like computers.

➢ To develop the abilities of analysis, synthesis, reasoning, computation, and so on.

➢ To develop interest in mathematics.

I.2.e.Values of Teaching Mathematics

Values are regarded as desirable, important and are held in high esteem by the people who live in a particular society. Thus, values give meaning and strength to a person’s character by occupying a central place to all round development. Therefore, values reflect one’s personal attitudes, judgments, decisions, choices, behavior, relationships, dreams and vision. Napolean also remarked that the progress and improvements of mathematics is linked to the prosperity of the state. Therefore, mathematics plays an important role in the progress of society. Mathematics teaching has the values as given in the following figure.
I.2.f. Objectives of Teaching Mathematics

I.2.f.(i). Knowledge: The pupil acquires knowledge of terms, concepts, symbols, definitions, principles, processes and formulae of mathematics.

I.2.f.(ii). Understanding: The pupil develops understanding of terms, concepts, symbols, definitions, processes and formulae of mathematics.

I.2.f.(iii). Application: The pupil applies his/her knowledge and understanding of mathematics to unfamiliar situations.

I.2.f.(iv). Skill: To acquire skills of computation, drawing geometrical figures and reading tables, charts, graphs.
I.3. Mathematics Teachers and their Qualities

A person who teaches mathematics is called mathematics teacher. Mathematics teachers are supposed to have the following qualities.

I.3.a. Individual qualities

I.3.a.(i). Interest in mathematics: A mathematics teacher should have full command over subject matter. It is possible when he/she has interest in mathematics.

I.3.a.(ii). Positive attitude towards mathematics: A mathematics teacher should have positive attitude towards his/her teaching subject, because his/her self attitude directly influences the learning process of the children.

I.3.a.(iii). Resourcefulness: The teachers who have qualities of resourcefulness make arrangement of different means timely according to their needs and thus, succeed in making their teaching effective. A mathematics teacher should be creative and imaginative and both the qualities should be well mingled with his/her activities.

I.3.a.(iv). Self confidence and patience: A mathematics teacher should necessarily be self confident. For classification and analyzing the subject-matter, a teacher needs self confidence and patience. Lack of self-confidence and patience makes a mathematics teacher an irritative in nature and it costs bad influence on children. This leads him/her to fail in his/her teaching. The patience and self-confidence make a mathematics teacher be able to solve the problems of his/her students in very efficient manner.

I.3.a.(v). Good health: A mathematics teacher should be mentally and physically healthy. Generally it is said that a healthy mind lives in a healthy body. If health of a teacher is not good, he/she can’t perform teaching work efficiently, because power
and activeness bring prompts in teaching. It is not enough that a teacher is physically healthy but should be mentally healthy also.

I.3.a.(vi). **Personality** : Personality of teacher influences directly and indirectly to the students. So a mathematics teacher should do his/her work honestly, patiently and desirably. A teacher should continue his/her study. He/she should always be inspired to gain more and more knowledge with the use of different material, aids and different teaching methods, to maintain practical value of mathematics. A mathematics teacher should have experimental and heuristic attitudes.

I.3.b. **Professional qualities**

I.3.b.(i). **Knowledge of subject matter** : A mathematics teacher should have full knowledge of his/her subject. A title knowledge in subject-matter cannot make him/her trust worthy among students. A teacher can’t work with confidence unless he/she has full command over content. Lack of subject-matter knowledge puts fear in the mind of teachers that tended them to commit mistakes repeatedly.

I.3.b.(ii). **Presentation of subject matter** : A teacher should present the subject matter skillfully making interaction with the students, introducing good methods and applying various aids. Every problem should be introduced to the students logically and in a systematic manner. He/she should first judge maturity of the students, then he/she should apply different methods to make his/her teaching more effective and comprehensive.

I.3.b.(iii). **Knowledge of individual differences** : A good teacher is one who has the knowledge to judge individual differences because every student is different in reading and writing, understanding and work speed. He/she is successful when he/she makes teaching arrangement according to individual differences. A mathematics teacher should necessarily have knowledge of psychology to make him/her able to
understand interest, ability and capacity of different students and thus, he/she can guide them properly.

**I.3.b.(iv).Knowledge of different teaching methods:** With a firm grip over subject matter, a mathematics teacher should know different teaching methods. He/she should clearly know the aims and objective of mathematics. Thus, required teaching learning situations can be created. He/she should abstract the students by effective teaching methods like analysis, synthesis, methods, inductive-deductive method, laboratory methods and project and problem solving method so that the students may get the opportunity of learning by doing and the knowledge they have gained can be more permanent and solid.

**I.3.b.(v).Interest in research work and mathematics applications:** A mathematics teacher should be able to understand research work. A mathematics teacher should apply scientific and discovery methods for the solution of different mathematical problems. Priority should be given to experimental work so that students may be habitual of learning by self doing and hence the teacher can work as a scientist and research.

**I.3.b.(vi).Power to know the difficulties of the students:** It is very necessary for a mathematics teacher know where the students are feeling difficulty in solving problems. The solution of students’ problems depends upon the ability and capacity of the teacher to grasp them and there by a teacher gains popularity among the students. For a mathematics teacher, knowledge of psychology is also essential that helps him/her to diagnose the problems of the students.

**I.3.b.(vii).Inspiration to drill work:** Practical work through examples understands the basic concept of formulae. This method of learning makes them be creative and the knowledge received becomes permanent. He/she should examine the student both
through oral and written test so that different skills and habit of regulating can be developed in the students. So a mathematics teacher should inspire and motivate the students to do more and more drill work so that the students may learn through practice.

**I.3.c. Social qualities:** With individual and professional qualities, a mathematics teacher should have social qualities. Human being is a social creative and has to live in society and deal with the society and so social qualities are necessary to a mathematics teacher.

**I.3.c.(i). Leading capacity:** Mathematics teacher should have capacity to lead the students. Leadership quality in a mathematics teacher is different from other teachers. Teacher’s leadership totally is based upon his/her character and personality. If a teacher is sound in character and personality, he/she can inspire the students to participate in different activities in a group.

**I.3.c.(ii). Social feeling:** To be a good teacher, one should have some social feelings. The teachers should accept the social traits that help in classroom teaching and community. They should process high decision making power, courage, positive attitude, habit to accept the weakness and feelings of cooperation. Hence, they can establish good relationship wherever they work. By organising co-curricular activities, one can develop in students social feelings.

**I.3.c.(iii). Impartial behaviours:** A teacher should behave, with all the students equally. It is injustice and unsocial to have affection with an individual. A teacher should make no difference of rich or power, weak or intelligent, low or high, familiar or not-familiar. His/her behavior should be impartial with all the students. Along
with qualities discussed above, the mathematics teachers are supposed to have the ability of metacognition.

1.4. Metacognition

Today, one of the main goals of education is to make the students gain the thinking skills and strategies which they will use throughout their lives, rather than storing information. A good education should be able to show the students how to learn, how to remember, how to motivate themselves and how to control their own learning, so that they can teach how to learn. For all these reasons, metacognitive skills are quite important. The concept of metacognition has been considered in recent years in field of education as a concept that is worked on. Metacognition is the awareness one has about his/her thinking process and how he/she is able to control these processes. Metacognition strategies are the sequential process individuals use to learn how to control themselves and to reach a goal. They significantly help the arrangements and control of the individual learning. Metacognition concept was put forward for the first time in 1976 by John Flavell and developed by many researchers until today. Metacognition plays an important role in communication, reading comprehension, language acquisition, social cognition, attention, self-control, memory, self-instruction, writing, problem solving, and personality development. Metacognitive skills are usually conceptualized as an interrelated set of competencies for learning and thinking, and include many of the skills required for active learning, critical thinking, reflective judgement, problem solving, and decision-making. Adults whose metacognitive skills are well developed are better problem-solvers, decision makers and critical thinkers, are more able and more motivated to learn, and are more likely to be able to regulate their emotions (even in difficult situations), handle
complexity, and cope with conflict. Individuals with a high level of metacognitive knowledge and skills identify blocks to learning as early as possible and change ‘tools’ or strategies to ensure goal attainment. The person who has the awareness of metacognitive knowledge, is able to know about his/her own strengths and weakness, the nature of task at hand, and available ‘tools or skills’.

1.5. Origin of Metacognition

The idea of deliberate, planful and goal-directed thinking applied to one's thoughts to accomplish cognitive tasks can be traced to the developmental psychology of Jean Piaget (Inhelder and Piaget, 1958). Piaget's work, although somewhat modified in light of later advances in developmental psychology, has nevertheless had a tremendous impact on how researchers, practitioners, and the general public conceptualize child and adolescent child development (Flavell, 1963). During the 1960s and 1970s, a group of researchers extended Piaget's work to questions concerning not only how the storage and retrieval of information develops but also how it is controlled. Over the same twenty-year period, a substantial body of work emerged that would eventually be viewed as the foundations of metacognitive research (Brown, 1978, Belmont & Butterfield, 1969, Corsini, 1971, Hagen & Kingsley, 1968, Hart 1965, and Markman, 1977). Despite the potential applications of these inquiries, the methodology of the early research was not highly sophisticated, making rigorous theories not yet available.

It was not until the 1980s that researchers in cognitive psychology collaborated with researchers in developmental psychology and educational psychology to produce more sophisticated methodologies for assessing metacognition (Cavanaugh & Perlmutter, 1982, Kluwe, 1982, Schoenfeld, 1987, and Schneider,

While it was apparent that people who, for instance, were in self-paced learning tasks would divide their study time in ways that were not arbitrary or undirected, what was not so obvious, given the research program was not yet well-developed, was the specific metacognitive mechanisms that gave rise to those differences in study times. Not until researchers sought answers to questions about both the basis for peoples judgments of learning and the accuracy of those judgments. They were, then able to codify and integrate how students chose strategies and allocated their study time (Hacker, Dunlosky & Graesser, 1998). Once established, these methods would become especially relevant to educational situations where learners have some control over their study activities (Schunk & Zimmerman, 1994, Pressley, Harris & Guthrie, 1992, and Jones & Idol, 1990).

Admittedly, while some use of study strategies and application of prior knowledge during study probably are performed intuitively and occur without conscious regulation, a great deal of studying and academic self-management involves conscious decision making and self-regulation. The degree to which students confront academic demands is primarily determined by how adroitly they employ various strategies. Many researchers and practitioners are now convinced that by promoting metacognitive processes during instruction, more durable and transferable learning can be achieved. "Theoreticians," in fact, "seem unanimous the most effective learners are self-regulating" (Butler & Winne, 1995 p. 245). What is basic to the notion of metacognition is the idea of thinking about one's own thoughts.
Metacognition, more specifically, is an appreciation of what one already knows, together with a correct apprehension of the learning task and what knowledge and skills it requires, combined with the agility to make correct inferences about how to apply one's strategic knowledge to a particular situation, and to do so efficiently and reliably (Barrows, 1988, Hartman, 1990, Paris & Myers, 1981, Schoenfeld, 1987, Paris & Winograd, 1990). These are the skills that enable students to change themselves from passive learners to active learners.

I.6. Definitions of Metacognition

**Flavell** (1976) sees metacognition as “the cognitive processes or outcomes of individuals or the knowledge of anything about them”.

According to **Brown** (1980) metacognition includes the capabilities such as the estimation of one’s own mental activities, planning, monitoring, and evaluation.

**Welton** and **Mallan** (1999) see metacognition as controlling and redirecting their own thinking processes consciously to think independently.

**Brown, Campione, and Barely** (1979) defined it as the control processes in which active learners engage as they perform various cognitive activities.

A recent definition describes metacognition as “one’s knowledge and beliefs about one’s own cognitive process and one’s resulting attempts to regulate those cognitive processes to maximize and memory” (**Ormrod**, 2006).

I.7. Components of Metacognition

Metacognition refers to one’s knowledge concerning one’s own cognitive processes or anything related to them (Flavell 1976). It consists of both.

1. Metacognitive knowledge
2. Metacognitive control
1.7.a. **Metacognitive knowledge**: Metacognitive knowledge refers to one’s knowledge and beliefs in his/her mental resources and his/her awareness about what to do. Metacognitive knowledge means one’s own cognitive strategies and knowledge about what to do under which circumstances (Flavell, 1979). Metacognitive knowledge is further subdivided into three categories as follows.

(i). Knowledge of person variables: It refers to how human beings learn and process information, as well as individuals’ knowledge of one’s own learning processes.

(ii). Knowledge of task variables: It includes knowledge about the nature of the task as well as the type of processing demands that it will place upon the individual.

(iii). Knowledge of strategy variables: It includes knowledge about cognitive and metacognitive strategies and about when and where it is appropriate to use them.

1.7.b. **Metacognitive control**: However, metacognition requires one, besides the knowledge mentioned above, to use this knowledge effectively. The ability to use metacognitive knowledge is called metacognitive control skills. It consists of leading mental operations in metacognitive processes and can be defined as the ability to use the metacognitive knowledge strategically in order to attain cognitive objectives (Coutinbo, 2007). Metacognitive control is considered as the ability to use knowledge to regulate and control cognitive processes. It is related with metacognitive activities that are considered as the ability to use knowledge to regulate and control cognitive processes. It is related with metacognitive activities that help to control one’s thinking and learning (Ozsoy, et.al, 2009). It helps to regulate and oversee learning, and consists of planning and monitoring cognitive activities, as well as checking the outcomes of those activities.
I.8. Metacognitive skills

Metacognition refers to learners’ automatic awareness of their own knowledge and their ability to understand, control and manipulate their own cognitive process. Metacognitive skills are important not only in school, but throughout life. Mumford (1986) says that it is essential that an effective manager be a person who has learned to learn. Metacognitive skills are important organizers of all of the tasks that one performs. They enable planning, setting goals, initiating work, sustaining future-oriented problem solving activities, monitoring and managing progress on tasks to detect and correct errors, and keeping track of the effect of one’s behaviour on others.

I.9. Principles of Metacognition

I.9.(i). Planning: Planning is the prerequisite of any activity (Dirkes 1985). The success of any endeavor depends upon proper planning. Planning as far as any learning activity is concerned consists of the following aspects. The learners should have self-awareness on these aspects. (Wenniert, 1987). They are goal setting, time management, analyzing, strengths and weaknesses, analysis of previous learning, anticipation, self responsibility, self determination etc., (Khun,1988, Schohenfeldl, Borkoweski, 1983). Awareness on these aspects will be very helpful to take up the learning activity successfully.

I.9.(ii). Focusing attention: Focusing attention or selective listening is the next strategy for achievement. ‘O’ Malley and Chamot listed strategies which are the higher order executive skills that may entail planning, monitoring or evaluating the success of a learning activity.

I.9.(iii). Information management: In learning, the students have to adopt a number of metacognitive skills. They have to process the information for proper understanding. During processing of the information successful learners adopt
number of techniques. They are translation, conceptualization, combination, assimilation and elaboration.

1.9.(iv).Memory: While learning, learners have to remember a number of facts, ideas, incidents, years, concepts, etc. New knowledge should be associated with previous knowledge to remember better (John Flavell, 1985; Michael Dressley). So the learner has to employ a number of techniques to remember the new information, retrieve previous knowledge, etc. Use of mnemonic strategies helps learners to retrieve the information they need. Successful learners deliberately employ certain mnemonic strategies to remember better.

1.9.(v).Monitoring: Self regulation or monitoring one’s own learning plays an important role in metacognition (Hive, Newmann 1999, Stewar, 1983). Successful learners employ a number of techniques while learning to check their learning process. They are self questioning, self talk, self management of resources, strategies selection, self reporting, self appreciation etc. (Sternberg, Spear, Swerling 1996). Metacognition involves the active monitoring and consequent regulation and orchestration of various processes such as meta memory and meta learning (Pesut, 1990).

1.9.(vi).Evaluation: After the learning process, learner should evaluate themselves to find out whether they have reached the learning outcomes. It is termed as self evaluation. Self Evaluation helps the learners to check whether the objectives of learning are achieved or not. Some of the techniques are self checking, error detection, self correction, de bugging, self review, self questioning, and self judgement (Wong 1986, Wenniert, Kluwe 1987, Paris, Wasik 1988).
Figure I.2
Metacognitive principles of intellectual alertness

Selection of the content

Planning
- Setting goals
- Time setting
- Strength-weakness
- Look for help

Monitoring
- Selective focus
- Self questioning
- Mnemonics
- Self regulation
- Any other strategy

Evaluation
- Errorduction
- Self checking
- Debugging

Achievement
I.10. Models of Metacognition

I.10.a. Flavell’s model of metacognition

A number of models have been proposed from different conceptualizations of metacognition. Some are more general and provide a theoretical framework for metacognition. The models proposed by Flavell (1976) and Brown (1978) explain metacognitive knowledge and metacognitive experience especially well. Metacognitive experience refers to executive processes such as awareness, control and evaluation. The models by Flavell and Brown can be used as good guides for readers to understand and conceptualize the components of metacognition.

In his work, Flavell (1976) proposed that our metacognitive knowledge base consists of what we have learned, through experience, about cognitive activities. He further mentioned that it could be subdivided into three highly interactive knowledge variables personal variables, task variables, and strategy variables. Flavell suggested that a strong metacognitive knowledge base is critical to successful learning and a good learner is one who has metacognitive knowledge about the self as learner, about the nature of the cognitive task at hand, and about appropriate strategies for achieving academic goals. Figure I.3 explains the components of metacognition as stated by Flavell.

Figure I.3
Flavell’s model of metacognition

![Flavell's Model of Metacognition Diagram](image-url)
Four classes of metacognition phenomena can also be depicted as follows:

1. **Metacognitive Knowledge**
   Started knowledge and beliefs about people as cognitive creatures. Cognitive tasks, goals, experiences, beliefs about self as a learner and thinker.

2. **Metacognitive Experiences**
   Conscious affective experience

3. **Tasks and Goals**
   The objectives of a cognitive enterprise and information available during a cognitive enterprise

4. **Strategies (Actions)**
   Cognitions and other behaviors employed to achieve goals and tasks

- **Person Variable**
- **Task Variable**
- **Strategy Variable**

- **Manner of Delivery**
- **Pacing**
- **Abundant or meager Information**
- **Well or poorly organised**
- **Trustworthy at untrustworthy**
- **Familiar or Unfamiliar?**
- **Match strategies and goals to information available**
The first attempt to generate a formal model of metacognition was presented by Flavell (1979). He acknowledged the significance of metacognition in a wide range of applications which included reading, oral skills, writing, language acquisition, memory, attention, social interactions, self-instruction, personality development and education.

**I.10.b. Brown’s model of metacognition**

Brown (1987) divides metacognition into two broad categories. The first category is related to knowledge of cognition which involves the reflection of cognitive abilities and activities. This involves the conscious reflection of cognitive activities during the accomplishment of a task. The second component of metacognition is related to self regulatory mechanisms employed during an ongoing attempt to learn or solve problems. This mechanism is defined by Brown as the regulation of cognition. According to Brown, the knowledge of cognition and the regulation of cognition are closely related to each other. The knowledge about cognition is stable, fallible and often late developing in human thinkers and learners. In the beginning, metacognition was considered to be ‘knowing about knowing’ (Brown 1987). Whereas, regulation of cognition consisted of activities used to regulate and control learning activities, monitoring activities and evaluating activities. Brown feels that expert learners are normally equipped with a high degree of metacognitive awareness and are able to monitor and evaluate their learning activities strategically.
I.11. Facilitation of Metacognition

Here are some strategies which teachers can use in their classroom to help students develop metacognition.

- **Identifying “what is known” and “what is not known”**
  At the beginning of a research activity students need to make conscious decisions about their knowledge. Initially students write “What they already know about…” and “What they want to learn about…” As students research the topic, they will verify, clarify and expand, or replace with more accurate information, each of their initial statements.

- **Talking about thinking**
  Talking about thinking is important because students need a thinking vocabulary. During planning and problem solving situations, teachers should think aloud so that students can follow demonstrated thinking processes. Modeling and discussion develop the vocabulary students need for thinking and talking about
their own thinking. Labeling thinking processes when students use them is also important for student recognition of thinking skills.

Paired problem solving is another useful strategy. One student talks through a problem, describing his/her thinking processes. His/her partner listens and asks questions to help clarify thinking. Similarly, in reciprocal teaching (Palinscar, Ogle, Jones, Carr, & Ransom, 1986), small groups of students take turns playing teacher, asking questions, clarifying and summarizing the material being studied.

➢ **Exposure to problem solving strategies**

Other sources of metacognitive instruction especially with older students can be the biographies, journals, letters and other personal writings of famous experts in the field they are studying. Such exposure to the problem solving strategies of legendary thinkers can be inspirational and informative for students.

➢ **Using prompts**

Using prompts such as ‘What can do first?’, ‘What else might try?’ and ‘How well is strategy working?’ reminds the students to think about their thinking while they are working.

➢ **Keeping a thinking journal**

Another means of developing meta-cognition is through the use of a journal or learning log. This is a diary in which students reflect upon their thinking, make note of their awareness of ambiguities and inconsistencies and comment on how students have dealt with difficulties. This journal is a diary of process.

➢ **Planning and self regulation**

Students must assume increasing responsibility for planning and regulating their learning. It is difficult for learners to become self directed when learning is planned and monitored by someone else.
Students can be taught to make plans for learning activities including estimating time requirements, organizing materials, and scheduling procedures necessary to complete an activity. The resource center’s flexibility and access to a variety of materials allow the student to do just this. Criteria for evaluation must be developed with students so that they learn to think and ask questions of themselves as they proceed through a learning activity.

- **Debriefing the thinking process**

  Closure activities focus student discussion on thinking processes to develop awareness of strategies that can be applied to other learning situations.

  A three step method is useful. First, the teacher guides students to review the activity, gathering data on thinking processes and feelings. Then, the group classifies related ideas, identifying thinking strategies used. Finally, they evaluate their success, discarding inappropriate strategies, identifying those valuable for future use, and seeking promising alternative approaches.

- **Self evaluation**

  Guided self evaluation experiences can be introduced through individual conferences and checklists focusing on thinking processes. Gradually self evaluation will be applied more independently. As students recognize that learning activities in different disciplines are similar, they will begin to transfer learning strategies to new situations.

**I.12. Importance of creating a metacognitive environment**

A metacognitive environment encourages awareness of thinking. Planning is shared between teachers, school libraries, media specialists, and students. Thinking strategies are discussed. Evaluation is ongoing.
The metacognitive abilities of students grow and thrive in an environment where the actual processes of thinking are an important part of the instruction and conversation during the day. To create this environment teachers and students must develop a language of thinking that they all use consistently. When teachers use terms like ‘strategy’, ‘process’ and ‘metacognition’ frequently, teachers communicate their importance to students and emphasize the processes that are important for effective learning.

Metacognitive strategies are already in teachers’ repertoires. One must become alert to these strategies and consciously model them for students. Problem solving and research are activity in all subjects provide opportunities for developing metacognitive strategies. Teachers need to focus students’ attention on how tasks are accomplished. Process goals, in addition to content goals, must be established and evaluated with students to enable them to discover that understanding and transferring thinking processes improves learning.

**I.13. Steps Involved in Learning a Metacognitive Skill**

Learners with good metacognitive skills are able to monitor and direct their own learning processes. When learning a metacognitive skill; learners typically go through the following steps (Pressley, Borkowski and Schneider, 1987).

**I.13.(i).** Learners establish a motivation to learn a metacognitive process. This occurs when either they themselves or someone else gives them reason to believe that there would be some benefit to knowing how to apply the process.

**I.13.(ii).** They focus their attention on what it is that they or someone else does that is metacognitively useful. This proper focusing of attention puts the necessary information into working memory. Sometimes this focusing of attention can occur through modelling, and sometimes it occurs during personal experience.
I.13.(iii). They talk to themselves about the metacognitive process. This talk can arise during their interactions with others, but it is their talk to themselves that is essential. This self talk serves purposes:

- It enables them to understand and encode the process.
- It enables them to practice the process.
- It enables them to obtain feedback and to make adjustments regarding their effective use of the process.
- It enables them to transfer the process to new situations beyond those in which it has already been used.

I.13.(iv). Eventually, they begin to use the process without even being aware that they are doing so. This process usually represents a high level implementation of the phases of learning and instruction described by Gagne.

I.14.Dimensions of Metacognition

I.14.(i).Planning : It involves metacognition that is related to starting a problem and organization of knowledge. The learners should have self-awareness on some aspects. They are goal setting, time management, self determination and self responsibility.

I.14.(ii).Memory : This refers to the learners’ awareness of knowledge about their own memory systems and using their memories effectively.

I.14.(iii).Monitoring : It involves metacognition that is related to checking the progress of a solution to a problem. Its focus is on the ability of student themselves to monitor their solving process and to maintain the attitude necessary to solve a problem. Some of the techniques are self checking, self talk, self appreciation, self questioning, and so on.
I.14.(iv). Evaluation: It involves metacognition that is related to checking the reasonableness of a solution to a problem. Some of the techniques are self checking, error detection, self correction, self review and self judgment.

I.14.(v). Achievement: It involves metacognition that is related to basic ideas of mathematics. Some of the techniques are to recall basic skills and recall the basic ideas.

I.15. Metacognition and its impact on Teaching

Many teachers are likely to have inert knowledge about teaching (and learning). Teacher education commonly provides teachers with a variety of classroom methods, but doesn’t always ensure teachers understand when, why, and how to use them. As a result, much of what teachers have learned may remain inert or inactive, due to lack of knowledge of the contexts and procedures for using these methods.

Teachers who demonstrate a wide range of metacognitive skills perform better in their teaching and complete work more efficiently, planning the way to approach a task, monitoring, comprehension and evaluate the progress towards completion of a task. These are the metacognitive skills that may help the teachers to improve their competency in teaching. Metacognition has its following impact on teaching,

- It enables awareness and control over how teachers think about their teaching.
- It enables the teachers to self regulate their teaching activities, depending upon the specific students, goals and situation.
- Some metacognition is domain specific and some is domain general.
- Two general types of metacognition are executive management strategies that help the teachers to plan monitor and evaluate/revise their thinking process and products, and strategic knowledge about what information/strategies/skills that they have, when and why to use them, and how to use them.
Executive management metacognition in teaching includes planning what and how the teachers are going to teach, checking up on or monitoring how the lesson is going on while teaching, making adjustments as needed, and evaluating how a lesson went after it is finished. Based on internal and external feedback, the last phase of evaluating is planning how to improve your future performance in similar situations, thereby completing an executive management cycle.

Metacognition in teaching also includes knowing what instructional strategies are in teacher’s repertoire, what they entail, when and why to use them, and how to apply them. This type of metacognition is needed for effective planning of a lesson, for switching gears during or after a lesson upon awareness that a teaching approach isn’t working as expected, and selecting alternative approaches. Research suggests pre-service teachers need such explicit information about teachings strategies, because they may not know how to implement teaching strategies they learn in their undergraduate courses.

These general types of metacognition help teachers teach intelligently across subject areas and help them maximize their impacts on students by systematic reflection on and improvement of instruction.

I.16.Teaching

Whether one is teaching at preschool level, school level or higher level, whether one is teaching languages, Sciences, Mathematics, History, Geography, Commercial subjects or technical subjects, every classroom teacher has certain functions to perform. Though teaching is one of the oldest professions, as old as mankind, and has been with them for a long time, a unified conception of teaching
acceptable to all has not yet been arrived at. The concept of teaching is like a blurred picture. It is a vague concept, its boundaries are not clear.

Teaching and training are not identical. Training can be considered as a subaspect of teaching. It resembles teaching in so far as it is aimed at action which displays intelligence. Teaching is formation of habit and training is a method of shaping habit. Teaching may be said to be essentially a two fold activity. It involves communicating information which can be called instructing. It also includes communicating judgment which includes helping to develop the ability to feel, think, use information, interpret and enjoy intellectual virtues among the students.

Teaching can be considered as a triadic relationship among the teacher, the learner and the subject content. This triadic relationship is dynamic and over changing; changes in the student and changes in a body of knowledge induce changes in the teacher and their interrelationship.

Teaching is a complex art and is dependent on method of teaching, curricula, infrastructure, technology, and so forth. It is a demanding job that requires in-depth knowledge of subject content and age-specific pedagogy. It also calls for divergent skills such as patience, leadership, creativity, administration, counseling and media specialization and so on. The individuals, who teach the students answer the call, encounter many frustrations. They are required to develop goals for classroom instruction and with these goals they should develop lesson plans while transacting effective classroom management. They should also monitor and nourish the special needs of every child and stand with current educational advancement and topic knowledge. Secondary school teachers facilitate the students to learn in depth to disseminate more information pertaining to subjects introduced in elementary and
middle schools. They specialise in a specific subject such as Tamil, English, Mathematics, History, Physical Science, Biological Science and Vocational disciplines.

Robin (2000) defines, “Teaching is offering a unique, definite, and essential social service. It is an emphasis upon intellectual techniques in performing its service. It has a long period of specialized training and a broad range of autonomy for both the individual practitioner and the occupational group. As a whole, the practitioners perform and act within the scope of professional autonomy”.

People have always felt that the teachers must possess excellence in all respects of their conduct which is going to affect children’s behavior positively. Besides, if teachers’ disposition is bored, it would also influence children’s living socially and morally upright. In fact, good teachers are models of social and moral leadership which not only influence their students but also generate impetus (force) for all-round growth of a country. One who really wants to be a good teacher has to have excellence in communication not only oral but also in writing. Teachers should have content knowledge and effective teaching.

Rabindranath Tagore has said, ‘The teachers can never truly teach, unless they are still learning. A lamp can never light another lamp unless it continues to burn its own flame’. This statement clearly reveals that the journey of teachers does not end with pre-service training but that it continues throughout their career. The primary responsibility of creating a suitable environment rests on the shoulders of the teachers.
Teaching is more than a method or skill or style. Teaching has its own forms, its own elements, its own regularities. It takes place under specific conditions such as time limits, authority relations, individual abilities and instructional structures and is influenced by an environment which contains such factors as more, organizational structures, cultural resources as well as physical resources and persons.

Teaching is an art, a science, a skill and a technology. The teacher has to have the creative proficiency of an artist, precise attitude of a scientist and perfected skill of a craftsman. It is the very complexity of the teaching situation that makes it a demanding art. With freedom to adopt teaching to achieve goals with the infinite variety of students, teaching becomes an art—an art that builds upon knowledge and skill. Teaching is an immortal profession.

I.17.Teacher Education with special reference to secondary school teacher education

The success of the education system is dependent more on the teachers than on other facilities. Selecting the right type of prospective teachers and providing relevant professional education to them will go a long way in improving the quality of education. There are five types of teacher education in Tamil Nadu.

a. Pre-primary teacher education
b. Primary teacher education
c. Secondary teacher education
d. Higher secondary teacher education
e. Higher studies-Higher education
I.18. Secondary Teacher Education

Secondary education is described as the weakest link in the educational chain. Secondary education pays the way for those who want to take up jobs. Secondary school teachers undergo training in colleges of education after graduation. These colleges are under the control of universities. Successful candidates were awarded L.T. and B.T. With the changing concept of teacher preparation, now the nomenclature of the degree is known as Bachelor of Education (B.Ed.). B.Ed. is a one year course, after university graduation secondary grade trained teachers with a B.A. or B.Sc. degree can also take this course, if they desire to do so. The trainees specialise in two optional subjects, which they had specialized in the degree course and which they will teach in the high school.

I.19. Objectives of Secondary Teacher Education

The objectives of secondary teacher education are to enable the prospective teachers.

- to possess the competence to teach subjects of his / her specialisation on the basis of accepted principles of learning and in the content of the new school curriculum.

- to develop skills, understanding, interest and attitude which would enable his / her to foster all round growth and development of the children under his / her care.

- to possess sufficient theoretical and practical knowledge of health and physical education, games and recreational activities and work experiences.

- to develop skills in identifying, selecting, innovating and organising learning experiences for teaching the general and special subjects.
to develop understanding of psychological principals of growth and development and individual differences.

to develop skills in guiding and counseling the children in solving their personal as well as academic problems.

to understand the role of the school in changing the society.

to underline investigatory projects and action research.


The graduate training (B.Ed.) course is for ten months duration. During this short period of training, the prospective teachers are trained in methods of teaching covering at least two subjects. The prospective teachers who have completed under graduate degree should select either English or Tamil as one of the optionals. The prospective teachers acquire theoretical knowledge of the method of teaching these subjects. Besides, they undergo practical aspects of training that consist of the activities of observation, demonstration and criticism of lesson. The Objectives of B.Ed. Mathematics programmes are to enable the prospective teachers.

- to understand the nature and development of mathematics.
- to understand the aims and objectives of teaching mathematics.
- to know the importance of teaching mathematics in relation to other subjects.
- to formulate the general instructional objectives and specific learning outcomes.
- to acquire competence in teaching mathematics and structuring lesson plans.
- to apply methods of teaching of mathematics.
to understand the various psychological aspects involved in teaching mathematics.

to understand the curriculum development in mathematics.

to understand the models of teaching mathematics.

to know the importance of learning theories and strategies in mathematics.

to acquire the skills on the usage of learning theories in mathematics

to acquire the skills of organising mathematical laboratory.

to know the importance of aesthetic and recreational mathematics.

to know the importance of computers in teaching and learning of mathematics.

I.21. Present Status of Teacher Education

In those days teaching was taken up by people who were passionate about it. Now most are in it out of compulsion or by accident. The security of a permanent teaching job still ensures a steady demand for B.Ed., courses but not with high motivation and inclination for the profession. There are no role models to inspire the applicants and absolutely no inspirational content. The attraction is merely due to the availability of a license for appointment. Mushrooming of teacher education institutions with faculty raw and inexperienced and unsuitable for teacher education institutions is the common scene nowadays.

Teacher Education means professional preparation of teachers. It is a preparation of persons for family, for society and for the country. It is nurturing of creativity, inculcation of commitment and generation of strong will to contribute at the highest level of efficiency through a value-based approach. It is an important human vehicle to improve the quality of school education. It is the process, which makes the individuals realize the magnitude and potentialities; and if it is nurtured and
inculcated in the right direction, it could make significant contribution to the identified sectors. It empowers the individual with necessary skills and competence for achieving personal development.

Teacher education in our country has large dimensions in terms of administrative and organizational structure at different levels, policy making, academic inputs, regulatory mechanism, financial powers, etc. All these come under three major factors such as

i. Input-building, equipment, library, laboratory, books, classrooms, teaching-learning material, audiovisual aids, playground and human resources

ii. Process-training, teaching and learning received by teachers and students, methods, approaches, transactional modes and

iii. Product-students’ achievement teachers’ commitment towards their profession and overall development of students and teachers

Education enriches a society. Teacher education also enriches it more in the sense that the qualitative improvement of the society depends primarily on the qualitative teachers and teaching. It inculcates the necessary psychological skills and competencies among teachers and makes them professionally able to meet the demands of the society. More and more prioritized zones of teaching for human development and excellence come under the purview of teacher education. The teachers now work or discharge their duties and responsibilities genuinely as promoters or accelerators of human resource development.

Teachers are said to be the builders of nation. It is with this view that the Secondary Education Commission considered teacher as the most important factor in the contemplated national reconstruction. A teacher, through an interactive process,
shapes the personality of the students and attempts to make them citizens. Thus, he/she shares the responsibility of shaping the destiny of our country. A positive favourable attitude makes the work not only easier but also more satisfying and professionally rewarding. A negative unfavourable attitude makes the teaching task harder, more tedious and unpleasant. In addition, a teachers’ attitude not only affects his / her behavior in the classroom but also influences the behavior of his / her students. Moreover, effective and productive learning on the part of the pupils can be achieved by employing teachers with desirable attitudes by shaping their attitudes in the desired direction. The attitudes and aptitudes of the teachers are shaped even when they are the prospective teachers.

**Figure I.6**

**Characteristics of prospective teachers**

<table>
<thead>
<tr>
<th>Values</th>
<th>Emotional intelligence</th>
<th>Cognitive ability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Honesty, Tolerance, Sensitivity, Flexibility, Sympathy, Punctuality</td>
<td>Emotional stability, Motivation, Empathy, Cooperation, Decision making, Judgment skills, Managing stress.</td>
<td>Strengthen their attitudes, General knowledge, Broad mindedness, participation in professional development, Obedience to higher authorities, Accepting individual differences</td>
</tr>
<tr>
<td>Teaching Competency, Managerial, Organisational, Evaluative, Leadership, Interpersonal Communication</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
I.22. Role of Teacher Educators in developing Metacognition

- The teacher educators should provide some activity related to the topic of the day as planned in the course outline, in which the learner can react in a desired way.
- The teacher educators should involve the learners so that they participate and accept same responsibility for the learning process.
- The teacher educators should be competent to teach the subject allotted to them.
  At the same, they should follow good techniques of teaching to make learning fruitful.
- The teacher educators can encourage leadership qualities, democratic outlook and reasoning and debating.
- Teacher educators should continuously read and then only they can gain up to date knowledge, otherwise technology will expose their ignorance.
- The teacher educators have always to be learner and change in teaching notes with the availability of the knowledge on the topic.

I.23. Teaching Competency

Teaching competencies includes knowledge, skills and values the student teacher, must demonstrate for successful completion to the teacher education programme (Houston 1987).

Teaching competencies are functional abilities which teachers show in their teaching activities. It is rightly said that teaching competency is an ability to apply to practical situations, the essential principles and techniques of teaching. It includes knowledge of contents as well as processes, and methods and means of conveying in an interesting way.
I.24. Definition of Teaching Competency

Donald M. Medley (1982) defined the teaching competency as ‘those of knowledge, abilities and beliefs a teacher process and brings to the teaching situation’.

I.25. Importance of Teaching Competencies

International Encyclopedia of Teaching and Teacher Education classified teaching competencies into six classes. They are

- Cognitive based teaching competencies
- Performance based teaching competencies
- Consequence based teaching competencies
- Exploratory competencies
- Managerial teaching competencies
- Affective teaching competencies

I.26. Repertoire of Teaching Competencies

The teacher’s repertoire consists of the following

- **Knowledge of Subject Matter**: Adequate knowledge in the content areas is essential for any teacher to perform competently. The acquisition of knowledge and understanding of any subject would not be just a matter of collecting facts and information about the subject, more importantly; it is learning to think in a way that is characteristic of that discipline. The knowledge, thus, acquired are organised conceptually to provide a conceptual structure to the discipline, which is coherent and stable.

- **Planning**: Teachers’ planning refers to the aspect of teaching where teachers formulate a course of action. It is an activity that is typically carried out in the absence of students and before the actual teaching. Teacher’s plans which serve as ‘scripts’ (Whether they are done on paper or in one’s mind), include decisions on
what to teach and how to teach the chosen content. It involves deciding what to teach first, and what next and also planning for other supplementary activities that might act as a ‘bridge’ or a ‘gap-filling exercise’. The competencies required to perform these tasks involved in planning are mostly cognitive and can be mastered by practice.

Motivation: Even when the plan is good, an important function of the teacher in implementing it is to motivate the learners who are de-motivated to the task of learning and nature those who are already well motivated. There are several ways in which one can achieve this:

- By giving students meaningful, relevant and interesting things to do.
- By adopting a positive attitude towards learners, praising and encouraging the positive efforts by learners will help to keep up motivation.
- By giving encouraging feedback to their responses to oral questions or written assignments.
- By involving learners in the classroom activities that demand inter-student communication and co-operative efforts on their part.
- By linking the day’s lesson with that of the next and also (if possible) to other subjects by drawing from their past experiences and proceeding at a pace that is most suitable to them.
- By building into the tasks, some amount of flexibility, so that learners with varying abilities and experiences find them challenging enough even while, not frustrating their efforts.

Presentation and communication: After ensuring the students’ interest in the learning, teacher in the classroom has to transact with the students in the context of a specific subject matter. The teacher is expected to communicate with the students in a number of ways so that the learners attain various types of learning
outcomes. In order to achieve this effectively, the teacher may have to manifest various types of skills including lecturing, explaining, eliciting through questions, conducting discussion, dramatizing, reading, demonstrating, using audiovisual aids, and so on. All these may be categorized into skills for effective presentation and communication in the instructional situation.

**Evaluation:** Evaluation of the students’ achievement of a pre specified objective is part and parcel of a teacher’s function. The evaluation skills include preparing question papers and conducting viva voce. But these are only a part of the total evaluation function of a teacher. He/she has to observe the students in many different situations in order to judge the extent to which the expected terminal behaviours have been actually achieved by them. This includes so many activities. A teacher has to first of all, select the suitable techniques and tools of evaluation. It is obvious that one cannot measure the length of a stick by using a weighting machine. Similarly, for measuring the skills of performing experiments, one cannot have a written examination. Hence the teacher has to select the suitable techniques and tools for measurement according to what he/she would like to measure.

Once the tools are decided on, one has to set about measuring the concerned behaviour. This would give the actual achievement of the terminal behaviour. A teacher should compare the actual terminal behaviour of the students with their expected behaviour. This helps him / her to judge the extent to which the expected terminal behaviour has been achieved. The gap between the two indicates the areas in which students have not learnt. The teacher should make use of this feedback to improve his / her teaching as well as to provide the necessary remedial help to the students. All these activities mentioned, need competencies on the part of the teacher and it is called Evaluation Competencies.
Classroom management and discipline: Instructional process in the class can go on effectively only when there is a healthy and conducive climate in the classroom. Thus, classroom management becomes a very critical function of a teacher. The teacher has to possess various skills which would help him in managing the class in such a way with a healthy and conductive climate.

I.27. Preparation of Mathematics Teachers before going to the class

I.27.a. Previous knowledge and experience of the children: A mathematics teacher should know well the previous knowledge and experiences of the children before going to the class. Then he/she should link previous knowledge of the children to their new knowledge.

I.27.b. Selection of teaching aids and required apparatus: To make his/her teaching effective, a teacher should select and arrange the different teaching aids and apparatus systematically before going to the class. Thus, he/she can make the teaching and learning more smooth and affective.

I.27.c. Selection of appropriate examples: Before going to the class, a mathematics teacher should consider that what type and how much examples he/she has to give in his/her teaching to make the teaching more simple and effective.

I.27.d. Preparation of lesson plan: Lesson plan preparation is further step when he has selected right teaching aids apparatus, right examples and previous knowledge and experience of the children while preparing the lesson plan, a mathematics teacher should know the order of points to be taught in class and well consider the lesson plan that involves all the skills that can be developed in a child. It should contain proper drill work, oral work, written work, home work, evaluation, etc.
\textbf{I.27.e. Importance to drill work} : After finishing a concept, formulae, method rule and lesson, the teacher should previously determine a kind of questions to be given in drill work.

\textbf{I.28. Training the Mathematics Teachers}

The prospective mathematics teachers should be trained in

- the Modern methods and techniques in the teaching of mathematics,
- the skills in the teaching of mathematics and to develop the skills in them through classroom teaching,
- acquiring skills relating to planning their lessons and presenting them effectively,
- understanding of the technology of teaching mathematics and giving them practice in the use of audio visual aids, and
- developing a theoretical and practical understanding of the various methods and techniques of teaching mathematics and the importance of self-learning devices.

\textbf{I.29. Skills for Learning and Teaching Mathematics}

The prospective teachers should possess mathematical skills which are needed for them in their teaching process. The skills are

- ability to innovate, investigate and create during the teaching learning of mathematics,
- ability to apply knowledge relating to the discipline,
- ability to collect material of mathematical interest such as puzzles, biographies, models and so on,
- ability to apply known rules, basic operation, formulae and methods,
- ability to recognize mathematical terms, symbols, facts and so on,
- ability to facilitate mathematics learning through problem solving and using active methods, and
- ability to explain mathematical ideas.

I.30. Dimensions of Mathematics Teaching Competency

I.30.a. Knowledge: The prospective teachers give the pupil knowledge of terms, concepts, symbols, definitions, principles and formulae of mathematics.

I.30.b. Understanding: The prospective teachers develop the understanding of terms, concepts, principles and formulae of mathematics.

I.30.c. Application: The prospective teachers teach to apply the knowledge of mathematics to unfamiliar situation.

I.30.d. Sequencing of presented material: Prospective teachers should handle the audio-visual aids in a proper way, properly displayed.

I.30.e. Skill: Prospective teachers’ skills of computation, drawing geometrical figures and graphs.

I.30.f. Affective: Prospective teachers’ encouragement of the students through appropriate reinforcement.

I.30.g. Evaluation: Prospective teachers’ ability to ask questions whether students understand or not. Teacher applies summative as well as formative evaluation.

I.30.h. Closure of the lesson: Prospective teachers’ ability to review major points of the lesson and closes the lesson.

To be a good teachers, one should love three things; his / her subject, students and profession. It is proved in various researches that the teaching competency is positively correlated with the attitude towards the concerned subject.
I.31. Attitude

Attitude can be defined as an organization of beliefs, habits and motives associated with a particular object. ‘An attitude is a readiness to respond in such a way that behavior is given a certain direction’. According to Sorenson, ‘An attitude is a particular feeling about something’. It therefore involves a tendency to behave in a certain way in situations which involves that something, whether person, idea or object. It is partially rational and partially emotional and is acquired, not inherent, in an individual’. According to Whittaker ‘An attitude is a predisposition or readiness to respond in a predetermined manner to relevant stimuli’. Attitude reflects man’s behavior and the teacher who thinks well of his / her profession is sure to contribute much towards the pupils and society. Attitudes are formed through experience.

I.32. Importance of Attitude towards teaching

A teacher who has a positive attitude towards his/her profession can only bring the desirable changes in the child. The establishment of good relationship between teacher and class is vitally important and determines whether the process of learning is going to be a cooperative effort, an uneasy alliance, or a cold war.

I.33. Dimensions of Attitude towards Teaching Profession

I.33.a. Academic aspect of teaching profession: This area includes statements pertaining to the academic aspect of the profession. These statements are related to the predispositions teachers generally have for the type of work they are doing. The predispositions they have for their commitment to academic work, the predispositions they have for their professional growth, etc., are some of the ingredients of this component.
I.33.b. Administrative aspect of teaching profession: This area includes statement on the predisposition of teachers on their involvement in school administrative tasks. This work is pertaining to curricular development and co-curricular activities.

I.33.c. Social and psychological aspects of teaching profession: This component pertains to the predispositions of teachers as regards to the social status of teaching profession, the morale boosting, and its influence on moulding the future generations. The psychological feelings of security or insecurity and the pleasure or pain in general are also inculcated in this component.

I.33.d. Co-curricular aspects of teaching profession: It relates to dispositions of teacher’s roles and functions in the area of co-curricular activities and their importance as a part and parcel of teaching profession functional aspect is highlighted in this component.

I.33.e. Economic aspect of teaching profession: Predisposition about the economic profitability of the profession in terms of salary and other benefits, besides other aspects, are included in this component.

I.34. Need for the Study

Teacher education in India has to face the challenge of producing teachers for a new society. In order to meet the challenge successfully, it is necessary to improve the quality of teacher education. Teacher education thus holds the most crucial position in the education system today. Teaching is a lifetime profession and also due to the rapid explosion of knowledge and attitude of teachers towards their profession is changing rapidly. Attitude is a mental state of readiness. It should be possessed by the persons positively if she/he wants to shine in his/her field. Each specific type of competence is called competency. Teaching competency is the sum total of all the
competencies possessed by the teacher that are used in teaching situation. Teaching competency that includes self-control process, and metacognitive skills processing. Metacognitive skills are related to thinking about thinking and more precisely, thinking about one’s own learning. The investigator, being the mathematics teacher and teacher educator for about a decade, finds the relevance of metacognition in the teaching of mathematics. The experiences have taught the investigator that the mathematics teachers should possess the skill of metacognition so that they can improve the same to the students. As far as the studies reviewed by the researcher are concerned, the areas related to prospective mathematics teachers, their teaching competency and metacognition are hardly touched. The present study “Metacognition, Teaching Competency and Attitude towards Teaching Profession of Prospective Mathematics Teachers” therefore, is undertaken.

I.35. A Brief Resume of Succeeding Chapters

The dissertation is presented in five chapters. The first chapter gives the background of the study. The study of the related literature is discussed in the second chapter. The third chapter gives details about the methodology followed, the sample selected, the tool used, the statistical technique applied and the delimitations fixed. The analysis of the data, interpretation of the result are discussed in the fourth chapter. The last chapter as well as the fifth summaries the whole matter. The recommendations as the educational implications and the suggestion for further research are also given in the fifth chapter. The books and websites referred are listed and given under “Bibliography” given thereafter. The copies of the tools used in this study are given in the appendix that follows.