CHAPTER –I
INTRODUCTION AND CONCEPTUAL FRAMEWORK

1.1 INTRODUCTION

Education is a conscious and deliberate process in which one personality acts upon another in order to modify the development of the other by communication and manipulation of knowledge. It helps man to make a deliberate and conscious effort to live comfortably and happily in his physical and social environment.

It is considered as an eye opener for the human being, as it gives insight to discriminate between the good and the bad. It teaches how to behave with the others and lead the peaceful live. Education is considered to be the process of making the overall development of a person. Education gives experience to an individual to make preventive measure to a problem that he/she is going to face in their life. Individuals use the past and present experiences to solve the future problem by the means of education. According to Nelson Mandela,

“Education is the most powerful weapon which you can use to change the world”

www.wisdomquotes.com

1.1.1 Meaning of Education

Etymologically the term “education” is traced out from the different sources. According to one view, “education” originated from the Latin word “educate which means, “to bring up” or “to nourish”. There is another derivation from the Latin word “educere” which means, “to lead”. According to this view, the main purpose of education is to “lead” or “draw out” rather than “to put in”. There is another view according to
which the term “education” comes from the Latin word “educaatum” which means “the art of teaching or training”. Education is thus means both acquisition of knowledge and experience as well as the development of skills, habits and attitudes which help a person to lead a full and worth while life in this world.

Webster defines education as the process of educating or teaching. Educate is further defined as “to develop the knowledge, skill or character of….‖ Thus form these definitions, one can assume that the purpose of education is to develop the knowledge, skill, or character of students.

“The only purpose of education is to teach a student how to live his life-by developing his mind and equipping him to deal with reality. The training he needs is theoretical, i.e., conceptual. He has to be taught to think, to understand, to integrate, to prove. He has to be taught the essentials of the knowledge discovered in the past and he has to be equipped to acquire further knowledge by his own effort.” said Ayn Rand

(Teacher’s Mind Resources: http://www.TeachersMind.com)

1.1.2 Definitions of Education

According to UNESCO (1989), “Education is an organized and sustained instruction designed to communicate a combination of knowledge, skills and understanding valuable for all the activities of life”.

According to Lubbock, “Education is the harmonious development of all our faculties. It begins in the nursery, and goes on at school, but does not end there. It continues through life, whether we well or not”(Good, 1973).

Education is a process of adjustment of the individual to adjust himself to the world of nature, the world of men and the world of value. It also exercises influence on one’s vocation, home life, friendship, marriage, travel, recreation and hobbies and tells upon his personality.

1.1.3 Principles of Education

Swami Vivekananda emphasized the following principles in the Teaching-Learning process (Aggarwal et al, 2006).

Self-Teaching: “No one was ever taught by another. Each of us has to teach himself. A child educates himself.”

Living by Examples of Teacher: “Words even thoughts, contribute only one-third of the influence in making an impression the two-thirds”.

Teaching through Positive Suggestions: “We should give positive ideas. Negative ideas only weaken men both physically and mentally. If speak kind words to them and encourage them, they are bound to improve in time”.

Concentration as only Method of Teaching: “The power of concentration is the only key to the treasure house of knowledge”.

Qualities of the learner: “The conditions necessary for the taught are purity, a real thirst after knowledge and perseverance”.
1.1.4 Structure of Education in India

In India formal education is given to individuals through

i. Primary education

ii. Secondary education

iii. Higher secondary education

iv. Higher education

1.2 HIGHER SECONDARY EDUCATION

Indian Government framed a New National Policy on Education (1978) during the fifth year plan and implemented the new system of education called 10+2+3 pattern since 1978-1979 in all parts of the country. This pattern meant 10 years of general education followed by diversified Higher Secondary Education (HSE) and then 3 years of University Education. This new pattern of Education is an educational reform of great significance.

According to Kothari commission (1964-1966) “A new higher secondary course beginning in class XI to be instituted and classes XI and XII to provide specialized studies in different subjects.

National curriculum framework (2005) suggests science education for higher secondary students should enable the learner to

i. know the facts and principles of science and its applications, consistent with the stage of cognitive development,
ii. acquire the skills and understand the methods and processes that lead to
generation and validation of scientific knowledge,

iii. develop a historical and developmental perspective of science and to enable her to
view science as a social enterprise,

iv. relate to the environment, local as well as global and appreciate the issues at the
interface of science, technology and society,

v. acquire the requisite theoretical knowledge and practical technological skills to
enter the world of work,

vi. nurture the natural curiosity, aesthetic sense and creativity in science and
technology,

vii. imbibe the values of honesty, integrity, cooperation, concern for life and
preservation of environment and

viii. cultivate 'scientific temper'- objectivity, critical thinking and freedom from fear
and prejudice.

The aims and objectives of teaching science at the higher secondary stage are

i. to acquaint him/her with the 'Scientific method' and enable him/her to develop the
scientific attitude

ii. to familiarize the pupil with the world in which he lives and to make him/her
understand the impact of science on society as to enable him/her to adjust himself
to his/her environments

iii. to give the pupil a historical perspective, so that he/she may understand the
evolution of scientific development
1.3 CONCEPTUAL FRAMEWORK

1.3.1 Introduction

One of the hallmarks of psychological and educational theories and researches on learning is the emphasis on helping students to become more knowledgeable and responsible for their own cognition. Researchers agree that while growing students become aware of their own thinking as well as more knowledgeable about cognition in general. Furthermore, as they act on this awareness they tend to learn better. The labels for this general developmental trend vary from theory to theory, but they include the development of metacognitive knowledge, metacognitive awareness, self regulation etc.

Metacognition can be regarded as the second order cognition which means ‘thinking about thinking’. Knowing how to learn and knowing the appropriate strategies to accomplish a particular learning task are valuable skills that needed for becoming independent, learner driven learners. Cognitive and Meta cognitive processes play a vital perspective which focuses on individual learners and their interest and needs (Nelson and Cornner, 2008). All students possess unique abilities and immense potential and certain standard practices help them to develop their innate resources and ensure a comfortable routine to remain in a successful self learning mode. This will lead to cultivate a sense of ownership among learners and development of domain knowledge through the integration of discussions and reflections about the learning task. This type of learner centered approach purport the influential impact on the development of Meta cognitive skills among learners. Using appropriate differentiation to challenge all types of learners in the classroom and employing variety of instructional activities in order to involve them in the learning process are the needed skills in the learner centered classroom. This will open up an instructional structure for creating a classroom that offers the best opportunity for all
students to learn, prepare a community of learners who are self directed, interactive, co-operative and focused on quality.

Practices on Planning, Monitoring, and Evaluating makes a class room to a MOLE (Meta cognitively- Oriented Learning Environment). Effective learning is an activity of construction, monitoring and review of the effectiveness of approaches and strategies towards accomplishing the learning goals. These aspects of learning help the learners to become aware of the processes of their learning (Steven, 2009). The instructional practices based on Planning, Monitoring and Evaluating brought about increases in attainment and raise their overall strategic awareness by redirecting learners’ attention towards the process of learning rather than the products of learning. Researchers believe that application of cognitive and meta cognitive strategies will undoubtedly lead to an effective learning process which equips the learner to study the subjects more apprehensively with more interest, higher speed and less text anxiety (Dirkes, 1985). Some of the major definitions of metacognition put forth by prominent Educationists are given in table 1.1.
TABLE 1.1
NUTSHELL FORM OF DEFINITIONS OF METACOGNITION

<table>
<thead>
<tr>
<th>Educationist</th>
<th>Year</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flavell</td>
<td>1979</td>
<td>One’s knowledge concerning one’s own cognitive processes</td>
</tr>
<tr>
<td>Brown</td>
<td>1987</td>
<td>Knowledge and awareness one has of his own thinking processes and strategies and the ability to evaluate and regulate one’s own thinking processes.</td>
</tr>
<tr>
<td>Schraw and Dennison</td>
<td>1994</td>
<td>&quot;cognition about cognition&quot;, or &quot;knowing about knowing”</td>
</tr>
<tr>
<td>Livingston</td>
<td>1997</td>
<td>Thinking about thinking</td>
</tr>
<tr>
<td>Fisher</td>
<td>1998</td>
<td>Awareness of one’s own cognitive functioning and application of one’s cognitive resources for learning</td>
</tr>
<tr>
<td>Hartmann</td>
<td>2001</td>
<td>Awareness of one’s own thinking, awareness of the context of one’s conceptions, an active monitoring of one’s cognitive process, an attempt to regulate one’s cognitive process in relationship to further learning.</td>
</tr>
<tr>
<td>Jbeli</td>
<td>2003</td>
<td>‘Metacognition is thoughtfulness’</td>
</tr>
<tr>
<td>Kramarski.et.al</td>
<td>2004</td>
<td>‘Awareness and management of one’s own thought’</td>
</tr>
<tr>
<td>Pintrich</td>
<td>2004</td>
<td>Higher order thinking which involves active control over the cognitive processes engaged in learning. Activities such as planning how to approach a given learning task, monitoring comprehension, and evaluating progress toward the completion of a task are metacognitive in nature.</td>
</tr>
<tr>
<td>Martinez</td>
<td>2006</td>
<td>‘The monitoring and control of thought’</td>
</tr>
<tr>
<td>Martini &amp; Shore</td>
<td>2008</td>
<td>‘Knowledge about one’s own cognitive process’</td>
</tr>
</tbody>
</table>

All of these definitions point towards the significance of analyzing the thought processes of learners and the need for developing metacognitive behaviour through Planning, Monitoring and Evaluating the learning process.
1.3.2 COGNITIVE PROCESSES

Cognition, which refers to the higher processes involved in understanding and dealing with the world around us in the foundation on which all the experiences of the child have to be built (Gourgey, 1998). Cognition can be defined as the process of information about the environment that is received through the senses. Cognition refers to mental activity and behavior through which knowledge of the world is attained and processes includes perception, memory and thinking.

Cognitive processes are unobservable mental actions used to manipulate information. Cognitive processes produce cognitive products and it may be processed again, or they may be manifested in performance. Cognitive process can be applied to any kind of information. Students' cognitive systems have the potential to process not only the various kinds of information found in educational curricula, but also information that teachers provide to students to help them achieve the educational objectives. Cognition is both an effect caused by previous events, including cognitive ones and a cause of future events. Students' cognitive processing during teaching consists of reciprocal interactions among their cognitive processing system on the one hand, and the curriculum and instructional cues on the other. If students were exposed to curricular information devoid of instructional cues that is without instruction they almost surely would learn something. The intent of supplementing curricula with instruction is to improve the quality of students' cognitive processing beyond their natural levels. Thus, the objective of teaching is to influence the cognitive processing students use to learn.

Metacognition is a broadly defined concept incorporating cognitive process that refers to, monitors or controls any aspect of cognition. It is now seen as a central
contributor to many aspects of cognition including memory, attention, communication, problem solving and intelligence with important application in education

1.3.3 ORIGIN OF METACOGNITION

The term metacognition first appeared around 1976 in the work of developmental psychologist John Flavell from Stanford University. He used the term to denote: “One’s knowledge concerning one’s own cognitive processes and products or anything related to them and refers, among other things, to the active monitoring and consequent regulation and orchestration of these processes, usually in the service of some concrete goal or objective.”(Flavell, 1976).

This definition emphasizes the executive role of metacognition in the overseeing and regulation of cognitive processes. Executive processes and those responsible for the goal-directed processing of information and selection of action, and for the implementation and monitoring of task-specific cognitive processes.

Following Flavell’s idea of metacognition as active monitoring and consequent regulation and orchestration of cognitive process to achieve cognitive goals. Research in the area investigated different forms of monitoring, regulation and orchestration, such as checking, planning, selecting and inferring(Brown, 1987); or simply made judgments about what a person knows or does not know about how to accomplish a task. According to Brown(1987), “Metacognition refers to understanding of knowledge, an understanding that can be reflected in either effective use or overt description of the knowledge in question”. This definition calls attention to an important aspect of metacognition: awareness of one’s own knowledge or understanding of knowledge.
1.3.4 DISTINGUISHING METACOGNITION FROM COGNITION

A prime problem with the concept of metacognition is that it is often difficult to distinguish between what is meta and what is cognitive (Brown, 1987). For example, the skill needed to read a text differs from the skill of monitoring one’s understanding of the text. The first is an example of a cognitive skill, the second of a metacognitive skill. Another example is, the knowledge of computer programming is cognitive, and the knowledge that one is better at reading than at implementing software is of metacognitive nature.

Flavell (1976), in his model of metacognition, assumes that metacognition and cognition differ in their content and function, but they are similar in their forms and quality i.e., both can be acquired, be forgotten, be correct or incorrect. The contents of metacognition are the knowledge, skills and information about cognition (part of the mental world), while cognition is about things in both the real world and mental images thereof (i.e., objects, persons, events, physical phenomena, signs etc., skills to handle these entities, and information on the tasks). Thus, one way to differentiate metacognitive thinking from other kinds of thinking is to consider its source.

Cognition and metacognition differ in function in the following way. The function of cognition is to solve problems, to bring cognitive enterprises to a good end. The function of metacognition is to regulate a person’s cognitive operation in solving a problem or executing a task, for example, realizing one does not understand, deliberately increasing one’s concentration to block out environmental distractions, consciously using one’s memories to progress toward understanding, etc. (Hacker et. al, 1998).
TRADITIONAL ACCOUNTS OF METACOGNITION

Most accounts of metacognition make a basic distinction between metacognitive knowledge (what one knows about cognition) and metacognitive control processes (how one uses that knowledge to regulate cognition).

Knowledge of cognition

Knowledge of cognition refers to what individuals know about their own cognition or about cognition in general. It usually includes three different kinds of metacognitive awareness: declarative, procedural, and conditional knowledge (Brown, 1987). Declarative knowledge refers to knowing “about” things. Procedural knowledge refers to knowing “how” to do things. Conditional knowledge refers to knowing the “why” and “when” aspects of cognition.

Declarative knowledge

Declarative knowledge includes knowledge about oneself as a learner and about what factors influence one’s performance. For example, research investigating metamemory (knowledge about memorial processes) indicates that adults have more knowledge than children about the cognitive processes associated with memory. Similarly, good learners appear to have more knowledge about their own memory and are more likely than poor learners to use what they do know (Garner et al., 1986; Ibe, 2009).

Procedural knowledge

Procedural knowledge refers to knowledge about the execution of procedure skills. Individuals with a high degree of procedural knowledge use skills more automatically (Stanovich, 1990), are more likely to sequence strategies effectively,
(Livingston, 1997), and use qualitatively different strategies to solve problems (Zimmerman, 1998).

From an instruction standpoint, a number of studies reported that helping students to increase their procedural knowledge improves their performances. King (1992), compared two groups of fifth-grade students in which one group solved problems using problem-solving prompt card and the other group solved problems without it. Those who received explicit procedural training in how to use the prompt card solved more problems on a paper-and-pencil test than the control group. The explicit training group also performed better than the control group on a novel computer task.

**Conditional knowledge**

Conditional knowledge refers to knowing when and why to apply various cognitive actions. (Garner et al., 1986). It may be thought of as declarative knowledge about the relative utility of cognitive procedures. Recent studies suggest that conditional knowledge continues developing at least through middle childhood (Lin, 2002, Kramarski et al., 2004; Kleitman et al., 2007; Pulmones, 2009). Pintrich (1992) found that although kindergarten students showed conditional knowledge about their own learning, they showed less knowledge than older children. Similarly, older children and adults appear better than younger learners to selectively allocate their attention based on conditional task demands (Roll, 2011).

Many studies reported that skilled learners possess declarative, procedural and conditional knowledge about cognition. This knowledge usually improves their performance. Many theorists believe that metacognitive knowledge appears early and continues to develop at least throughout adolescence (Brown, 1997; Garner and
Adults tend to have more knowledge about their own cognition than do young children and are better able to describe that knowledge(Baker, 1989). However, a number of studies revealed that children as young as six can reflect with accuracy on their own cognition, especially when asked to do so in a familiar domain.

**Regulation of Cognition**

Regulation of cognition refers to metacognitive activities that help to control one’s thinking or learning. Although a number of regulatory skills have been described in the literature, three essential skills are included in all accounts: planning, monitoring and evaluation.

Brown(1987), has argued that regulatory processes—including, planning, monitoring and evaluation may not be conscious or statable in many learning situations. One reason is that many of these processes are high automated, at least among adults. A second reason is that some of these processes have developed without any conscious reflection and therefore are difficult to report to others. A number of empirical studies support this assumption. Research also indicates that knowledge of cognition and regulation of cognition not independent of one another.

**1.3.6 METACOGNITION AND INSTRUCTION**

The quantity and quality of children’s metacognitive knowledge and monitoring skills through systematic training may be feasible as well as desirable(Flavell, 1979). Empirical research has shown that metacognition has the potential to increase the meaningfulness of students’ learning in different domains(Hartman, 2001).
Metacognition has the potential to empower students to take charge of their own learning, increase self efficacy, and decrease the potential for learned helplessness, all of which are desirable educational goals. Developing one’s metacognitive skills might be the route through which affective and attitudinal variables are affected, which suggests that metacognition is a key factor for educational endeavors. Educational researchers now investigated ways of teaching students to reflect on their knowledge and to use their cognitive resources strategically through metacognitive control.

Researchers say that the curriculum should be oriented towards the development of metacognitive skills via programmes that include the explicit teaching of metacognition (Hartman, 1998). Such programmes would involve incorporating a range of learning experiences which encourages reflection on learning goals and strategies in relation to course content. The encouragement of student questioning of a reflective kind, the sharing amongst peers and study strategies and the use of reflective diaries help to improve metacognitive ability and student performances. Hartman advocates that teachers should teach metacognitively. Teaching with metacognition means that teachers will think about their own thinking regarding instructional goals, teaching strategies, sequence-learning materials, students’ characteristics and needs, and other issues related to curriculum, instruction and assessment before, during and after lessons in order to maximize their instructional effectiveness. On the other hand, teaching for metacognition means that teachers will think about how their instruction will activate and develop their students’ metacognition (Hartman, 2001).

1.3.7 INDIVIDUAL DIFFERENCES IN METACOGNITIVE DEVELOPMENT

One important merit of metacognition based instruction is the ability of learners to develop their metacognition. An extremely important but often neglected aspect of
learning is that students often have the requisite knowledge and skills for performing complex tasks but fail to use them: the skills remain inert. Sometimes it is because they are not motivated or confident to apply them, and sometimes because they do not recognize that the situation calls for the use of those skills (Gourgey, 1998). That is, learners may have declarative and procedural knowledge, but not the contextual or conditional knowledge needed for its application and transfer.

Research showed that these students have problems: a) determining the difficulty of a task; b) monitoring their comprehension effectively, i.e. not recognizing when they do not fully understand something (e.g. task directions, information in textbooks); c) planning ahead (e.g. what they need to do and how long each part should take); d) monitoring the success of their performance or determining when they have studied enough to master the material to be learned; e) using all the relevant information; f) using a systematic step-by-step approach; and g) selecting and employing appropriate representations (Hartman, 2001).

All these abilities are metacognitive in nature. Most of the individuals engage in metacognitive processes when confronted with cognitive tasks, yet some people are more metacognitive than others. Recent research indicated that the more metacognitive one is, the more strategic and successful one is likely to be in cognitive endeavors (Lin, 2002, Kramarski et al., 2004; Kleitman et al., 2007; Pulmones, 2009). Metacognitive awareness allows individuals to plan, sequence, and monitor their learning in a way that directly improves performance.

Zimmerman (1998), pointed out that it is not enough for students to have metacognitive knowledge (or skills); they must also regulate its use when confronted with stress, competing attractions and fatigue. Magno (2010), characterized the metacognitive
processes of self-regulated learners in terms of planning, setting goals, organizing, self-monitoring and self-evaluating at various times during the learning process.

Metacognition is necessary, but not sufficient, for academic success. The most important point is that through practice of self-regulation, students can develop voluntary control over their own learning. Teachers can enhance students’ awareness and control over learning by teaching them to reflect on how they think, learn, remember and perform academic tasks at all stages before, during and after task execution (Lin, 2008).

1.3.8 MODELS OF METACOGNITION

Flavell’s Model of Metacognition

*Flavell(1979)*, offered a model of metacognition with four components.

a) Metacognitive knowledge
b) Metacognitive experience
c) Metacognitive goals (tasks)
d) Metacognitive actions (Strategies)

The Flavell’s model of metacognition is shown in fig 1.1

Metacognitive knowledge refers to the personal perspectives of one’s own learning abilities as well as others. Metacognitive experience is the conscious consideration of intellectual experiences that accompany any success or failures in learning. Metacognitive goals or tasks of metacognition are the actual objectives of a cognitive endeavor. Metacognitive actions or strategies refer to the utilization of specific techniques they may assist in understanding.
Brown’s model of metacognition

Brown (1987), divided metacognition into broad categories: (i) knowledge of cognition, as activities that involve conscious reflection on one’s cognitive abilities and activities; and (ii) regulation of cognition, as activities regarding self-regulatory mechanisms during an ongoing attempt to learn or solve problems. According to Brown, these two forms of metacognition are closely related, each feeding on the other recursively, although they can be readily distinguishable. The Brown model of metacognition is shown in fig.1.2
Knowledge about cognition refers to the information that human thinkers have about their own cognitive processes. Regulation of cognition consists of the activities used to regulate and oversee learning. These processes include planning activities (predicting outcomes, scheduling strategies, and various form of vicarious trial and error, etc) prior to undertaking a problem; monitoring activities (monitoring, testing, revising, and rescheduling one’s strategies for learning) during learning; and checking outcomes (evaluating the outcome of any strategic actions against criteria of efficiency and effectiveness).

*Tobias and Everson* (1998) proposed a *hierarchical model* which supports the view that Metacognition skills could be developed in an incremental way. In this pyramidal model, knowledge monitoring is viewed as the most basic meta cognitive skill, supporting the development of other metacognitive skills shown as upper layers of the model, such as Evaluation of learning, Selection of strategies, and Planning.

1.3.9 METACOGNITIVE ACTIVITIES

While there are several approaches to metacognitive instruction, the most effective one involves a mixture of theory and practice. The learner must be given some knowledge of cognitive processes and strategies (that will be used as metacognitive knowledge), as well as opportunities to practice both cognitive and metacognitive strategies; evaluation of the outcome of their efforts is also important for the development of metacognitive regulation (Brown, 1987). Simply providing knowledge without experience or vice versa does not seem to be sufficient for the development of metacognitive control. Hence, it is necessary to design metacognitive activities that can be embedded into instructional contexts. A list of metacognitive activities that have been commonly applied in experimental studies and in the classroom are listed below

Reflective Questions

Reflective questions can be employed by teachers and researchers to promote discussion that begins with revision of the details of the learning experience and moves toward critical thinking and creation of an action plan. This can encourage students to reflect on strategies that they can use to perform a learning task and explain their reasons for using those strategies.

Metacognitive Scaffolding

Scaffolding means providing support to students to bridge the gap between what they can do on their own and what they can do with guidance from others (Hartman, 2001). Scaffolding may take the format of models, cues, prompts, hints, partial solutions, etc. The main characteristic of scaffolds is that they have to be regulated according to the amount of help the learner needs, and eventually the help should be not
necessary anymore. The goal of metacognitive scaffolding is for students to become independent self-regulating thinkers who are more self-sufficient and less teacher-dependent.

**Self-questioning**

Self-questioning strategies are effective ways of promoting self-directed learners. Research on self-questioning shows that questions created by the student are much more effective than questions given to the student by someone else. Self-questions such as “Have I left out anything important?” can help a student self-direct in identifying the omission of important points or examples. The more students practice generating and using self-questions in diverse situations the more likely they are to develop the habit of self-questioning so that it becomes a skill, which is used automatically and unconsciously as the situation requires. It is important to regularly have students adapt their self-questions to the needs of the specific subject and task. Self-questioning can guide the learner’s performance before, during, and after task performance; it can improve self-awareness and control over thinking and thereby improve performance; self-questioning can improve long-term retention of knowledge and skills; it can improve the ability to apply and transfer knowledge and skills students learn; and finally, it can improve attitudes and motivation as a result of improved performance (Hartman, 2001).

**Thinking aloud and Self-explanations**

Thinking aloud is a technique of externalizing one’s thought processes as one is engaged in a task that requires thinking. The thinker says out loud all of the thoughts and feelings that occur when performing a task (e.g. solving a problem, answering a question, conducting an experiment, reading through textbook notes, etc.). It is a method that can
be used either by the teacher or tutor, or by two students working together, or by a student working alone. Teachers can use the think aloud method to serve as expert models showing students how to use metacognitive knowledge and strategies when working on a variety of tasks; for example, to let students see and hear how they plan, monitor, and evaluate their work. When the thinker-talker is the subject-matter expert, the process allows the expert to model their own thinking for students. This modeling shows how to think about the learning material (knowledge, skills, procedures, etc.). It lets the students hear what goes on in an expert’s head when a text is read, a homework assignment is attacked, study for a test is planned, an essay is written, an error is found, or a problem is solved. Also, when modeling academic performance, it is important to intentionally make occasional mistakes, so that students can observe and become aware of them and also of strategies for recovering from them and self-correcting (Hartman, 2001). Lin(2002) state that think-aloud modeling may be in the form of self-questions (e.g. “Did I carefully check my work?”) or self-instructional directive statements (e.g. “That’s not what I expected. I’ll have to retrace my path”). They recommend that teachers use think-aloud modeling for showing students how to: summarize, access prior knowledge, self-monitor, obtain help, and self-reinforce. This modeling should involve communicating with students so that the lesson is an interactive dialogue instead of a monologue, and modeling should be gradually phased out as student competence and responsibility increase. Self-explanation is the process of clarifying and making more complete to oneself the content of an exercise, a text, an example, etc. Several studies in cognitive science point that students who spontaneously self-explain when they study learn more (Chi et al., 1989). Moreover, self-explanations are usually more effective than explanations provided by others, because they require students to actively elaborate their existing knowledge. Besides that, the student naturally addresses her specific problems in
understanding the content when self-explaining, what leads to a more constructive learning.

**Self-assessment**

Students who observe and evaluate their performance accurately may react appropriately by keeping and/or changing their study strategies to achieve the goal of, for example, maximizing their grade in a course or on a test. Thus, it is desirable to engage students in activities that will help them to assess themselves and to explain explicitly what they know and do not know.

**1.3.10 METACOGNITIVE INSTRUCTIONAL STRATEGIES**

Metacognitive strategies consist of the processes that lead to mental processes and can be explained as the ability to use metacognitive knowledge strategically to reach cognitive goals. Metacognition requires the capabilities such as awareness of the learning process, planning and selecting strategies, monitoring the learning process and correcting errors, to be able to control the strategies used.

**Meta-memory**

This refers to learners' awareness of and knowledge about their memory systems and strategies for using memories effectively. The various types of knowledge important in metacognition are declarative, procedural and conditional knowledge. Declarative knowledge pertains to the facts necessary to accomplish a task, while the steps or procedures and even strategies on how a task is done fall under the domain of procedural knowledge. Conditional knowledge refers to knowing why certain strategies work, when to use them and why one strategy is better than another.
Self-planning

This refers to estimate the time required to complete the task, organize materials and study time. Self-planning involves the selection of appropriate strategies and the allocation of resources that affect performance. Examples include making predictions before reading, strategy sequencing and allocating time or attention selectively before beginning a task (Taylor, 1999). Experienced learners possess more knowledge about cognition and use that knowledge to regulate their learning before they undertake a task.

Self-monitoring

This term refers to the learners' ability to monitor the degree to which they understand information being communicated to them, to recognize failures to comprehend, and to employ repair when failures are identified. Self-monitoring refers to one’s own awareness of comprehension and task performance. The ability to engage in periodic self-testing while learning is a good example. Researches indicated that monitoring ability develops slowly and is quite poor in children and even adults (Ganz et al. 1990). Studies also suggested that monitoring ability improves with training and practice. For example, McDonald (2005), examined fifth and sixth grader’s ability to solve computer problems. The first group received specific computer problem-solving training, the second received computer problem solving training plus self-monitoring training, while the third received no training. The monitored computer problem solving group solved more of the difficult problems than either of the remaining groups and took less time to do so. The group receiving problem solving and monitoring training also solved complex problems faster than the control group.
Self-evaluation

This term refers to one's qualitative assessment about how well he learned the concept. Self-evaluating refers to appraising the products and a regulatory process of one’s learning. Typical examples include re-evaluating one’s goals and conclusions. A number of studies indicate that metacognitive knowledge and regulatory skills such as planning are related to evaluation.

Self-regulation

This term refers to the learner's ability to make adjustments in their own learning processes in response to their own learning processes in response to their perception of feedback regarding their current status of learning. It also refers to accurate self assessment of what is known or not known and how to go about what is not known. Researchers agreed that regulatory competence improves performance in a number of ways, including better use of cognitive resources such as attention, better use of strategies, and a greater awareness of comprehension breakdowns. A number of studies report significant improvement in learning when regulatory skills and an understanding of how to use these skills are included as part of classroom instruction (Lin.et.al,2001).

1.3.11 NEED FOR METACOGNITION IN SCIENCE EDUCATION

Science has a dominant place in the school curriculum. This is so because every sector recognizes an increasing contribution of this discipline to the progress of the modern world. Scientific literacy enables people to use scientific principles and processes in making personal decisions and to participate in discussions of scientific issues that affect society.
Science besides satisfying the intellectual curiosity of man provides materials and media for intellectual exercises and has disciplinary effect on the minds of individuals. Many misconceptions about scientific principles exist in student for various reasons. Therefore in addition to construction, reconstruction is often necessary.

The conventional teaching methods are not sufficient to arouse interest in science among the students and do not meet up to the intellectual, psychological and emotional needs of the students. The methods of teaching science need to be changed. The modern teaching concept holds the view that it is more learner centered and learner driven. Education has been undergoing a slow evolution; from teacher centered system to learner centered system and this demands changes in the instructional process and materials used for making the process more effective. In the teaching-learning process, learner is to be active and learning should affect desirable changes in behavior, in habits, style of living, adjustment of knowledge, skills etc. It aims at maximizing learning experience.

Innovation in all spheres of life including education is at the threshold of the new millennium. Teachers in the present age have a responsibility of enriching the student with ever exploding information through effective instructional strategies. The principle role of teacher is to plan for systematized instruction and provides learning experiences which are basic essentials for effective and dynamic instruction. The class room can turn to be a wonder world of excitement for students with easy absorption of learning material through apt use of teaching learning strategies.

The evolution of new learning theories has important implications for teaching. The current learning theory in education is the constructivist theory, which focuses on students and how they should be taught. Constructivism emphasizes that students should be encouraged to explore, to observe, to work in groups, to discuss their ideas with each
other, to carry out analogies and reach to conclusions and draw inferences. One of the basic principles underlying constructivism is that, learners should construct new understanding by using what they already know. Metacognition is thinking about thinking, knowing’ what we know’ and ‘what we don’t know’. Metacognition is grounded in constructivist theory, and it provides the foundation upon which students can construct new information. Metacognition refers to higher order thinking which involves active control over the cognitive processes engaged in learning. Activities such as planning how to approach a given learning task, monitoring comprehension, and evaluating progress toward the completion of a task are metacognitive in nature.

Metacognition guides learner decisions on task choice, the effort they will spend and the strategies chosen. The metacognitive strategies activate the learner’s relevant knowledge about their own strengths and weaknesses pertaining to the task as well as their motivation for completing a task. Guidance in recognizing and practice in applying metacognitive strategies, will help students successfully solve problems throughout their lives.

1.4 ATTITUDE TOWARDS SCIENCE

Attitudes towards science influence views of science and classroom participation. Students who have positive attitudes show increased attention to classroom instruction and participate more in science activities (Schibeci, 1984). Most research indicates that students develop more negative attitudes toward studying science, toward their science classes, and towards their science teachers the longer they study typical school science (Osborne et al., 1998; 2003). It is important to develop student positive attitude towards science. When they have positive attitudes, the learning of scientific information and science process skills are enhanced (Halladyna et al., 1982). Achievement, motivation and
student interest are influenced by positive and negative attitudes (Hough et al. 1982). Koballa (1988) found that students with positive attitudes towards science had positive attitudes towards their science teacher, science curriculum and science-classroom climate.

It is believed that if students were allowed to demonstrate higher cognitive abilities, their attitudes toward science might be positively affected. The studies reviewed suggest that there is a relationship between attitude and methods of instruction. Moreover, it is known that conventional teaching and traditional teaching methods have negative effects on the ability of learning science for the majority of the students (Schibeci, 1984; Hough et al. 1982; Koballa, 1988).

Metacognitive approach, according to Lippmann (2005), is intended to encourage positive attitude towards the subject. Research by Nelson and Corner (2008) on metacognitive awareness enhanced more positive attitude towards subject and the teacher.

1.5. HOME ENVIRONMENT

Home is the first institution which is responsible for the education of the child and parents are the first educators. Home environment includes the conditions, forces and external stimuli at home which impinge upon individual. The physical, social as well as intellectual environment of the home is a reinforcing force which shapes the individuals. Educational and cultural level of parents, parental attitude towards education, value orientation of the family members and socio-economic status of the family normally affect the achievement of every student.

Family is the social-biological unit that exerts the greatest influence on the development and perpetuation of the individual’s behaviour. Various researchers have identified the following characteristics of home environment or parental child rearing
practices permissiveness, willingness to devote time to the child, parental guidance, parental aspiration for achievement, provisions for the child’s intellectual needs, affective rewards, instrumental companionship, prescription, physical punishment, principled discipline, neglect, deprivation of privileges, protectiveness, power, achievement demands, indulgence, conformity, independence, emotional and verbal responsively, involvement with the child, physical and temporal environment, avoidance of restriction and punishment, provision of appropriate play materials, etc. There exists a great overlapping in the kinds of behaviours which are in association with different characteristics (Mehra, 1988)

1.6 CONCLUSION

Principle and structure of Education, Development of metacognition, Metacognitive models, Metacognitive instructional strategies, Need for metacognition in science, Attitude towards science and Home environment are dealt in the conceptual frame work. The next chapter deals with review of related literature.