CHAPTER-1

INTRODUCTION

The goal of this section is to expand on the brief introduction to Metacognition, Problem solving ability and Self-esteem. This chapter provides the details about the concept of metacognition, details about the historical roots of the metacognition, various models of metacognition, different methods of the assessment of metacognition, educational implications of the metacognition, similarly for problem solving ability and self-esteem.

1.1 INTRODUCTION TO METACOGNITION

“Metacognition” is one of the latest buzz words in educational psychology, but what exactly is metacognition? The length and abstract nature of the word makes it sound intimidating, yet it is not as daunting a concept as it might seem. We engage in metacognitive activities everyday. Metacognition enables us to be successful learners and has been associated with intelligence (e.g., Borkowski, Carr, & Pressley, 1987; Sternberg, 1984, 1986a, 1986b). 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. Because metacognition plays a critical role in successful learning, it is important to study metacognitive activity and development to determine how students can be taught to better apply their cognitive resources through metacognitive control.

“Metacognition” is often simply defined as “thinking about thinking.” In actuality, defining metacognition is not that simple. Although the term has been part of the vocabulary of educational psychologists for the last couple of decades and the concept for as long as humans have been able to reflect on their cognitive experiences, there is much debate over exactly what metacognition is. One reason for this confusion is the fact that there are several terms currently used to describe the same basic phenomenon (e.g., self-regulation, executive control), or an aspect of that phenomenon (e.g., meta-memory) and these terms are often used interchangeably in
the literature. While there are some distinctions between definitions (see Van Zile-Tamsen, 1994, 1996 for a full discussion), all emphasize the role of executive processes in the overseeing and regulation of cognitive processes.

The term “metacognition” is most often associated with John Flavell, (1979). According to Flavell (1979, 1987), metacognition consists of both metacognitive knowledge and metacognitive experiences or regulation. Metacognitive knowledge refers to acquired knowledge about cognitive processes, knowledge that can be used to control cognitive processes. Flavell further divides metacognitive knowledge into three categories: knowledge of person variables, task variables and strategy variables.

It has been over 30 years since the notion of metacognition was introduced into the field of psychology by John Flavell in 1979. Research activity in metacognition began with John Flavell, who is considered to be the ‘father of the field’ and thereafter a considerable amount of empirical and theoretical research dealing with metacognition can be registered.

There are three main areas of research in which metacognition have prominent role: developmental psychology, with emphasis on theory of mind; experimental psychology, focusing mainly on meta-memory; and educational psychology, with emphasis on self-regulated learning. However, there is also significant work in neuropsychology that connects metacognition with executive functions and pre-frontal brain areas. Another line of research connects metacognition with social cognition, as well as with co-regulation and other regulation of behaviour and cognition. More recent developments include the study of metacognition in clinical psychology.

The variety of areas and perspectives through which metacognition is being studied is due to the fact that metacognition is inextricably woven with awareness of mental states and with consciousness. In humans, it is at the roots of every day memory and of scientific thinking, as well as of social interactions that require awareness of one's and others' thinking.

Distinction in metacognition is executive management and strategic knowledge. Executive management processes involve planning, monitoring, evaluating and revising one's own thinking processes and products. Strategic
knowledge involves knowing what (factual or declarative knowledge), knowing when and why (conditional or contextual knowledge) and knowing how (procedural or methodological knowledge). Both executive management and strategic knowledge metacognition are needed to self-regulate one's own thinking and learning (Hartman, 2001).

Finally, there is a distinction between domain general and domain-specific metacognition. Domain general refers to metacognition which transcends particular subject or content areas, such as setting goals. Domain specific refers to metacognition which is applied in particular subject or content areas, such as editing an essay or verifying one's answer to a mathematics problem.

1.1.1 Concept of metacognition

Metacognition is a concept that has been used to refer to variety of epistemological processes. Metacognition essentially means cognition about cognition; that is, it refers to second order cognitions: thoughts about thoughts, knowledge about knowledge, or reflections about actions. So if cognition involves perceiving, understanding, remembering and so forth, then metacognition involves thinking about one's own perceiving, understanding, remembering etc. these various cognitions about cognitions can be labeled 'meta perception', 'meta-comprehension' and 'meta memory' with 'metacognition' remaining the super ordinate term.

Nelson (as cited in Efklides, 2008) defined, “Metacognition as a model of cognition that functions at a meta level; metacognition represents the object level, that is cognition.” This definition underscore the functioning of metacognition at a “meta” level, which means that metacognition is a representation of cognition and that metacognition and cognition are connected through the monitoring and control functions.

According to Brown (1987), “Metacognition refers loosely to one's knowledge and control of own cognitive system.”

Schraw & Sperling-Dennison (1994) defined, “Metacognition as the ability to reflect upon, understand and control one's learning.”

Flavell (1979) defined metacognition as, “Knowledge and cognition about cognitive phenomena.” Refined this definition by specifying classes of phenomena
that constitute monitoring and control of cognition, such as metacognitive knowledge and metacognitive experiences.

Baker & Brown (1984) defined metacognition as, “the knowledge and control a child has over his or her own thinking and learning activities, including reading.”

Gradually, the concept has been broadened to include anything psychological, rather than just anything cognitive. For instance, if one has knowledge or cognition about one's own emotions or motives concerning a cognitive enterprise (e.g. being aware of his anxiety while solving a problem in an exam paper), this can be considered metacognitive. In fact, the recent literature completes the term, by adding to its cognitive domain, the emotional one - referring to the emotions that accompany the cognitive processes and the person's ability to monitor them, as well as the domain of cognitive habits.

Similarly, Flavell (1979), when trying to define the concept of metacognition, refers to all those conscious cognitive or affective experiences that accompany and pertain to an intellectual enterprise. Although the term itself may seem mysterious, Metacognitive acts are common. For instance, take some time to answer two questions. First, when was the last time you failed to recall someone's name, but were you absolutely sure that you knew the name? These frustrating events called tip-of-the-tongue states happen a lot and may increase in frequency, as we grow older. They are Metacognitive in nature because you are having a thought (I am sure I know the person's name) about cognition (in this case, your thought is “that the person's name is in your memory”).

Second, when was the last time you decided to write down lengthy directions, or perhaps even brief ones and how often do you make a list of groceries to buy at the market? In such circumstances, you may realize that there is little chance of remembering important information, so you naturally rely on external aids for examples, lists, Palm pilots or even other people to ensure that you won't forget.

Understanding the limits of your own memory also is a form of Metacognition because it concerns your beliefs and knowledge about memory.
1.1.2 Components of metacognition

Although metacognition may have sometimes-indistinct boundaries, key distinctions can be made. First, we can distinguish between knowledge and skills – between “knowing that” and “knowing how”, the old distinction between theory and practice, between competence and performance. One may “know that” he/she should distinguish relevant from irrelevant information in a problem and another has the ability to do this in practice, perceiving what is relevant in a “noisy” environment. Similarly, one may know that different strategies can be applied in different problems and another has the ability to select the suitable strategy, when needed, to resolve a problem. Ann Brown (1987) distinguishes between knowledge about cognition and regulation of cognition. Knowledge about cognition can be “stable, stable but fallible or late developing” information that human thinkers have about their own cognitive processes, which usually remains relatively consistent within individuals. Regulation, on the other hand, can be “relatively unstable, rarely stable and age independent”. Brown (1987), Regulation of cognition refers to the activities used to regulate and oversee learning. One may show self-regulatory behavior in one situation but not another and a child may show self-regulatory behavior where an adult does not. Regulation may be also affected by patterns of arousal (anxiety, fear, interest) and self-concept (self-esteem, self-efficacy). These processes include planning activities (predicting outcomes, scheduling strategies and various forms of vicarious trial and error, etc.) prior to undertaking a problem; monitoring activities (monitoring, testing, revising and re-scheduling one’s strategies for learning) during learning; and checking outcomes (evaluating the outcome of any strategic actions against criteria of efficiency and effectiveness) at the end. Kluwe (as cited in Louca, 2003) brought further definition to the concept of ‘metacognition’ describing activities referred to as ‘metacognitive’: (a) the thinking subject has some knowledge about his own thinking and that of other persons; (b) the thinking subject may monitor and regulate the course of his own thinking, i.e. may act as the causal agent of his own thinking”. Moreover, Kluwe uses the term 'executive processes' to denote both monitoring and regulating strategies. Executive monitoring processes involve one's decisions that help: (a) to identify the task on which one is currently working, (b) to check on current progress
of that work, (c) to evaluate that progress and (d) to predict what the outcome of that progress will be. Executive regulation processes are those that are “directed at the regulation of the course of one's own thinking.” They involve one's decisions that help (a) to allocate his or her resources to the current task, (b) to determine the order steps to be taken to complete the task and (c) to set the intensity or (d) the speed at which one should work the task. Flavell (1987) tried to classify part of the domain of metacognition. The key concepts in the taxonomy are metacognitive knowledge and metacognitive experience.

“Metacognitive knowledge refers to the part of one's acquired word knowledge that has to do with cognition or perhaps better, psychological matters”.

Metacognitive knowledge can be sub divided into three categories: knowledge of person variables, task variables and strategy variables.

Metacognitive experiences are conscious experiences that are cognitive and affective. What makes them metacognitive experiences rather than experiences of another kind is that they have to do with some cognitive endeavour or enterprise, most frequently a current, ongoing one. For example, if one suddenly has the anxious feeling that one is not understanding something and wants and needs to understand it, that feeling would be a metacognitive experience.

Schraw & Sperling-Dennison (1994) distinguished metacognition into two major components, including knowledge about cognition and regulation of cognition. Knowledge about cognition includes three sub processes that facilitate the reflective aspect of metacognition; namely declarative knowledge, (i.e., knowledge about self and about strategies), procedural knowledge (i.e., knowledge about how to use strategies) and conditional knowledge (i.e., knowledge about when and why to use strategies.) Regulation of cognition includes a number of sub-processes that facilitate the control aspect of learning. These five component skills of regulation are planning, information management strategies, comprehension monitoring, debugging strategies and evaluation.

According to Schraw (1998), “Metacognition had two distinct component, knowledge of cognition and regulation of cognition. Knowledge of cognition includes three different kinds of metacognitive awareness: declarative, procedural and
conditional knowledge. Regulation of cognition includes planning, monitoring and evaluation.


Desoete (2008) view, “Metacognition as consisting of Metacognitive knowledge and Skills. There were four metacognitive skills, namely, prediction, planning, monitoring and evaluation.

Nelson & Narens (1990) proposed a theoretical mechanism to represent a metacognitive system consisting of two structures, an 'object-level' and a 'meta-level', the latter containing a model of the former. The mechanism incorporates two relations in terms of flow of information from one level to the other comprising 'control' and 'monitoring' functions. 'Control', which is the information flowing from the meta-level to the object-level, affects the object level processes by initiation, continuing or terminating an action. 'Monitoring', on the contrary, lies on the assumption that the meta-level is informed by the object-level, a process that results in changing the state of the meta-level's model.

On the other hand Efklides (2008) suggested, “Three different facets of metacognition; namely, Metacognitive knowledge, Metacognitive Experiences and Metacognitive Skills”.

Metacognitive knowledge is declarative knowledge stored in memory and comprises models of cognitive processes, such as language, memory and so forth. It also encompasses information regarding persons, tasks, strategies and goals. Metacognitive Experiences are what the person is aware of and what she or he feels when coming across a task and processing the information related to it. They take the form of metacognitive feelings, metacognitive judgements and online- task specific knowledge. Metacognitive Skills refer to the deliberate use of strategies in order to control cognition. Metacognitive skills comprise orientation strategies, planning strategies, strategies for regulation of cognitive processing, strategies for monitoring the execution of planned action and strategies for the evaluation of the outcome of the task processing.
In the present study the term Metacognition refers to the “Knowledge and Control of own cognitive system which is composite of two main components Metacognitive Knowledge and Metacognitive Regulation. The Metacognitive Knowledge includes three sub processes that facilitate the reflective aspect of metacognition; namely declarative knowledge, (i.e., knowledge about self and about strategies), procedural knowledge (i.e., knowledge about how to use strategies) and conditional knowledge (i.e., knowledge about when and why to use strategies.) Metacognitive Regulation includes a number of sub processes that facilitate the control aspect of learning. These Four component skills of regulation are planning, monitoring, self-control and self-evaluation.

1.1.3 Complex relation between Metacognition and Cognition

Most definitions of metacognition include both knowledge and strategy components; however, there are a number of problems associated with using such definitions. One major issue involves separating what is cognitive from what is metacognitive. What is the difference between a cognitive and a metacognitive strategy?

Can declarative knowledge be metacognitive in nature? For example, is the knowledge that you have difficulty understanding the principles from bio-chemistry cognitive or metacognitive knowledge? Flavell himself acknowledges that metacognitive knowledge may not be different from cognitive knowledge (Flavell, 1979). The distinction lies in how the information is used.

Recall that metacognition is referred to as “thinking about thinking” and involves overseeing whether a cognitive goal has been met. This should be the defining criterion for determining what is metacognitive. Cognitive strategies are used to help an individual achieve a particular goal (e.g., understanding a text) while metacognitive strategies are used to ensure that the goal has been reached (e.g., quizzing oneself to evaluate one's understanding of that text). Metacognitive experiences usually precede or follow a cognitive activity. They often occur when cognitions fail, such as the recognition that one did not understand what one just read. Such an impasse is believed to activate metacognitive processes as the learner attempts to rectify the situation (Roberts & Erdos, 1993).
Metacognitive and cognitive strategies may overlap in that the same strategy, such as questioning, could be regarded as either a cognitive or a metacognitive strategy depending on what the purpose for using that strategy may be. For example, you may use a self-questioning strategy while reading as a means of obtaining knowledge (cognitive), or as a way of monitoring what you have read (metacognitive). Because cognitive and metacognitive strategies are closely intertwined and dependent upon each other, any attempt to examine one without acknowledging the other would not provide an adequate picture.

Knowledge is considered to be metacognitive if it is actively used in a strategic manner to ensure that a goal is met. For example, a student may use knowledge in planning how to approach a math exam: “I know that I (person variable) have difficulty with word problems (task variable), so I will answer the computational problems first and save the word problems for last (strategy variable).” Simply possessing knowledge about one's cognitive strengths or weaknesses and the nature of the task without actively utilizing this information to oversee learning is not metacognitive.

Most conceptualizations of metacognition have in common that they take the perspective of “higher-order cognition about cognition.” There is a higher order agent overlooking and governing the cognitive system, while simultaneously being part of it. This is the classical homunculus problem or Comte's paradox: One cannot split one's self in two, of whom one thinks whilst the other observes him thinking. The issue whether cognition and metacognition can be disentangled is not merely an academic one. In fact, metacognition draws on cognition. It is very hard to have adequate metacognitive knowledge of one's competencies in a domain without substantial (cognitive) domain-specific knowledge, such as knowledge about relevant concepts and theories in a domain, about intrinsic difficulties of a domain and about what is irrelevant. In terms of metacognitive skills, one cannot engage in planning without carrying out cognitive activities, such as generating problem-solving steps and sequencing those steps. Similarly, one cannot check one's outcome of a calculation without comparing the outcome with an estimation of it, or recalculating the outcome in another way. If metacognition is conceived as (knowledge of) a set of
self instructions for regulating task performance, then cognition is the vehicle of those self-instructions. These cognitive activities in turn are subject to metacognition, for instance, to ongoing monitoring and evaluation processes. This circular process of metacognitive and cognitive activities makes it hard to disentangle them in the assessment of metacognition. Occasionally, metacognition can be observed in students' verbalized self instructions, such as “this is difficult for me, let's do it step-by-step” or “wait, I don't know what this word means.” Metacognition, however, is not always explicitly heard or seen during task performance. Instead, it has often to be inferred from certain cognitive activities. For instance, doing things step-by-step may be indicative of planned behavior, although self-instructions for planning are not explicitly verbalized. Future research has to differentiate far more precisely between explicitly verbalized metacognitive knowledge and self-instructions, cognitive activities that are indicative of metacognition and purely cognitive activity.

1.1.4 Metacognition and Intelligence

Metacognition, or the ability to control one's cognitive processes (self-regulation) has been linked to intelligence (Borkowski et al., 1987; Brown, 1987; Sternberg, 1984, 1986a, 1986b). Sternberg refers to these executive processes as “metacomponents” in his triarchic theory of intelligence (Sternberg, 1984, 1986a, 1986b). Metacomponents are executive processes that control other cognitive components as well as receive feedback from these components. According to Sternberg, metacomponents are responsible for “figuring out how to do a particular task or set of tasks and then making sure that the task or set of tasks are done correctly” (Sternberg, 1986b, p. 24). These executive processes involve planning, evaluating and monitoring problem-solving activities. Sternberg maintains that the ability to appropriately allocate cognitive resources, such as deciding how and when a given task should be accomplished, is central to intelligence.

1.1.5 Metacognition and Cognitive Strategy Instruction

Although most individuals of normal intelligence engage in metacognitive regulation when confronted with an effortful cognitive task, some are more metacognitive than others. Those with greater metacognitive abilities tend to be more successful in their cognitive endeavors. The good news is that individuals can learn
how to better regulate their cognitive activities. Most often, metacognitive instruction occurs within Cognitive Strategy Instruction programs.

Cognitive Strategy Instruction (CSI) is an instructional approach which emphasizes the development of thinking skills and processes as a means to enhance learning. The objective of CSI is to enable all students to become more strategic, self-reliant, flexible and productive in their learning endeavours (Scheid, 1993). CSI is based on the assumption that there are identifiable cognitive strategies, previously believed to be utilized by only the best and the brightest students, which can be taught to most students (Halpern, 1996). Use of these strategies have been associated with successful learning (Borkowski, Carr, & Pressley, 1987; Garner, 1990). Metacognition enables students to benefit from instruction (Carr, Kurtz, Schneider, Turner & Borkowski, 1989; Van Zile-Tamsen, 1996) and influences the use and maintenance of cognitive strategies. While there are several approaches to metacognitive instruction, the most effective involve providing the learner with both knowledge of cognitive processes and strategies (to be used as metacognitive knowledge) and experience or practice in using both cognitive and metacognitive strategies and evaluating the outcomes of their efforts (develops metacognitive regulation). Simply providing knowledge without experience or vice versa does not seem to be sufficient for the development of metacognitive control (Livingston, 1996).

The study of metacognition has provided educational psychologists with insight about the cognitive processes involved in learning and what differentiates successful students from their less successful peers. It also holds several implications for instructional interventions, such as teaching students how to be more aware of their learning processes and products as well as how to regulate those processes for more effective learning.

1.1.6 Historical Roots of Metacognition

Although the term “Metacognition” has been part of the vocabulary of educational psychologists for the last three decades, but the concept exists for as long as humans have been able to reflect on their cognitive experiences. “Know Thyself”
- Inscription at the Oracle of Apollo in Delphi, Greece
  “The Life which is Unexamined is not Worth Living”
- Socrates rebuttal when found guilty of heresy

These famous quotes herald the importance of self-reflection and self-awareness, which place Metacognition at the pinnacle of personal growth. And even though many people may not make time to seriously reflect on their lives, except perhaps on a birthday or an occasional New Year's Eve, almost everyday of our lives, we do rely on our metacognition. When we do, metacognition is typically used as a tool to deal with everyday problems such as turning off a cell phone when traffic is extra heavy, or writing a note when it is absolutely essential to remember something.

The importance of using metacognition to improve our daily lives is not all limited to our contemporary world, but extends back to antiquity. In fact, according to Dunlosky & Metcalfe (2009) the first documented success at controlling the mind to improve memory begins with a gruesome tale involving the poet Simonides (557-468 BCE) which was later told by Cicero in his De Oratore. Accordingly to the Cicero it was Simonides who created the method of “Loci”, which is a powerful mnemonic strategy that is used to improve memory. He discovered that order is what most brings light to our memory. And he concluded that “those who would like to employ this part of their abilities should choose localities, then from mental images of the things they wanted to store in their memory and place these in the localities.”

**Comte's Paradox and Turn-of-the-20th-Century Introspection**

“Introspection”, a technique used by early psychologists to find answers to psychological questions, was also a first sign of interest in metacognitive processes. The definition of 'introspection' as 'the reflection on one's own conscious experience' makes such connections all too obvious.

August Comte (as cited in Dunlosky & Metcalfe, 2009), a French philosopher who founded positivism, argued that “as for observing…intellectual phenomena while they are taking place, this is clearly impossible. The thinking subject cannot divide himself into two parts, one of which would reason, while the other would observe its reasoning. In this instance, the observing and the observed organ being identical, how
could observation take place? The very principle upon which (the introspection) is based, therefore, is invalid.

Nelson (1996) referred to this argument as Comte's paradox. Without a resolution to Comte's paradox, it would seem that metacognitive monitoring or self evaluation is a mere illusion and potentially not privy to scientific enquiry.

According to Woodworth (as cited in Dunlosky & Metcalfe, 2009), “Introspection is the observation by an individual of his own conscious action…Notice that it is a form of observation and not speculation or reasoning from past experience. It is a direct observation of fact.”

Wilhelm Wundt (1832-1920) was perhaps the most famous advocate of this introspective method. He argued that the subject of psychological science is immediate experience, which cannot be separated from the introspective method.

According to Nelson (1996), “The immediate experiencing” or Concurrent introspection-advocated by Wundt and others entirely sidestepped Comte's paradox, because it involved an introspector who indirectly and passively observed the mind “out of the corner of the mental eye”

Accordingly, Comte's paradox - that introspection could not occur because the observing organ and the observed organ were identical-was not a paradox at all, because for concurrent introspection to occur, just a portion of the mental organ was needed to look back upon itself. Furthermore, Neuroscientific research gives answer to Comte's Paradox. According to neuroscientific research, different systems of the brain are responsible for self-reflection and memory retrieval. At a molar level, the prefrontal cortex apparently plays a critical role in self reflection, whereas the medial temporal lobe is critical for memory it self. So, a failure to retrieve the labels for some lobes of the brain that is based on disrupted medial temporal lobe dysfunction can still be reflected by intact functioning of the prefrontal cortex. Of course, the neurological analysis of self reflection and memory is much more complex. Nevertheless, other psychologists of the era believed that even if concurrent introspectionism was possible, it would be inadequate and misleading. Franz Brentano (1838-1917) argued that concurrent introspections are inadequate because people cannot observe intense emotions as they arise in the heat of the moment and they are misleading because the
act of observing inner processes may change them. For Brentano, concurrent introspection was out. Instead of concurrent introspection, he advocated retrospective introspection, in which one observes a mental process by recalling the events stored in memory that arose from that process. At the turn of the 20th century Comte's paradox was not considered to present a real problem and concurrent and retrospective introspection were commonly used to investigate the mind. Nevertheless, even though turn of the century introspectionism relied heavily on metacognitive monitoring, it fell well short of producing a theory of human thought and action that relied on modern principles of metacognition.

Some Shortcoming of Introspectionism:

Perhaps the most important problem with introspectionism is that scientists of the era used introspection as a tool to discover the structure or functions of the mind. That is, these scientists were less interested in investigating people's introspections per se; instead, they used introspection as a tool—a virtual window into the mind. How introspection was used as a methodological tool is what undermined its ultimate success at providing a valid or even consistent description of the mind.

First, introspection was often believed to produce an accurate picture of the mind. That is, by using introspection in an appropriate manner, introspector presumably reported accurately and completely about how their minds operated, such as reporting on the sensations produced by a stimulus or about the ongoing functions of an underlying mental process. Woodworth's (1921) definition reveals the received view at the time that introspection involved the direct observation of fact and even Brentano (as cited in Dunlosky & Metcalf, 2009) assumed that when done retrospectively, such 'inner perception is infallible and does not admit of doubt'. Even if introspection were infallible and did not admit of doubt, it might still be largely inadequate if the mental processes that an experimenter wants to investigate do not produce mental images or sensations that are available to introspection. That is, the sensations and mental processes that are the focus of introspection must produce mental images that the introspector could perceive. If images are not always produced, then introspection could at best produce an incomplete and hence not entirely accurate depiction of thought.
In a study by Karl Marbe, reported in 1901, participants lifted two weights and were instructed to decide which one was the heaviest—a standard task of psychophysics. The participants also used introspection to report what thoughts were in their minds immediately before they made this decision. Participants judged the weights but often failed in their introspections the decision of which weight was heaviest seemed to mysteriously arise from nowhere. Kulpe, one of the Wundt's students and Kulpe's students, conducted similar experiments and they repeatedly found that many thought processes were not accompanied by images. The repeated demonstration of such imageless thoughts suggested that either form of introspection either concurrent or retrospective was limited in what it could reveal about how the human mind operated. A second pitfall of the introspective method was that this method does not produce the reliable results. Introspection was not sufficiently reliable; many scientists began to question its worth as a scientific method. The most well known and outspoken critic of introspection was John B. Watson, who defined behaviorism and established it as a prominent school of psychology. Watson argued strongly that consciousness could not be experimentally studied, so there was no need for introspective techniques, which he criticized as being a defective method. In the 1920s, behaviourism grew in its influence. Many prominent psychologists continued to explore mental processes throughout the mid 1900s, but behaviourism eventually would become the dominant school of American psychology, fueled by the innovative and influential work by Clark Hull, B.F. Skinner and Edward Tolman among many others. In fact, modern metacognitive research had to wait the 1960s, which saw a resurgence in psychologists' interest in the mind and ultimately what is now considered the cognitive revolution.

1.1.7 The Cognitive Renaissance:

Behaviourism had a strangle hold on psychology for nearly 40 years and produced a wealth of data and theory relevant to how both human and nonhuman animals behave. In 1960s many psychologists desert behaviourism, because of two factors: growing dissatisfaction with behaviourism as providing an adequate explanation for animal behaviour and a new approach to how to think about behaviour in terms of mental processes. The behaviourists strangle hold was gradually loosened.
by the discovery of many instances in which behaviour could not be explained solely by stimulus-response connections. It was not until the 1960s that a large number of eminent psychologists turned from behaviourism toward a non-apologetic study of cognition, but troubling discoveries for behaviourism were readily available even in the 1920s. In 1932, E.C. Tolman advocated that not all behaviour could be explained by strict stimulus-response behaviourism. According to Tolman, animal behaviour is also influenced by motivational factors, such as the animal's drive to obtain reward and their incentive to do so. Although Tolman's views were certainly well regarded, they had little immediate influence in converting behaviourists into would be cognitive psychologists. Nevertheless, many other demonstrations throughout the mid-20th century would uncover chinks in the armor of behaviourism and lead to its downfall as the dominant school of psychology. With a new model to guide the reemerging field, articles began to appear in the late 1950s and through the 1960s that would clearly mark the beginning of the cognitive renaissance. To name a few, Broadbent (1958) published his now-classic book on the bottleneck model of attention, Paivio (1969) investigated imaginable processes and Mandler (1967) explored organizational processes in memory. Textbooks emerged that focused on exploring mental life, such as Miller's (1962) psychology: The Science of Mental Life and Ubric Neisser's (1967) cognitive psychology. The latter volume was highly influential in fostering interest in cognition among teachers and would be cognitive psychologists. In their book, Plans and the structure of Behaviour (1960), Miller, Galanter and Pribram sought to replace stimulus response descriptions of humans with a conception based on the relationships between internal images and the construction and use of plans in the control of behaviour.

Miller et al. had given a basic unit of analysis, which was to supplant the behaviourists' stimulus response reflex. Illustrated in the figure below, their test-operate-test-exist (TOTE) unit is a feedback loop in which the outcome of a test informs (a) whether the desired state being tested for is present (congruity), in which case the loop is exited and the relevant operation is terminated or (b) whether the desired state being tested for is not present (incongruity), in which case the operation continues. The TOTE is intentionally general and depending on what flows across the
arrows, such as neural energy or information, the TOTE can reflect the operation of a simple neural reflex or the operation of information driven mechanism. The generality of the TOTE mechanism allows it to apply equally well in analyzing any human activity, including metacognitive ones. The general metacognition model introduced by Nelson and Narens (1990) was inspired by the TOTE mechanism. For the metacognitive model, some process of the mind is monitored, which for the TOTE mechanism is analogous to testing an outcome. The outcome of such monitoring can then serve to control one's thought by either terminating that process or by continuing until some goal has been achieved. Some other models have also played their role in controlling human behaviour and thought. Here, two other models are discussed that will help illustrate metacognitive process involved in other forms of cognition, human memory and problem solving. In 1968, Atkinson and Shiffrin proposed that human memory is a system composed of a series of stores. Information from the environment is copied into a sensory store and when attended, is then transferred to a short-term store, which is limited in capacity. Once information resides in the short-term store, we can then operate on it by using a variety of control processes, such as rehearsing the information repeatedly or elaborating on the information in the meaningful fashion. These control processes are metacognitive in nature. The information in the short-term store is an object level cognition and meta-level processing acts upon it is in this case by applying control processes that increase the likelihood the information is transferred to the long term store.

In Human Problem Solving, Newell and Simon (as cited in Dunlosky & Metcalfe, 2009) argue that problem solving can be understood as “a collection of information processes that combine a series of means to attain an end” and these means in general include choosing a goal for a problem, selecting a method to generate a solution and evaluating the results of that method. These problem-solving processes are recursive in nature, so, for instance, if one realizes that a method has not produced the desired result, a new method may be chosen and applied to the problem. These processes are metacognitive in nature, because they involve evaluating progress and using the outcome of such evaluations to make decisions about how to solve problems. Despite these obvious references to metacognitive processes in early and
influential theories of cognition, the overwhelming response of cognitive scientists was to investigate the cognitive components embedded in these models, such as by exploring the structure of the short-term store or by describing how people represent problems as they solve them. In contrast, an exploration of the metacognitive processes, such as how people monitor and control these processes, was largely ignored.

The Return of Introspection and the Rise of the Metacognitive School of Psychology:

Lieberman (1979) eloquently argued for a limited return to introspection in the analysis of human thought and action. Instead of rejecting introspection as totally unreliable and invalid, he argued that introspective data could produce invaluable evidence about how human think so that we cannot reject introspection. Seemingly at odds with Lieberman (1979), Nisbett and Wilson (1977) argued that verbal reports also known as “introspections”-are largely invalid because people cannot observe their cognitive processes. The answer of the contradictory conclusions, offered by Lieberman (1979) and Nisbett and Wilson (1977), was given by Ericsson and Simon (1980) in their classic article, “Verbal Reports as Data”. They propose a theory of introspective reports, or verbal reports, that explains when introspections will be valid and when they will not. According to Ericsson and Simon's theory, people's introspections will be valid when they focus on information that is currently in short-term store. In contrast, when people are asked to introspect about information not currently in the short-term store, the validity of their introspections may be hampered because they may no longer have access to the sought-after information never resided in the short-term store. The model predicts people's introspections will be largely invalid, unless of course they make a correct guess about what was going on in their minds. By demonstrating how introspective techniques can validly reveal at least some aspects of cognition, Ericsson and Simon (1980, 1984) provided a cornerstone that was essential for the growth of a new metacognitive school. Even with this cornerstone laid, others were still needed before scientists would adopt a metacognitive perspective as a means to further understand human thought and behaviour. J.T.Hart's (1965) doctoral dissertation reported that people have
surprisingly good knowledge of which memory items they would be able to recognize, even if they cannot recall them. In Hart's recall-judgment-recognition (RJR) experimental paradigm, subjects were given common-knowledge questions. Where recall failed, they rated the likelihood that they would be able to recognize the item in a multiple-choice task. Their judgments about this were largely accurate. Thus, this research is also fundamental research in the field of metacognition because this paper predates the rise of contemporary metacognition research. Hart introduced an innovative method to empirically test the accuracy of people's metacognitive experiences.

Arguably, the most influential advocate for metacognition during its infancy was John H. Flavell, who coined the term “meta-memory” in 1970. In this decade, the term “meta” began to arise in articles and conference papers and much groundbreaking research in the area was conducted. This growing interest in metacognition set the stage for Flavell's (1979) American Psychologist article, called “Metacognition and Cognitive Monitoring: A New Area of Cognitive Developmental Inquiry”. Flavell (1979) defined metacognition as “Knowledge and cognition about cognitive phenomena” and refined this definition by specifying classes of phenomena that constitute monitoring and control of cognition, such as metacognitive knowledge and metacognitive experiences. Although Flavell and his colleagues, most notably Henry Wellman, began to champion a metacognitive approach in the 1970s, the beginning of this approach can be traced back to the 1960s, when Flavell (1963) was assimilating Jean Piaget's theory on child development in the landmark book, The Developmental Psychology of Jean Piaget. It was the theoretical work of Jean Piaget and his colleagues that the notions of children having thoughts about thoughts clearly arouse. These “Thoughts about thoughts” were considered a pinnacle of child development in that they signified the presence of formal operations, which Flavell (1963) eloquently describes as “the crowning achievement of intellectual development, the final equilibrium state toward which intellectual evaluation has been moving since infancy”. Flavell goes on to emphasize that, “the most important general property of formal operational thought, the one from which Piaget derives all others, concerns the real versus the possible….Formal thinking is above all propositional...
thinking. The important entities which the adolescent manipulates in his reasoning are no longer the raw reality data themselves but assertions or statements-propositions which contain these data”.

It seems likely that the theorizing by Piaget and his colleagues was directly responsible for inspiring Flavell to further consider the importance of “thoughts about thoughts” for early child development. Thus, the 1970s saw the rise of the metacognitive school of psychology mainly from empirical research and theory construction in developmental psychology. Psychologists like Brown, Flavell and Kluwe etc. continued to refine what counted as metacognition. Since then, a metacognitive approach has been adopted by researchers in many domains of psychology, including social, cognitive, educational, child and adult developments and clinical. The growth of metacognitive research within each of these domains has its own history. Some of these histories are lengthy, such as for cognitive and educational psychology, which began near the rise of the Metacognitive School of Psychology. In other domains, systematic exploration of metacognitive processes is just now catching on.

The story of metacognition can be traced to antiquity, with Simonides heralding the power of his method of Loci to control memory. Metacognitive processes played an especially important role for late - 19th and early-20th century psychologists, who used introspection as a tool to discover the inner workings of the mind. Unfortunately, at the turn of the 20th century, introspective techniques were found to be somewhat inadequate and misleading the finding did not always replicate across laboratories and many inner processes could not be revealed by introspection because they did not produce mental images. With much vigor, Watson banished introspection from psychology and the study of consciousness as the pursuit of psychological inquiry and he offered behaviourism as a replacement. Several decades later, many psychologists in turn found behaviorism inadequate and they began to develop models of behaviour that once again relied on mental processes. Even the earliest models of cognition included metacognitive processes. Nevertheless, metacognition itself did not become the object of systematic investigation until the late 1960s and early 1970s, when Joseph Hart gave us methods to investigate the
validity of people's introspections and John Flavell persuasively argued that metacognitive processes were vital to child development and to human behaviour in general.

1.1.8 Metacognition and Three Types of Knowledge

To increase their metacognitive abilities, students need to possess and be aware of three kinds of content knowledge: declarative, procedural and conditional. Declarative knowledge is the factual information that one knows; it can be declared—spoken or written. An example is knowing the formula for calculating momentum in a physics class (momentum = mass times velocity). Procedural knowledge is knowledge of how to do something, of how to perform the steps in a process; for example, knowing the mass of an object and its rate of speed and how to do the calculation. Conditional knowledge is knowledge about when to use a procedure, skill, or strategy and when not to use it; why a procedure works and under what conditions; and why one procedure is better than another. For example, students need to recognize that an exam word problem requires the calculation of momentum as part of its solution.

This notion of three kinds of knowledge applies to learning strategies as well as course content. When they study, students need the declarative knowledge that (1) all reading assignments are not alike; for example, which a history textbook chapter with factual information differs from a primary historical document, which is different from an article interpreting or analyzing that document. They need to know that stories and novels differ from arguments. Furthermore they need to know that there are different kinds of note taking strategies useful for annotating these different types of texts. And (2) students need to know how to actually write different kinds of notes (procedural knowledge) and (3) they need to know when to apply these kinds of notes when they study (conditional knowledge). Knowledge of study strategies is among the kinds of metacognitive knowledge and it too requires awareness of all three kinds of knowledge.

1.1.9 Metacognition and Study Strategies

Research shows that explicitly teaching study strategies in content courses improves learning. (Commander & Valeri-Gold, 2001; Ramp & Guffey, 1999;
Research also shows that few instructors explicitly teach study strategies; they seem to assume that students have already learned them in high school—but they haven’t. (McKeachie, 1988). Rote memorization is the usual learning strategy—and often the only strategy—employed by high school students when they go to college (Nist, 1993).

Study strategies are diverse and don’t work in every context. For example, reading for information acquisition won’t work in a literature course and won’t work if students are supposed to critically evaluate an article. But students who have learned only the strategy of reading to pass a quiz on the information will not go beyond this strategy. Study strategies don’t necessarily transfer into other domains. Students need to know they have choices about which strategies to employ in different contexts. And students who learn study skills in one course need to apply study strategies in other contexts than where they first learned it.

Students need to monitor their application of study strategies. Metacognitive awareness of their learning processes is as important as their monitoring of their learning of the course content. Metacognition includes goal setting, monitoring, self-assessing and regulating during thinking and writing processes; that is, when they’re studying and doing homework. An essential component of metacognition is employing study strategies to reach a goal, self-assessing one’s effectiveness in reaching that goal and then self-regulating in response to the self-assessment.

**Monitoring Problems with Learning**

When students monitor their learning, they can become aware of potential problems. Nickerson, Perkins and Smith (1985) in The Teaching of Thinking have categorized several types of problems with learning.

**Problems with Process; Making errors in encoding, operations and goals:**

1. **Errors in Encoding**

Missing important data or not separating relevant from irrelevant data. For example, some literature students will base their interpretation of a poem on just the first stanza.
2. **Errors in Operations**

   Failing to select the right subskills to apply. For example, when proofreading, some students will just read to see if it sounds right, rather than making separate passes that check for fragments, subject-verb disagreement and other errors they have learned from experience they are likely to make.

   Failing to divide a task into subparts. For example, some math students will jump right to what they think is the final calculation to get the desired answer.

3. **Errors in Goal Seeking**

   Misrepresenting the task. For example, students in a speech communication class instead of doing the assigned task of analyzing and classifying group communication strategies used in their group discussions will just write a narrative of who said what. Not understanding the criteria to apply. For example, when asked to evaluate the support provided for the major claim of an article, students will explain why they liked the article rather than apply appropriate evaluative criteria.

**Problems with Cognitive Load**

   Too many subskills necessary to do a task. For example, some students might have not yet learned how to carry out all the steps in a complex nursing procedure. Not enough automatic, internalized subskills. For example, students in an argument and persuasion class might have to check their notes on how to analyze persuasive strategies because they have not internalized the procedure.

**Problems with Abilities**

   Lacking the level of needed mental abilities. For example, students are asked to think abstractly about general concepts and issues, but they can only think concretely about specific situations.

   A good way to discover what kind of errors students are making in their thinking processes is to get them to unpack their thinking, to tell you step by step how they are going about the task. By listening to how they are doing the cognitive task, an instructor can detect where the student is going wrong. Asking students to describe their thinking processes also develops their metacognitive abilities—a very necessary skill to improve thinking.
1.1.10 Metacognition and Motivation

Metacognition affects motivation because it affects attribution and self-efficacy. When students get results on tests and grades on assignments (especially unexpected results such as failures), they perform a mental causal search to explain to themselves why the results happened. When they achieve good results, students tend to attribute the result to two internal factors: their own ability and effort. When they fail, they might attribute the cause to these same internal factors or they might, in a self-protective rationalization, distance themselves from a sense of personal failure by blaming external causes, such as an overly difficult task, an instructor’s perverse testing habits, or bad luck. This tendency to attribute success to ability and effort promotes future success because it develops confidence in one’s ability to solve future unfamiliar and challenging tasks. The converse is also true. Attributing failure to a lack of ability reduces self-confidence and reduces the student’s summoning of intellectual and emotional abilities to the next challenging tasks; attribution theory also explains why such students will be unwilling to seek help from tutors and other support services: they believe it would not be worth their effort. In addition to blaming failure on external causes, underachievers often “self-handicap” themselves by deliberately putting little effort into an academic task; they thereby protect themselves from attributing their failure to a painful lack of ability by attributing their failure to lack of effort (Stage et al, 1998)

Metacognition and At-Risk Students

The last two decades have seen a great deal of research directed towards improving the academic success of at-risk students. As McKeachie (1988) explains, the problems are

- Students “enter the higher levels of education with . . . strategies that handicap them in achieving success.”
- “Neither home backgrounds nor schools have helped young adults become aware of alternative ways of approaching learning situations and of options other than increasing or decreasing one’s effort as one approaches different learning situations”
Teachers give plenty of feedback about the correctness of learning outcomes but not about how to achieve these outcomes. The use of learning strategies is linked to motivation. When students fail, they tend to assign the cause to something stable and unchangeable—low innate ability—rather than to something they have the ability to change—employing different, more effective, learning strategies.

1.1.11 Models of Metacognition

J. H. Flavell (1979):

Flavell's Classical Model (1979): A model of Cognitive Monitoring John Flavell of Stanford University is regarded as a foundation researcher in metacognition. He was influenced by the work of Jean Piaget.

According to Flavell (1979), the monitoring of a wide variety of cognitive enterprises occurs through the actions and interactions among four classes of phenomena a) Metacognitive knowledge b) Metacognitive experiences c) Goals (or tasks) and d) Actions (or strategies) Metacognitive knowledge is that segment of a child's or an adult's stored word knowledge that has to do with people as cognitive creatures and with their diverse cognitive tasks, goals, actions and experiences. An example would be a child's acquired belief that unlike many or her friends, she is better at arithmetic than at spelling. Metacognitive experiences are any conscious cognitive or affective experiences that accompany and pertain to any intellectual enterprise. An example would be the sudden feeling that you do not understand something another person just said. Flavell assumed that metacognitive knowledge and metacognitive experiences differ from other kinds only in their content and functions, not in their form or quality. Goals (or tasks) refer to the objectives of a cognitive enterprise, while actions (or strategies) refer to the cognitions or other behaviors employed to achieve them.

(A) Metacognitive Knowledge

This refers to the segment of acquired world knowledge that has to do with cognitive matters. It is the knowledge or beliefs accumulated through experience and stored in long-term memory that concern the human mind and its doings. Some of this stored knowledge is declarative ('knowing that') and other procedural ('knowing
how’). For example, your declarative knowledge is knowing how and when to supplement your poor memory by the use of shopping lists and other external memory aids. One’s knowledge of any given metacognitive item could be both declarative and procedural. For example, one might both know as a verbalizable fact that writing a shopping list is a good memory strategy and also 'know to' write them on appropriate occasions.

Metacognitive knowledge consists primarily of knowledge or beliefs about what factors or variables act and interact to affect the course and outcome of cognitive enterprises. These factors or variables fall into three major categories: person, task and strategy.

Stated very briefly, knowledge of person variables refers to general knowledge about how human beings learn and process information, as well as individual knowledge of one’s own learning processes. For example, you may be aware that your study session will be more productive if you work in the quiet library rather than at home where there are many distractions. Knowledge of task variables include knowledge about the nature of the task as well as the type of processing demands that it will place upon the individual. For example, you may be aware that it will take more time for you to read and comprehend a science text than it would for you to read and comprehend a novel.

Finally, knowledge about strategy variables include knowledge about both cognitive and metacognitive strategies, as well as conditional knowledge about when and where it is appropriate to use such strategies.

**Person category:**

The person category encompasses everything that you might believe about the nature of yourself and other people as cognitive processors. It can be further categorized into beliefs about intra-individual differences, inter-individual differences and universals of cognition. An example of the first subcategory would be one's belief that one person remembers more easily than another; of the second, a belief that one can learn most things better by listening than by reading; of the third subcategory the ascertainment that we usually forget many of the things we have learned as time passes.
Task Category:

Knowledge of a task variables include knowledge about the nature of the task as well as the type of processing demands that it will place upon the individual. An example would be the knowledge that it is easier to learn the essence or gist of a story, than its exact wording.

Strategy Category:

Knowledge about strategy variables include knowledge about both cognitive and metacognitive strategies, as well as conditional knowledge about when and where it is appropriate to use such strategies. A child may come to believe, for example, that one good way to learn and retain information, is to pay particular attention to the main points and try to repeat them to him/herself in his/her own words. Finally, most metacognitive knowledge actually concerns interactions or combinations among two or three of these three types of variables. To illustrate a combination involving all three, one might believe that a pupil (unlike his/her brother - person variable) should use strategy A (rather than strategy B, - strategy variable) in task X (as contrasted with task Y - task variable).

Levels of conscious awareness of metacognitive knowledge:

The metacognitive knowledge is not fundamentally different from other knowledge stored in long-term memory. Thus, a segment of it may be activated as the result of a deliberate, conscious memory search, for example, for an effective strategy. On the other hand and no doubt more commonly, the segment may be activated unintentionally and automatically by retrieval cues in the task situation. However activated, it may and probably often does influence the course of the cognitive enterprise without itself entering consciousness. Alternatively, it may become or give rise to a conscious experience (metacognitive experience).

Limits of metacognitive knowledge:

It can be inaccurate, can fail to be activated when needed, can fail to have much or any influence when activated and can fail to have a beneficial or adaptive effect when influential. Metacognitive knowledge can have a number of concrete and important effects on the cognitive enterprises of children and adults. It can lead somebody to select, evaluate, revise and abandon cognitive tasks, goals and strategies.
Further more, it can lead to any of a wide variety of metacognitive experiences and helps us interpret the meaning and behavioral implications of these metacognitive experiences.

(B) **Metacognitive Experiences** :

The other major conceptual entity in the taxonomy is metacognitive experiences. Metacognitive experiences can be fully or less fully conscious and verbalizable, brief or lengthy, simple or complex in context. What makes them metacognitive experiences rather than experiences of another kind is that they have to do with some cognitive (and often affective) endeavour or enterprise, most frequently a current, ongoing one. For example, if one suddenly has the anxious feeling that he/she does not understand something and wants and needs to understand it, that feeling would be a metacognitive experience. One is having a metacognitive experience whenever he/she has the feeling that something is hard to perceive, comprehend, remember or solve; if there is a feeling that he/she is far from the cognitive goal. Metacognitive experiences are especially likely to occur in situations that stimulate a lot of careful, highly conscious thinking and provide many opportunities for thoughts and feelings about your own thinking to arise. They may also occur at any time before, during or after a cognitive endeavor; may be more apt to occur when the cognitive situation is something between completely novel and completely familiar; and when attentional and mnemonic resources are not wholly preempted by more urgent subjective experiences, such as pain, anxiety, or depression. Thus, a metacognitive experience can be any kind of affective or cognitive conscious experience that is pertinent to conduct in an ongoing cognitive situation or enterprise. Metacognitive experiences can have very important effects on cognitive goals or tasks, metacognitive knowledge and cognitive actions or strategies. First, they can lead somebody to establish new goals or revise old ones. Experiences of puzzlement or failure, for example, can have any of these effects.

Second, metacognitive experiences can affect one's metacognitive knowledge store by adding to it, deleting from it, or revising it, as in Piaget's model of assimilation and accommodation. Finally, metacognitive experiences can activate strategies aimed at either cognitive or metacognitive goals. As an example of the
former, one senses (metacognitive experience) that he/she does not yet know a certain chapter in a text well enough to pass tomorrow's exam, so he/she reads it through once more (the cognitive goal here, to improve his/her knowledge). As an example of the latter, one wonders (metacognitive experience) whether he/she understands the chapter well enough to pass tomorrow's exam, so he/she tries to find out by asking oneself questions about it and noting how well he/she is able to answer them (the metacognitive goal, here, is to assess one's own knowledge).

(C) **Metacognitive goals and tasks:**

Metacognitive goals and tasks are the desired outcomes or objectives of a cognitive venture. This was Flavell's third major category. Goals and tasks include comprehension, committing facts to memory, or producing something, such as a written document or an answer to a math problem, or of simply improving one's knowledge about something. Achievement of a goal draws heavily on both metacognitive knowledge and metacognitive experience for its successful completion.

(D) **Metacognitive strategies:**

Metacognitive strategies are designed to monitor cognitive progress. Metacognitive strategies are ordered processes used to control one's own cognitive activities and to ensure that a cognitive goal (for example, solving a math problem, writing an effective sentence and understanding reading material) has been met. A person with good metacognitive skills and awareness uses these processes to oversee his own learning process, plan and monitor ongoing cognitive activities and to compare cognitive outcomes with internal or external standards. Further more, a single strategy could be invoked for either cognitive or metacognitive purposes and to move toward goals in the cognitive or metacognitive domains. He gave the example of asking oneself questions at the end of a learning unit with the aim of improving knowledge of the content, or to monitor comprehension and assessment of the new knowledge. Flavell (1987) in his chapter Speculations about the Nature and Development of Metacognition, tried to classify part of the domain of metacognition. According to that model metacognition had two components: (1) Metacognitive Knowledge and (2) Metacognitive Experiences.
Gregory Schraw (1998)

According to the model presented by Schraw (1998) the metacognition is a multidimensional phenomenon and it is domain-general in nature and metacognitive knowledge and regulation can be improved using a variety of instructional strategies. Gregory Schraw makes a distinction between two components of metacognition, knowledge of cognition and regulation of cognition.

(A) Knowledge of cognition

Knowledge of cognition refers to what individuals know about their own cognition or about cognition in general. It includes at least three different kinds of metacognitive awareness: declarative, procedural and conditional knowledge. 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.

Components of Metacognition

- Declarative Knowledge
- Procedural Knowledge
- Conditional Knowledge
- Planning
- Monitoring
- Evaluation
- Regulation of Cognition
- Knowledge of Cognition

Declarative knowledge:

Declarative knowledge includes knowledge about oneself as a learner and about what factors influence one's performance.

Procedural knowledge:

Procedural knowledge refers to knowledge about doing things. Much of this knowledge is represented as heuristics and strategies. Individuals with a high degree of procedural knowledge perform tasks more automatically, are more likely to possess a larger repertoire of strategies, to sequence strategies effectively and use qualitatively
different strategies to solve problems. Typical examples include how to chunk and categorize new information.

**Conditional knowledge**

Conditional knowledge refers to knowing when and why to use declarative and procedural knowledge. For example, effective learners know when and what information to rehearse. Conditional knowledge is important because it helps students selectively allocate their resources and use strategies more effectively. Conditional knowledge also enables students to adjust to the changing situational demands of each learning task.

**Regulation of cognition:**

Regulation of cognition refers to a set of activities that help students control their learning. Research supports the assumption that metacognitive regulation improves performance in a number of ways, including better use of attentional resources, better use of existing strategies and a greater awareness of comprehension breakdowns. Although a number of regulatory skills have been described in the literature, for example according to Schraw & Dennison (1994) regulation is divided into planning, information management, monitoring, debugging and evaluation; three essential skills are included in all accounts: planning, monitoring and evaluation.

**Planning:**

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.

**Monitoring:**

Monitoring refers to one's on-line awareness of comprehension and task performance. The ability to engage in periodic self-testing while learning is a good example.

**Evaluating:**

Evaluating refers to appraising the products and efficiency of one's learning. Typical examples include re-evaluating one's goals and conclusions. There are two main points to emphasize about knowledge of cognition and regulation of cognition.
The first is that the two are related to one another. The second is that both components appear to span a wide variety of subject areas and domains - that is, they are domain-general in nature.

In summary, metacognition consists of knowledge and regulatory skills that are used to control one's cognition. While metacognition is used in a general sense to subsume a number of individual components, all of these components are intercorrelated and two general components corresponding to knowledge about cognition and regulation of cognition. Preliminary evidence suggests these two components are intercorrelated somewhere in the \( r = 0.50 \) range.

**Nelson & Naren (1990)**

Nelson & Naren (1990) suggest an alternative model of metacognition and the 'control' - 'monitoring' processes. In this model, there are two critical features: the first is the splitting of cognitive processes into two or more specifically interrelated levels. This model shows a simple metacognitive system containing two interrelated levels that Nelson and Naren's call the “Meta-level” and the “Object-level”. The second critical feature of a metacognitive system is also a kind of dominance relation, defined in terms of the direction of the flow of information. This flow gives rise to a distinction between what they call “Control” versus “Monitoring”. The object level can be viewed as the ongoing cognitive process of interest, such as attention, learning, language processing, problem solving and so forth. The meta-level also contains a model that is a person's understanding of the task they are performing and the ongoing cognitive processes that are engaged while they complete the task. This model is partly informed by people's monitoring of their progress on task, but it also may be informed by their metacognitive knowledge.

Two general flows of information between both levels are postulated. Information about the state of the object level is conveyed to the meta-level through monitoring processes, while instructions from the meta-level are transmitted to the object level through control processes. Thus, if errors occur on the object level, monitoring processes will give notice of it to the meta-level and control process will be activated to resolve the problem. This seems an elegant and simple mode, including both metacognitive knowledge and skills.
**Metacognitive Knowledge**: Metacognitive Knowledge (MK) is a declarative knowledge stored in memory and comprises models of cognitive processes, such as language, memory and so forth. It also encompasses information regarding person, as well as information about tasks, strategies and goals. More specifically, metacognitive knowledge regarding person involves the self and the others as cognitive beings, that is, how we or other people process various tasks and how good are on them, what was felt during a specific task processing. Metacognitive task knowledge involves task categories and their features, relations between tasks, as well as the ways they are processed. Metacognitive strategy knowledge involves knowledge of multiple strategies as well as the conditions for their use. Finally, metacognitive goal knowledge involves knowledge of what sort of goals people pursue when confronted with specific tasks or situations.

Metacognitive knowledge gets continuously enriched, updated and differentiated by integrating information coming from the monitoring of cognition at a conscious level through observation of one's and others' behavioural actions and their outcomes when dealing with specific tasks in various contexts, through awareness of our metacognitive experiences as well as through communication and interaction with others.

**Metacognitive Experiences**: Metacognitive experiences (ME) are what the person is aware of and what she or he feels when coming across a task and processing the information related to it. They are the interface between the person and the task, the awareness the person has of task features, of the fluency of cognitive processing, of the progress toward the goal set, of the effort exerted on cognitive processing and of the outcome of processing. They take the form of metacognitive feelings, metacognitive judgments/estimates and online task-specific knowledge.

Feeling of knowing, feeling of familiarity and feeling of confidence are some indicative metacognitive feelings extensively studied in Metamemory research. Also, there are feelings studied in the context of problem solving, such as feeling of difficulty, that are crucial for the self-regulation of effort. Metacognitive judgments/estimates include judgment of learning, estimate of effort expenditure, estimate of time needed or spent, but also estimate of solution correctness and so
forth, that make clusters with feelings of difficulty and confidence. The online task-specific knowledge comprises task information that we are attending to and ideas or thoughts that we are aware of as we deal with a task (e.g., cognitive procedures we are applying). It also comprises MK that we retrieve from memory in order to process the task; for example, MK about tasks and procedures that we used in the past, comparison of the current with other tasks about their similarities or differences and so forth.

**Metacognitive Regulation:** Metacognitive experiences involve the use of metacognitive strategies or metacognitive regulation (Brown, 1987). Metacognitive strategies are sequential processes that one uses to control cognitive activities and to ensure that a cognitive goal (e.g., understanding a text) has been met. These processes help to regulate and oversee learning and consist of planning and monitoring cognitive activities, as well as checking the outcomes of those activities.

For example, after reading a paragraph in a text a learner may question herself about the concepts discussed in the paragraph. Her cognitive goal is to understand the text. Self-questioning is a common metacognitive comprehension monitoring strategy. If she finds that she cannot answer her own questions, or that she does not understand the material discussed, she must then determine what needs to be done to ensure that she meets the cognitive goal of understanding the text. She may decide to go back and re-read the paragraph with the goal of being able to answer the questions she had generated. If, after re-reading through the text she can now answer the questions, she may determine that she understands the material. Thus, the metacognitive strategy of self-questioning is used to ensure that the cognitive goal of comprehension is met.

**Metacognitive Skills:** Metacognitive skills (MS) refer to the deliberate use of strategies (i.e., procedural knowledge) in order to control cognition. Brown (1987) identified the control of cognition with executive control. Executive control involves selective attention and working memory, as well as planning, conflict resolution, error detection and inhibitory control and therefore, is related to metacognitive regulation; that is, to both monitoring and control. However, MS have characteristics that are distinct from MK and ME, which are products of different processes in the monitoring of cognition, as already discussed. Metacognitive skills comprise orientation
strategies, planning strategies, strategies for regulation of cognitive processing, strategies for monitoring the execution of planned action and strategies for the evaluation of the outcome of task processing. Such a conceptualization of MS implies that they are operating on cognition through the cognitive regulatory loop and that they can call in cognitive strategies - such as rehearsal, elaboration and so forth – to regulate cognition, as well as strategies to analyze task requirements and evaluate the response. In this direction, MS make use of online task-specific knowledge, as well as of MK. Moreover, for MS to be activated, there needs to be awareness of the fluency of cognitive processing and awareness that a conflict or error has occurred. The latter information is conveyed by ME, such as feelings of familiarity, of difficulty, or of confidence. Thus, ME provide the input that triggers control decisions (e.g., regulation of effort) or MS, either directly or indirectly through MK.

In conclusion, there is evidence as well as theoretical reasons to support the claim that metacognition is a multifaceted phenomenon and that ME, MK and MS are three distinct facets of metacognition, despite their close interrelations. These facets serve different functions in the self-regulation process, with ME and MK involved in the monitoring function that informs selfawareness as well as awareness of cognition and MS involved in strategy use for the control of cognition. Also, MK (being declarative knowledge of self and others) along with metacognitive judgments about other persons' current cognitive processing, are instrumental for the co-regulation and other regulation of cognition and behavior. Finally, MS can also contribute to the co-regulation and other regulation of cognition, possibly through the control of one's own cognition following feedback from the other persons or through the guidance given to the other person.

**A Multifaceted and Multilevel Model of Metacognition**

This tentative model posits that the object level comprises processes involved in cognition as well as in emotions/affect. It functions at a non-conscious level and involves two separate regulatory systems based on non-conscious monitoring and control processes. Products of each of the two regulatory systems, as well as of their interactions, along with perceptions of their behavioral outcomes, are represented at the personal awareness level. Emotions, thoughts, ideas, desires, perceptions and so
forth - as well as ME, MK and MS - are the components of self-awareness at this level. Also, at this level, integration of the person's explicit representation of the situation and of its demands with the action/behavior ensued is accomplished.

Note: ME = Metacognitive Experience, MK = Metacognitive Knowledge MS = Metacognitive Skills, MJ = Metacognitive Judgements = Monitoring, = Control

What is worth noting is that at the personal-awareness level, metacognition is not cold (i.e., purely cognitive) as the nature of MK would suggest; it is hot, because affect is integrated with the monitoring of cognition in the case of metacognitive feelings. Moreover, having represented at the same forum - that is, in conscious awareness - cognition, affect and metacognition, the self-regulation process is facilitated because the person is informed of what is subjectively significant and of the progress toward one's goal. In the case of control being needed, then ME and MK can activate MS and through them the cognitive regulatory loop. However, metacognitive feelings can also activate the affective regulatory loop, directly through their affective quality, or indirectly through MK and MS; in the latter case, there is cognitive control of emotion. At the same time, the personal-awareness level informs the meta-meta level that represents the social level of metacognition. This level comprises only metacognitive judgments about the one's and others' ME, MK and MS; it is informed by self-awareness at the personal level, as well as by information received from the ongoing interaction with others. Monitoring at this level is explicit and can take the form of reflection. It leads to a socially shared and negotiated representation of the person-in context. Control at this level is exercised in a conscious analytic mode and its access to one's own and others' cognition and affect at the object level is through the personal-awareness level of the interacting persons.

1.1.12 Assessment of Metacognition

Assessment of metacognition is a highly problematic task. The study of metacognition is heavily dependent on the development of valid measuring instruments and specifically appropriate tasks to measure metacognitive ability. The complexity of this task arises from two main sources, first the lack of a generally accepted conceptualization of what really the construct means and second the fact that the metacognition is an inner awareness or process rather than an overt behaviour and
consequently individuals themselves are often not aware of these processes. However, many methods for the assessment of metacognition are being used as mention below.

1. Questionnaires
2. Interviews
3. The analysis of think aloud protocols
4. Systematic observations
5. Stimulated Recall
6. On-Line Computer Log file registration
7. Eye-movement registration
8. Reflect when prompted
9. Multi-method assessment

All these assessment methods have their pros and cons. For instance, Questionnaires are easy to administer to large groups while scores on these questionnaires hardly correspond to actual behavioral measures during task performance. Results obtained through oral interviews have been questioned. Brown (1980) suggested that there is often a gap between what children say they know and how they perform. The think aloud protocols require individual assessments. In this method participants are asked to talk aloud during thinking, problem solving and / or learning and these verbal protocols are analyzed by means of coding schemes. This method has two problems. The first one refers to the question of the reactivity of the method: Is the process of thinking altered throughout the method of think aloud because thinking aloud needs resources of the cognitive system that could otherwise be used for the primary task? The second problem refers to the completeness of the verbal protocols: Are the protocols obtained by think aloud procedures complete or is any information about the cognitive processes missing? Systematic observational methods have three advantages. First, such methods record what learners actually do, rather than what they recall or believe they do. Second, they allow links to be established between learners' behaviours and the context of the task. Finally, particularly crucial for young children, they do not depend on the verbal abilities of the participants. However, observational method contains methodological difficulties. It requires coding framework to identify verbal and non-verbal indicators from the
videotaped events. When assessing metacognitive skills during hypermedia learning, concurrent assessment could be conducted with systematic observation via log file or eye movement analysis or verbalization methods. Data from the recording of eye movements lie somewhere in between, because they indicate what part of the screen the person is looking at, similarly to log-files, the data render no information about what comes to the mind of the person while looking at the information presented on that part of the screen. So that, data from log-file and eye movement register methods need more interpretation by the researcher.

Thus, each method has its own advantages and disadvantages. One clear distinction in assessment methods pertains to off-line versus on-line methods. Off-line methods are presented either before or after task performance, whereas on-line assessments are obtained during task performance. On-line methods appear to be more predictive of learning performance relative to off-line methods, even when the latter are administered retrospectively to task performance. In order to measure metacognition more accurately it has been suggested that researchers should use Multiple Methods that do not share the same source of error.

1.1.13 Educational Implications of Metacognition

Relating metacognition to developing one's self-knowledge and ability to 'learn how to learn' resulted in metacognition being awarded a high status as a feature of learning.

The ground for developing such an interest proved particularly fertile, especially in view of a constantly changing technological world when not only it is impossible for individuals to acquire all existing knowledge, but it is also difficult to envisage what knowledge will be essential for the future. Flavell (1987) proposed that good schools should be 'hotbeds of metacognitive development' because of the opportunities they offer for self-conscious learning.

What is the particular usefulness and adaptiveness of metacognition? According to Flavell (1987): "Metacognition is especially useful for a particular kind of organism, one that has the following properties. First, the organism should obviously tend to think a lot; by definition an abundance of metacognition presupposes an abundance of cognition. Second, the organism should be fallible and
error-prone and thus in need of careful monitoring and regulation. Third, the organism should want to communicate, explain and justify its thinking to other organisms as well as to itself; these activities clearly require metacognition. Fourth, in order to survive and prosper, the organism should need to plan ahead and critically evaluate alternative plans. Fifth, if it has to make weighty, carefully considered decisions, the organism will require metacognitive skills. Finally, it should have a need or proclivity for inferring and explaining psychological events in itself and others, a penchant for engaging in those metacognitive acts termed social cognition. Needless to say, human beings are organisms with just these properties.”

Flavell (1979) also states: “I find it hard to believe that children who do more cognitive monitoring would not learn better both in and out of school than children who do less. I also think that increasing the quantity and quality of children’s metacognitive knowledge and monitoring skills through systematic training may be feasible as well as desirable. “

The above seems especially true, if we consider that students at school cannot plan ahead, choose the right strategy every time to solve a particular task, monitor and evaluate the acts and results of their work and so on, unless they have mastered some kind of metacognitive ability. More importantly, metacognitive development leads students to independent learning, more permanent knowledge, motivation for learning and higher achievement. Metacognition is a ‘tool of wide application’ and its development gains additional importance and interest because of this fact. As cognition comes into play whenever we operate intellectually in any domain, the same can also apply to metacognition. Thus, although metacognition can be construed as domain specific knowledge, it should be remembered that its ‘domain’ spans all others. This very advantage allows the metacognitive processes to have a wide application in a range of different situations. It is important, for example, that basic strategies can apply in the metacognitive development of students regardless of grade, level or subject area. It is also important that such processes allow the learners to go far beyond the subject of instruction and apply their learning in other, similar situations. Teachers may not maximize their students’ potential if they tend to teach them only facts, rules or principles, without teaching them how they can learn more
about these or about another content. Similarly, teaching is of little value if it simply asks children to learn by heart some rules, without enabling them to reach conclusions themselves and without helping them to transfer rules in real situations, through problem solving. Such 'teaching' and 'learning' is, at best, limited and had no breadth, since it does not help children become independent learners, but links such learning to the particular situation in which it occurred and nothing more. On the other hand, expert thinkers are distinguished by the degree to which they strategically plan, manage their time and resources and monitor their progress during intellectually demanding tasks. They demonstrate metacognitive abilities, i.e., they think about and direct their own thinking. In this way, metacognitive strategies, by aiming to foster abilities such as self-awareness, self-control and self-monitoring, produce independent learners who control their own learning and learn how to learn for life. Metacognition has, nowadays, expanded its application to a number of educational and other enterprises. According to Flavell (1979) “Investigators have recently concluded that metacognition plays an important role and facilitates oral communication of information, oral persuasion, oral comprehension, reading comprehension, writing, language acquisition, attention, memory, problem solving, social cognition and various types of self-control and self-instruction. There are also clear indications that ideas about metacognition are beginning to make contact with similar ideas in the areas of social learning theory, cognitive behavior modification, personality development and education”.

Voices advocating the importance of metacognitive activity within educational contexts have resulted in placing metacognition high on educational research agendas.

1.1.14 Review of Theoretical Study

Although there is growing evidence, that metacognition is an important component of intelligence and cognition, there is confusion on the conceptual definition of the term. There are many different kinds of knowledge and processes subsumed under the term metacognition. According to Campione (1987), “this term has been used by different authors to mean different things”. In modern psychological literature, the term “metacognition” has been used to refer to knowledge about cognition and regulation of cognition.
The term 'metacognition' was introduced by John Flavell in the early 1970s based on the term 'meta memory' previously conceived by the same scholar. Flavell's definition was followed by numerous others, often portraying different emphasis on mechanisms and processes associated with metacognition. Although, metacognition is multidimensional construct in nature, most researchers suggest two components: knowledge of cognition and regulation of cognition. Knowledge of cognition refers to how much learners understand about their own memories and the way they learn. Regulation of cognition refers to how well learners can regulate their own memory and learning. Flavell uses the person-task-strategy taxonomy to define metacognitive knowledge, whereas, Brown, Schraw, Dennison, Jacobs and Paris have categorized metacognitive knowledge based on person's awareness of his/her knowledge: declarative, procedural and conditional knowledge. Regulation of cognition theoretically contains several different subcomponents including prediction, planning, selecting, information management, monitoring and evaluation and debugging. On the other hand Efklides (2008) suggested three different facets of metacognition; namely, metacognitive knowledge, metacognitive experiences and metacognitive skills. Most researchers believe that the two components of metacognition, knowledge of cognition and regulation of cognition are interdependent constructs. For example, awareness that one is not very good at a certain task would lead him/her to monitor his/her processes more carefully. On the other hand, if one monitors his actions and detects a lot of errors, he/she may conclude that the task is difficult. Does metacognition by definition require conscious processing, or may metacognitive activities also appear on a less conscious level? Some researchers (e.g., Nelson, 1996; Schnotz, 1992) claim that metacognition must be conscious in order to represent higher-order processing. Others (e.g., Baker, 1994; Reder, 1996; Veenman, Prins & Elshout, 2002; and Efklides, 2008) allow less conscious processing to be metacognitive by nature, for instance, if ideas about oneself have been firmly established or if the activity of checking yourself has become a regulatory 'good' habit. Many evaluations and self-monitoring processes run in the 'background' of the cognitive processes that are being executed. Only after an error is detected, rightfully or not, the system becomes alerted. An issue of particular importance to educators is
whether metacognition is general by nature, or rather task and domain specific. General metacognition may be instructed concurrently in different learning situations and may be expected to transfer to new ones, whereas specific metacognition has to be taught for each task or domain separately. Much research on metacognition only pertains to one specific task or domain, such as reading and text studying, writing, math problem solving, science classes and economics classes. Although these studies provide detailed information of how metacognition operates in specific tasks and domains, there is a need to compare metacognition across tasks and domains. So far, studies with multiple tasks or domains yielded inconclusive results. Research by Schraw et al. (Schraw, Dunkle, Bendixen & Roedel, 1995; Schraw & Nietfeld, 1998) revealed that monitoring skills are general by nature, whereas Kelemen, Frost and Weaver (2000) provided evidence against such a general skill. In the same vein, Glaser, Schauble, Raghvan and zeits (1992) observed many differences in metacognitive activity between different tasks, whereas Veenman et al. (Veenman, Elshout & Meijer, 1997; Veenman & Verjeij, 2003) obtained strong support for the generality of metacognitive skills. Central to the problems relating to metacognition is finding ways of recording and making available to others one's metacognitive thoughts. Both identifying and 'measuring' metacognition currently rely heavily on researchers' subjective interpretation in assessing what is cognitive and what is metacognitive. Attempts in this direction are usually restricted to the observable elements of one's metacognitive thinking' that is what one says and what one does. What remains unsaid by the researches could entail a richness of reflection that remains unexplored by researchers. More research is needed that will enhance our understanding on what constitutes metacognition, how it can be identified and whether it can be taught and how. These are just a few of the questions that are important to metacognitive literature, irrespective of discipline.

1.2 PROBLEM SOLVING ABILITY

Problem solving is a mental process which is the concluding part of the larger problem process that includes problem finding and problem shaping where problem is defined as a state of desire for the reaching of a definite goal from a present condition that either is not directly moving toward the goal, is far from it or
needs more complex logic for finding a missing description of conditions or steps toward the goal. Considered the most complex of all intellectual functions, problem solving has been defined as a higher-order cognitive process that requires the modulation and control of more routine or fundamental skills. Problem solving has two major domains: mathematical problem solving and personal problem solving where, in the second, some difficulty or barrier is encountered. Further problem solving occurs when moving from a given state to a desired goal state is needed for either living organisms or an artificial intelligence system.

While problem solving accompanies the very beginning of human evolution and especially the history of mathematics, the nature of human problem solving processes and methods has been studied by psychologists over the past hundred years. Methods of studying problem solving include introspection, behaviorism, simulation, computer modeling and experiment. Social psychologists have recently distinguished between independent and interdependent problem-solving.

The early experimental work of the Gestaltists in Germany placed the beginning of problem solving study e.g. Karl Duncker in 1935 with his book The psychology of productive thinking. Later this experimental work continued through the 1960s and early 1970s with research on conducted relatively simple but novel for participants’ laboratory tasks of problem solving. Choosing simple novel tasks was based on the clearly defined optimal solutions and their short time for solving, which made possible for the researchers to trace participants’ steps in problem-solving process. Researchers’ underlying assumption was that simple tasks such as the Tower of Hanoi correspond to the main properties of “real world” problems and thus the characteristic cognitive processes within participants' attempts to solve simple problems are the same for “real world” problems too; simple problems were used for reasons of convenience and with the expectation that thought generalizations to more complex problems would become possible. Perhaps the best-known and most impressive example of this line of research is the work by Allen Newell and Herbert A. Simon. Other experts have shown that the principle of decomposition improve the ability of the problem solver to make good judgment.
Simple laboratory-based tasks can be useful in explicating the steps of logic and reasoning that underlie problem solving; however, they usually omit the complexity and emotional valence of “real-world” problems. In clinical psychology, researchers have focused on the role of emotions in problem solving (D'Zurilla & Goldfried, 1971; D'Zurilla & Nezu, 1982), demonstrating that poor emotional control can disrupt focus on the target task and impede problem resolution (Rath, Langenbahn, Simon, Sherr, & Diller, 2004). In this conceptualization, human problem solving consists of two related processes: problem orientation, the motivational/attitudinal/affective approach to problematic situations and problem-solving skills. Working with individuals with frontal lobe injuries, neuropsychologists have discovered that deficits in emotional control and reasoning can be remedied, improving the capacity of injured persons to resolve everyday problems successfully (Rath, Simon, Langenbahn, Sherr, & Diller, 2003).

Problem Solving is very important but problem solvers often misunderstand it. This report proposes the definition of problems, terminology for Problem Solving and useful Problem Solving patterns.

We should define what is the problem as the first step of Problem Solving. Further, we should recognize common terminology such as Purpose, Situation, Problem, Cause, Solvable Cause, Issue and Solution. Even Consultants, who should be professional problem solvers, are often confused with the terminology of Problem Solving. For example, some consultants may think of issues as problems, or some of them think of problems as causes. But issues must be the proposal to solve problems and problems should be negative expressions while issues should be a positive expression. Some consultants do not mind this type of minute terminology, but clear terminology is helpful to increase the efficiency of Problem Solving. Third, there are several useful thinking patterns such as strategic thinking, emotional thinking, realistic thinking and empirical thinking and so on. The thinking pattern means how we think. So far, I recognized fourteen thinking patterns. If we choose an appropriate pattern at each step in Problem Solving, we can improve the efficiency of Problem Solving.
This report will explain the above three points such as the definition of problems, the terminology of Problem Solving and useful thinking patterns.

1.2.1 Definition of problem

A problem is decided by purposes. If someone wants money and when he or she has little money, he or she has a problem. But if someone does not want money, little money is not a problem.

For example, manufacturing managers are usually evaluated with line-operation rate, which is shown as a percentage of operated hours to potential total operation hours. Therefore manufacturing managers sometimes operate lines without orders from their sales division. This operation may produce more than demand and make excessive inventories. The excessive inventories may be a problem for general managers. But for the manufacturing managers, the excessive inventories may not be a problem.

If a purpose is different between managers, they see the identical situation in different ways. One may see a problem but the others may not see the problem. Therefore, in order to identify a problem, problem solvers such as consultants must clarify the differences of purposes. But oftentimes, problem solvers frequently forget to clarify the differences of purposes and incur confusion among their problem solving projects. Therefore problem solvers should start their problem solving projects from the definition of purposes and problems

1.2.2 What are problems?

We use the word problem to describe a wide range of situations of different importance, from the irritation of discovering that the car battery is flat, to the life threatening failure of an aircraft engine in mid-air.

Problems can be defined broadly as situations in which we experience uncertainty or difficulty in achieving what we want to achieve, e.g.

Stopping smoking is a problem when you decide you want to stop but cannot.
A computer malfunction is a problem if it prevents you completing work on time.
An excessive workload is a problem when it interferes with your ability to work effectively.
Poor communication is a problem when it reduces the efficiency of an organisation.

Problems arise when an obstacle prevents us reaching an objective, e.g. when a breakdown in a company's manufacturing plant (the obstacle) prevents it fulfilling orders (the objective).

Objective = something we have decided we need to achieve.
Obstacle = anything that prevents us achieving an objective.

objective + obstacle = PROBLEM

We encounter a large variety of problems during the course of our work, with objectives and obstacles of different types and importance. Defining these accurately is essential to finding an effective solution.

**Problems can be divided broadly into two groups:**

Those where the current situation is not what was expected (known as closed or maintenance problems)

Those where we want to change our current situation in some way but there is an obstacle preventing us doing so (known as open-ended or achievement problems).

**Closed problems** occur when something has happened that should not have happened, or something we expected to happen has not happened, i.e. there is a deviation from the normal or expected state of affairs. For example, it could be the unexpected resignation of a key member of staff, or the failure of the principal speaker to arrive at a conference. The cause (or obstacle) may be known or unknown, but something needs to be done about it.

**Open-ended problems** occur when we want to achieve a specific objective but there are certain obstacles blocking our progress. They can be subdivided into three groups:

- where we are unable to reach our current objective, e.g. failing to meet a sales target
- where our current objective could be exceeded, e.g. improved efficiency
- where a new objective could be achieved through problem solving, e.g. creating a new product or service.

Solving a problem involves finding ways to overcome any obstacles and to achieve our objective.
Although each problem is unique in terms of the information involved and requires a unique blend of thought processes to find a solution, all successful problem solving follows a basic pattern.

**Terminology of Problem Solving**

We should know the basic terminology for Problem Solving. This report proposes seven terms such as Purpose, Situation, Problem, Cause, Solvable Cause, Issue and Solution.

**Purpose**

Purpose is what we want to do or what we want to be. Purpose is an easy term to understand. But problem solvers frequently forget to confirm Purpose, at the first step of Problem Solving. Without clear purposes, we can not think about problems.

**Situation**

Situation is just what a circumstance is. Situation is neither good nor bad. We should recognize situations objectively as much as we can. Usually almost all situations are not problems. But some problem solvers think of all situations as problems. Before we recognize a problem, we should capture situations clearly without recognizing them as problems or non-problems. Without recognizing situations objectively, Problem Solving is likely to be narrow sighted, because problem solvers recognize problems with their prejudice.

**Problem**

Problem is some portions of a situation, which cannot realize purposes. Since problem solvers often neglect the differences of purposes, they cannot capture the true problems. If the purpose is different, the identical situation may be a problem or may not be a problem.

**Cause**

Cause is what brings about a problem. Some problem solvers do not distinguish causes from problems. But since problems are some portions of a situation, problems are more general than causes are. In other words causes are more specific facts, which bring about problems. Without distinguishing causes from problems, Problem Solving can not be specific. Finding specific facts which causes problems is the essential step in Problem Solving.
**Solvable Cause**

Solvable cause is some portions of causes. When we solve a problem, we should focus on solvable causes. Finding solvable causes is another essential step in Problem Solving. But problem solvers frequently do not extract solvable causes among causes. If we try to solve unsolvable causes, we waste time. Extracting solvable causes is a useful step to make Problem Solving efficient.

**Issue**

Issue is the opposite expression of a problem. If a problem is that we do not have money, the issue is that we get money. Some problem solvers do not know what Issue is. They may think of “we do not have money” as an issue. At the worst case, they may mix the problems, which should be negative expressions and the issues, which should be positive expressions.

**Solution**

Solution is a specific action to solve a problem, which is equal to a specific action to realize an issue. Some problem solvers do not break down issues into more specific actions. Issues are not solutions. Problem solvers must break down issues into specific action.

Now we can say that, Problem-solving is a mental process that involves discovering, analyzing and solving problems. The ultimate goal of problem-solving is to overcome obstacles and find a solution that best resolves the issue.

The best strategy for solving a problem depends largely on the unique situation. In some cases, people are better off learning everything they can about the issue and then using factual knowledge to come up with a solution. In other instances, creativity and insight are the best options.

**Thinking patterns**

This report lists fourteen thinking patterns. Problem solvers should choose appropriate patterns, responding to situations. This report categorized these fourteen patterns into three more general groups such as thinking patterns for judgements, thinking patterns for thinking processes and thinking patterns for efficient thinking. The following is the outlines of those thinking patterns.
Thinking patterns for judgements

In order to create a value through thinking we need to judge whether what we think is right or wrong. This report lists four judging patterns such as strategic thinking, emotional thinking, realistic thinking and empirical thinking.

Strategic thinking

Focus, or bias, is the criterion for strategic thinking. If you judge whether a situation is right or wrong based on whether the situation is focused or not, your judgement is strategic. A strategy is not necessarily strategic. Historically, many strategists such as Sunfucis in ancient China, Naplon, M. Porter proposed strategic thinking when they develop strategies.

Emotional thinking

In organizations, an emotional aspect is essential. Tactical leaders judge whether a situation is right or wrong based on the participants of emotional commitment. They think that if participants can be positive to a situation, the situation is right.

Realistic thinking

- Start from what we can do
- Fix the essential problem first

These two criteria are very useful. “Starting” is very important, even if we do very little. We do not have to start from the essential part. Even if we start from an easier part, starting is a better judgement than a judgement of not-starting in terms of the first part of realistic thinking. Further, after we start, we should search key factors to make the Problem Solving more efficient. Usually, 80 % of the problems are caused by only 20 % of the causes. If we can find the essential 20 % of the causes, we can fix 80 % of problems very efficiently. Then if we try to find the essential problem, what we are doing is right in terms of the second part of realistic thinking.

Empirical thinking

When we use empirical thinking, we judge whether the situation is right or wrong based on our past experiences. Sometimes, this thinking pattern persists on the past criteria too much, even if a situation has changed. But when it comes to our daily lives, situations do not change frequently. Further, if we have the experience of the
identical situation before, we can utilize the experience as a reliable knowledge data base.

**Thinking patterns for thinking processes**

If we can think systematically, we do not have to be frustrated when we think. In contrast, if we have no systematic method, Problem Solving frustrates us. This lists five systematic thinking processes such as rational thinking, systems thinking, cause & effect thinking, contingent thinking.

**Rational thinking**

Rational thinking is one of the most common Problem Solving Methods. This report will briefly show this Problem Solving Method.

1. Set the ideal situation
2. Identify a current situation
3. Compare the ideal situation and the current situation and identify the problem situation
4. Break down the problem to its causes
5. Conceive the solution alternatives to the causes
6. Evaluate and choose the reasonable solution alternatives
7. Implement the solutions

We can use rational thinking as a Problem Solving Method for almost all problems.

**Systems thinking**
Systems thinking are a more scientific Problem Solving approach than the rational thinking approach. We set the system, which causes problems and analyze them based on systems of functions. The following are the system and how the system works.

**System**

- **Purpose**
- **Input**
- **Output**
- **Function**
- **Inside cause (Solvable cause)**
- **Outside cause (Unsolvable cause)**
- **Result**

In order to realize Purpose, we prepare Input and through Function we can get Output. But Output does not necessarily realize Purpose. Result of the Function may be different from Purpose. This difference is created by Outside Cause and Inside Cause. We can not solve Outside Cause but we can solve Inside Cause. For example, when we want to play golf, Purpose is to play golf. If we can not play golf, this situation is Output. If we can not play golf because of a bad weather, the bad weather is Outside Cause, because we can not change the weather. In contrast, if we cannot play golf because we left golf bags in our home, this cause is solvable. Then, that we left bags in our home is an Inside Cause.

Systems thinking are a very clear and useful method to solve problems.

**Cause & effect thinking**

Traditionally, we like to clarify cause and effect relations. We usually think of finding causes as solving problems. Finding a cause and effect relation is a conventional basic Problem Solving Method.

**Contingent thinking**

Game Theory is a typical contingent thinking method. If we think about as many situations as possible, which may happen and prepare solutions for each situation, this process is a contingent thinking approach.
Thinking patterns for efficient thinking

In order to think efficiently, there are several useful thinking patterns. This report lists five patterns for efficient thinking such as hypothesis thinking, conception thinking, structure thinking, convergence & divergence thinking and time order thinking.

Hypothesis thinking

If we can collect all information quickly and easily, you can solve problems very efficiently. But actually, we can not collect every information. If we try to collect all information, we need so long time. Hypothesis thinking does not require collecting all information. We develop a hypothesis based on available information. After we developed a hypothesis, we collect minimum information to prove the hypothesis. If the first hypothesis is right, you do not have to collect any more information. If the first hypothesis is wrong, we will develop the next hypothesis based on available information. Hypothesis thinking is a very efficient problem-solving method, because we do not have to waste time to collect unnecessary information.

Conception thinking

Problem Solving is not necessarily logical or rational. Creativity and flexibility are other important aspects for Problem Solving. We can not recognize these aspects clearly. This report shows only what kinds of tips are useful for creative and flexible conception. Following are portions of tips.

- To be visual.
- To write down what we think.
- Use cards to draw, write and arrange ideas in many ways.
- Change positions, forms and viewpoints, physically and mentally.

We can imagine without words and logic, but in order to communicate to others, we must explain by words and logic. Therefore after we create ideas, we must explain them literally. Creative conception must be translated into reasonable explanations. Without explanations, conception does not make sense.
**Structure thinking**

If we make a structure like a tree to grasp a complex situation, we can understand very clearly.

Upper level should be more abstract and lower level should be more concrete. Dividing abstract situations from concrete situations is helpful to clarify the complex situations. Very frequently, problem solvers cannot arrange a situation clearly. A clear recognition of a complex situation increases efficiency of Problem Solving.

**Convergence & divergence thinking**

When we should be creative we do not have to consider convergence of ideas. In contrast, when we should summarize ideas we must focus on convergence. If we do convergence and divergence simultaneously, Problem Solving becomes inefficient.

**Time order thinking**

Thinking based on a time order is very convenient, when we are confused with Problem Solving. We can think based on a time order from the past to the future and make a complex situation clear.
The skills of problem solving

Problem solving requires two distinct types of mental skill, analytical and creative. Analytical or logical thinking includes skills such as ordering, comparing, contrasting, evaluating and selecting. It provides a logical framework for problem solving and helps to select the best alternative from those available by narrowing down the range of possibilities (a convergent process). Analytical thinking often predominates in solving closed problems, where the many possible causes have to be identified and analysed to find the real cause.

Creative thinking is a divergent process, using the imagination to create a large range of ideas for solutions. It requires us to look beyond the obvious, creating ideas which may, at first, seem unrealistic or have no logical connection with the problem. There is a large element of creative thinking in solving open problems.

The creative thinking skills can be divided into several key elements:

- fluency - producing many ideas
- flexibility - producing a broad range of ideas.
- originality - producing uncommon ideas.
- elaboration - developing ideas.

Effective problem solving requires a controlled mixture of analytical and creative thinking. Research has shown that, in general terms, each side or hemisphere of the brain is specialised to serve one of these groups of skills. The degree of specialisation of each hemisphere varies from person to person, but it has given rise to the terms right-brain thinking and left-brain thinking. Left-brain thinking is more logical and analytical and is predominantly verbal. Right-brain thinking is more holistic and is concerned with feelings and impressionistic relationships.

To be a good problem solver you need to be able to switch from one group of skills to the other and back again, although this is not always easy. Traditional education gives far greater encouragement to the development and use of left-brain thinking. This is reinforced in the way we are required to work, where emphasis is placed on rational, logical analysis of data in drawing conclusions.

Some other terms which are often used in discussions of creativity include:

**Intuition** - the ability to draw conclusions based on impressions and feelings rather than hard facts. It is a characteristic of right-brain thinking and some people rely on it more than others.

**Incubation** - the period between stopping conscious work on a problem and the time when we become aware of a solution or part solution. People struggling with problems often suddenly become aware of a solution after a period of incubation, during which the mind is occupied by other things.

**Invention** - the creation of new, meaningful ideas or concepts.

**Innovation** - putting new ideas or concepts to a practical use, as in the development of a new product or service.

### 1.2.3 The stages of problem solving

The problem solving process can be divided in different ways and the stages have been given various labels. This has been done to make it easier to understand but
how it is divided and the labels that are used are not important. To be a successful problem solver you need to understand what the stages involve and follow them methodically whenever you encounter a problem.

To be a successful problem solver you must go through these stages:

- recognising and defining the problem
- finding possible solutions
- choosing the best solution
- implementing the solution.

These stages are examined in detail in later articles, but here is a summary of what is involved at each stage.

1. **Recognising and defining the problem**

   Obviously, before any action can be taken to solve a problem, you need to recognise that a problem exists. A surprising number of problems go unnoticed or are only recognised when the situation becomes serious. Opportunities are also missed. There are specific techniques you can use to help you recognise problems and opportunities.

   Once you have recognised a problem you need to give it a label..... a tentative definition. This serves to focus your search for relevant information, from which you can write an accurate description or definition of the problem.
The process of definition differs for closed and open-ended problems. With closed problems you need to define all the circumstances surrounding the deviation from the norm. Sometimes this will provide strong clues as to the cause of the problem.

Defining open-ended problems involves identifying and defining your objectives and any obstacles which could prevent you reaching them. The problem definition provides the basis for finding solutions.

2. **Finding possible solutions**

Closed problems generally have one or a limited number of possible solutions, while open-ended problems usually can be solved in a large number of ways. The most effective solution to an open-ended problem is found by selecting the best from a wide range of possibilities. Finding solutions involves analysing the problem to ensure that you fully understand it and then constructing courses of action which will achieve your objective.

Analysing the problem involves identifying and collecting the relevant information and representing it in a meaningful way. Analysing closed problems helps you to identify all the possible causes and confirm the real cause, or obstacle, before looking for a solution. With open-ended problems you are looking for information which will help to suggest a range of possible ways to solve the problem. Analysis also helps you to decide what the ideal solution would be, which helps to guide your search for solutions.

Constructing courses of action to solve the problem involves discovering what actions will deal with any obstacles and achieve your objective. Workable solutions are developed by combining and modifying ideas and a range of creative techniques are available to help in this process. The more ideas you have to work with, the better your chances of finding an effective solution.

3. **Choosing the best solution**

This is the stage at which you evaluate the possible solutions and select that which will be most effective in solving the problem. It's a process of decision making based on a comparison of the potential outcome of alternative solutions. This involves-
• identifying all the features of an ideal solution, including the constraints it has to meet
• eliminating solutions which do not meet the constraints
• evaluating the remaining solutions against the outcome required
• assessing the risks associated with the 'best' solution
• making the decision to implement this solution

A problem is only solved when a solution has been implemented. In some situations, before this can take place, you need to gain acceptance of the solution by other people, or get their authority to implement it. This may involve various strategies of persuasion.

4. Implementing the solution

This involves three separate stages:
• planning and preparing to implement the solution
• taking the appropriate action and monitoring its effects
• reviewing the ultimate success of the action

Implementing your solution is the culmination of all your efforts and requires very careful planning. The plan describes the sequence of actions required to achieve the objective, the timescale and the resources required at each stage. Ways of minimizing the risks involved and preventing mistakes have to be devised and built into the plan. Details of what must be done if things go wrong are also included.

Once the plan has been put into effect, the situation has to be monitored to ensure that things are running smoothly. Any problems or potential problems have to be dealt with quickly. When the action is completed it's necessary to measure its success, both to estimate its usefulness for solving future problems of this type and to ensure that the problem has been solved. If not, further action may be required.

These stages provide a very flexible framework which can be adapted to suit all problems. With closed problems, for example, where there is likely to be only one or a few solutions, the emphasis will be on defining and analysing the problem to indicate possible causes. Open-ended problems, on the other hand, require more work at the idea generation stage to develop a large range of possible solutions.
At any stage in solving a problem it may be necessary to go back and adapt work done at an earlier stage. A variety of techniques and strategies are available to help you at each stage and these are described in later articles.

**General Steps in Problem Solving**

In order to correctly solve a problem, it is important to follow a series of steps. Many researchers refer to this as the **problem solving cycle**, which includes developing strategies and organizing knowledge. While this cycle is portrayed sequentially, people rarely follow a rigid series of steps to find a solution. Instead, we often skip steps or even go back through steps multiple times until the desired solution is reached.

1. **Identifying the Problem:** While it may seem like an obvious step, identifying the problem is not always as simple as it sounds. In some cases, people might mistakenly identify the wrong source of a problem, which will make attempts to solve it inefficient or even useless.

2. **Defining the Problem:** After the problem has been identified, it is important to fully define the problem so that it can be solved.

3. **Forming a Strategy:** The next step is to develop a strategy to solve the problem. The approach used will vary depending upon the situation and the individual's unique preferences.

4. **Organizing Information:** Before coming up with a solution, we need to first organize the available information. What do we know about the problem? What do we not know? The more information that is available, the better prepared we will be to come up with an accurate solution.

5. **Allocating Resources:** Of course, we don't always have unlimited money, time and other resources to solve a problem. Before you begin to solve a problem, you need to determine how high priority it is. If it is an important problem, it is probably worth allocating more resources to solving it. If, however, it is a fairly unimportant problem, then you do not want to spend too much of your available resources into coming up with a solution.

6. **Monitoring Progress:** Effective problem-solvers tend to monitor their progress as they work towards a solution. If they are not making good progress
toward reaching their goal, they will reevaluate their approach or look for new strategies.

7. **Evaluating the Results:** After a solution has been reached, it is important to evaluate the results to determine if it is the best possible solution to the problem. This evaluation might be immediate, such as checking the results of a math problem to ensure the answer is correct, or it can be delayed, such as evaluating the success of a therapy program after several months of treatment.

1.2.4 **Problem solving techniques**

These techniques are usually called problem solving strategies.

- **Abstraction:** solving the problem in a model of the system before applying it to the real system
- **Analogy:** using a solution that solves an analogous problem
- **Brainstorming:** (especially among groups of people) suggesting a large number of solutions or ideas and combining and developing them until an optimum is found
- **Divide and conquer:** breaking down a large, complex problem into smaller, solvable problems
- **Hypothesis testing:** assuming a possible explanation to the problem and trying to prove (or, in some contexts, disprove) the assumption
- **Lateral thinking:** approaching solutions indirectly and creatively
- **Means-ends analysis:** choosing an action at each step to move closer to the goal
- **Method of focal objects:** synthesizing seemingly non-matching characteristics of different objects into something new
- **Morphological analysis:** assessing the output and interactions of an entire system
- **Proof:** try to prove that the problem cannot be solved. The point where the proof fails will be the starting point for solving it
- **Reduction:** transforming the problem into another problem for which solutions exist
- **Research:** employing existing ideas or adapting existing solutions to similar problems
- **Root cause analysis:** eliminating the cause of the problem
- **Trial-and-error:** testing possible solutions until the right one is found
1.3 SELF-ESTEEM

Adolescence is a concept encompassing physical and emotional stages of transition from childhood to adulthood. With the dramatic physical changes and development, adolescents worldwide find themselves in a situation characterized by an uncertain status and events might affect their concept of their own. Self-esteem has been described as the judgments that we make about our own worth and the feeling associated with those judgments. It has been ranked as among the most important aspects of self-development since evaluation of our own competencies affect emotional experiences, future behaviour and long term psychological adjustment. A study by Donahue and Benson (1995) revealed that self-esteem has also been recognized as a predictor of social problems in the researches of psychological and social development. According to Holly (1987), self-esteem is influenced by culture, child rearing practices, achievement-related attributions and interactions with parents and teachers. Adolescence, being the stage of turmoil, is one of the periods in life of children, when self esteem increases and is highly influenced by the environment. Women are conditioned to suffer low self-esteem and inferior status. According to the Indian culture, the ‘females’ had been held in high esteem throughout the ages and have been worshipped. With changing times, gender perceptions are a societal construct, which are dependent upon socio-cultural practices in which the children, adult and youth grow up (NIHFW, 2005). Self-esteem is also viewed both as a personality trait and a psychological state. People have a typical level of self-esteem that is consistent across time. Studies by Yabiku et al. (1999), also found that children have higher self-esteem when their parents are loving, supportive and deeply involved in their lives. Self-esteem has also been found to have a direct correlation with quality and strength of parent-child relationships. Children from families with poor communication methods or dysfunctional families tend to have low self-esteem and trouble finding their own identity (Nunley, 1996). Even though one’s self forms according to experiences and relationships with families, school, work, etc., it is really a person’s perception of these experiences and relationships that have a greater impact on one’s self-esteem (Mecca et al., 1989).
Self-esteem can have a big part to play in how you feel about yourself and also how much you enjoy things or worry about things.

To understand self-esteem, it helps to break the term into two words. Let's first take a look at the word **esteem** (say: less-teen), which means that someone or something is important, special, or valuable. For example, if you really admire your friend's dad because he volunteers at the fire department, it means you hold him in high esteem. And the special trophy for the most valuable player on a team is often called an esteemed trophy. This means the trophy stands for an important accomplishment.

And **self** means, well, yourself! So put the two words together and it's easier to see what self-esteem is. It's how much you value yourself and how important you think you are. It's how you see yourself and how you feel about the things you can do.

Self-esteem isn't about bragging, it's about getting to know what you are good at and not so good at. A lot of us think about how much we like other people or things, but don't really think much about whether we like ourselves.

It's not about thinking you're perfect, because nobody is perfect. Even if you think some other kids are good at everything, you can be sure they have things they're good at and things that are difficult for them.

The most important thing to know about self-esteem is that it means seeing yourself in a positive way that's realistic, which means that it's the truth. So if you know you're really good at piano but can't draw so well, you can still have great self-esteem!

Self-esteem is a term used in psychology to reflect a person's overall evaluation or appraisal of his or her own worth. Self-esteem encompasses beliefs (for example, “I am competent” or “I am incompetent”) and emotions such as triumph, despair, pride and shame. A person's self-esteem may be reflected in their behaviour, such as in assertiveness, shyness, confidence or caution. Self-esteem can apply specifically to a particular dimension (for example, “I believe I am a good writer and feel proud of that in particular”) or have global extent (for example, “I believe I am a good person and feel proud of myself in general”).

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Psychologists usually regard self-esteem as an enduring personality characteristic ("trait" self-esteem), though normal, short-term variations ("state" self-esteem) also exist.

Synonyms or near-synonyms of self-esteem include: self-worth, self-regard, self-respect, self-love (which can express overtones of self-promotion) and self-integrity. Self-esteem is distinct from self-confidence and self-efficacy, which involve beliefs about ability and future performance.

1.3.1 Definitions of Self-esteem

Given its long and varied history, the term has no less than three major types of definition, each of which has generated its own tradition of research, findings and practical applications:

The original definition presents self-esteem as a ratio found by dividing one’s successes in areas of life of importance to a given individual by the failures in them or one’s “success / pretensions”. Problems with this approach come from making self-esteem contingent upon success: this implies inherent instability because failure can occur at any moment.

In the mid 1960s Morris Rosenberg and social-learning theorists defined self-esteem in terms of a stable sense of personal worth or worthiness, (see Rosenberg self-esteem scale). This became the most frequently used definition for research, but involves problems of boundary-definition, making self-esteem indistinguishable from such things as narcissism or simple bragging.

Nathaniel Branden in 1969 briefly defined self-esteem as “…the experience of being competent to cope with the basic challenges of life and being worthy of happiness”. This two-factor approach, as some have also called it, provides a balanced definition that seems to be capable of dealing with limits of defining self-esteem primarily in terms of competence or worth alone.

Branden’s (1969) description of self-esteem includes the following primary properties: Self-esteem as a basic human need, i.e., “…it makes an essential contribution to the life process”, “…is indispensable to normal and healthy self-development and has a value for survival.” Self-esteem as an automatic and inevitable consequence of the sum of individuals' choices in using their consciousness
something experienced as a part of, or background to, all of the individuals thoughts, feelings and actions.

Self-esteem is a concept of personality, for it to grow, we need to have self worth and this self worth will be sought from embracing challenges that result in the showing of success. Compare the usage of terms such as self-love or self-confidence.

1.3.2 Why Self-Esteem Is Important

Self-esteem isn't like a cool pair of sneakers you really want but can wait until your next birthday to get. All kids have self-esteem and having healthy or positive self-esteem is really important. It can help you hold your head high and feel proud of yourself and what you can do, even when things don't seem to be going so well.

Self-esteem gives you the courage to try new things and the power to believe in yourself. It lets you respect yourself, even when you make mistakes. And when you respect yourself, adults and other kids usually respect you, too.

Having positive self-esteem can also help you can learn to make healthy choices about your mind and body? If you think you're important, you'll be less likely to follow the crowd if your friends are doing something wrong or dangerous. If you have positive self-esteem, you know you're smart enough to make your own decisions. You value your safety, your feelings, your health — your whole self! Positive self-esteem helps you know that every part of you is worth caring for and protecting.

1.4 METACOGNITION AND PROBLEM SOLVING

Problem solving is a complex behavior. Regardless of how much experience or knowledge a problem solver has, each new problem situation is in some ways unique, requiring creative application of strategies for posing, solving and resolving the problem at hand. Metacognition is the awareness and understanding of one's self as a thinker. Expert problem solvers and effective thinkers of all kinds are usually self-aware thinkers. They plan strategies for attacking thinking problems. When they hit blind alleys, they stop, analyze and reflect. Effective thinkers pose alternatives for themselves and choose among them. Students' ability to reflect on their thinking “as thinking” and to analyze their own strategies are their metacognitive skills.
Surprisingly, metacognitive awareness is not uniformly developed in students. In reading, even college age students are unaware of how they can approach texts, plan their studying, or work through problems that have stumped them. In writing, inexpert writers may follow one procedure again and again without flexibility, even in the face of persistent failure.

However, teachers can promote awareness of strategies for thinking by engaging their students in activities that require reflection. Students can keep and share a “process log” where they write about the processes they employ in writing, reading, or problem solving generally. As students share their entries, they gain an awareness of alternatives to their own processes and the teacher can direct them to consider specific strategies. Teachers, as expert readers and writers, can also make their thinking strategies explicit by “thinking-aloud” with students as they read and write together. Group work or discussion time can also regularly include a “process observer,” namely a participant who agrees to pay attention to how the interaction progresses and to report to the group an analysis of its process. Activities like these, that require students to make the sometimes-invisible work of thinking visible and explicit, help all students to understand that as thinkers, they are in charge. More purposeful, flexible and creative problem solving is the result.

1.5 JUSTIFICATION OF THE PROBLEM

Adolescence is a period of stress and strain. Lots of students face problem during this phase in their life. Adolescents exhibits high rate of anti-social behavior like stubbornness, demandingness, arguing, teasing, loudness, threatening, cruelty, fighting, disobedience and sassiness. There must be some hidden causes of these problematic acts, the significant impairment of everyday functioning of youngsters with unsocialized aggressive conduct disorder (term given by Quay in 1986) are not a good sign of their future. Such adolescents exhibit relatively pattern of aggressive behavior over time, their problems do not tend to dissipate, but to continue into adulthood. Although for boys, a history of serious antisocial conduct before age 15 increases the chances of Psychopathology (criminals behavior, alcohol and drug abuse) in adulthood, for girls probability of depression and phobias increases (Robins
1986). These disorders of adolescents not only affect the lives of those who suffer but also live of others.

There is a common saying- “The wheel, that squeaks get the grease”. Significant efforts must be made to find the solution of these problematic behaviours. Education Psychologists considered metacognition as the pinnacle of personal growth. Metacognition is typically used as a tool to deal with every day problems and maintain the self-esteem of adolescents. After reviewing the literature the investigator considers lack of problem solving abilities and self-esteem as one of the major cause of their disruptive acts. Whereas problem solving ability is known as the climax of human abilities & plays an important role in present academic performance and social aspect. In the other hand, self-esteem is viewed both as personality trait a psychological state. It is also considered as important aspect self development. There skills can be developed during life time by providing suitable environmental factor and experience. In the present study investigator tries to study the meta-cognition in relation to problem solving and self-esteem. As we know future of man is not solely determined by his genetic endowment, but also by the environmental forces operative around him. Right from birth, he is embedded in an ever-enlarging series of concentric spheres (Bronfenbrenner, 1979) of which the family forms the closest and the most direct source of influence.

1.6 STATEMENT OF THE PROBLEM

“Metacognition among Senior Secondary Students In Relation To Their Problem Solving Ability and Self-Esteem.”

1.7 DEFINITIONS OF THE TERMS USED

(i) Metacognition

Nelson (as cited in Efklides, 2008) defined, “Metacognition as a model of cognition that functions at a meta level; metacognition represents the object level, that is cognition.”

This definition underscore the functioning of metacognition at a “meta” level, which means that metacognition is a representation of cognition and that
metacognition and cognition are connected through the monitoring and control functions.

According to Brown (1987), “Metacognition refers loosely to one's knowledge and control of own cognitive system.”

Schraw & Sperling-Dennison (1994) defined, “Metacognition as the ability to reflect upon, understand and control one's learning.”

Flavell (1979) defined metacognition as, “Knowledge and cognition about cognitive phenomena.”

Refined this definition by specifying classes of phenomena that constitute monitoring and control of cognition, such as metacognitive knowledge and metacognitive experiences.

Baker & Brown (1984) defined metacognition as, “The knowledge and control a child has over his or her own thinking and learning activities, including reading.”

(ii) **Problem Solving Ability**

Life is full of problems and man is able to solve them successfully only if he has proper experience and has learnt the art of overcoming difficulties in life. This habit may be acquired from early stages of education. As the child grows up he learns new methods of tackling problems. This habit of making efforts and solving independently the various problems prove useful in learning the various facts related to different curricular areas and also help the child in solving actual life problems at the later stage. Problem solving ability is a complex behavior. Regardless of how much experience or knowledge a problem solver has, each new problem situation is in some ways unique, requiring creative application of strategies for posing, solving and resolving the problem at hand. Meta-cognition is the awareness and understanding of one's self as a thinker. Expert problem solvers and effective thinkers of all kinds are usually self-aware thinkers. They plan strategies for attacking thinking problems. When they hit blind alleys, they stop, analyze and reflect. Effective thinkers pose alternatives for themselves and choose among them. Students' ability to reflect on their thinking “as thinking” and to analyze their own strategies is their meta-cognitive skills.
Self-Esteem

Self-esteem is a term used in psychology to reflect a person's overall evaluation or appraisal of his or her own worth. Self-esteem encompasses beliefs (for example, “I am competent” or “I am incompetent”) and emotions such as triumph, despair, pride and shame. A person's self-esteem may be reflected in their behaviour, such as in assertiveness, shyness, confidence or caution. Self-esteem can apply specifically to a particular dimension (for example, “I believe I am a good writer and feel proud of that in particular”) or have global extent (for example, “I believe I am a good person and feel proud of myself in general”).

Psychologists usually regard self-esteem as an enduring personality characteristic (“trait” self-esteem), though normal, short-term variations (“state” self-esteem) also exist.

Synonyms or near-synonyms of self-esteem include: self-worth, self-regard, self-respect, self-love (which can express overtones of self-promotion) and self-integrity. Self-esteem is distinct from self-confidence and self-efficacy, which involve beliefs about ability and future performance.

Given its long and varied history, the term has no less than three major types of definition, each of which has generated its own tradition of research, findings and practical applications:

1. The original definition presents self-esteem as a ratio found by dividing one’s successes in areas of life of importance to a given individual by the failures in them or one’s “success / pretensions”. Problems with this approach come from making self-esteem contingent upon success: this implies inherent instability because failure can occur at any moment.

2. In the mid 1960s Morris Rosenberg and social-learning theorists defined self-esteem in terms of a stable sense of personal worth or worthiness, (see Rosenberg self esteem scale). This became the most frequently used definition for research, but involves problems of boundary-definition, making self-esteem indistinguishable from such things as narcissism or simple bragging.

3. Nathaniel Branden in 1969 briefly defined self-esteem as “…the experience of being competent to cope with the basic challenges of life and being worthy of
happiness”. This two-factor approach, as some have also called it, provides a balanced definition that seems to be capable of dealing with limits of defining self-esteem primarily in terms of competence or worth alone.

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1. Self-esteem as a basic human need, i.e., “…it makes an essential contribution to the life process”, “…is indispensable to normal and healthy self-development and has a value for survival.”

2. Self-esteem as an automatic and inevitable consequence of the sum of individuals' choices in using their consciousness

3. Something experienced as a part of, or background to, all of the individuals thoughts, feelings and actions.

Self-esteem is a concept of personality, for it to grow, we need to have self-worth and this self-worth will be sought from embracing challenges that result in the showing of success. Compare the usage of terms such as self-love or self-confidence.

**DELIMITATIONS OF THE STUDY**

1. The present study is confined to senior secondary students of class twelfth.
2. The sample is restricted to 320 students.
3. The age group of the sample is restricted to 16-20 years.
4. The present study is confined to ten urban and ten rural area schools.
5. The present study is confined to Jhajjar district schools only.