IRJIF I.F. : 3.015

North Asian International Research Journal of Social Science & Humanities

ISSN: 2454-9827 Vol. 3, Issue-9 September-2017

HOLISTIC DEVELOPMENT OF PROCESS ORIENTED SKILLS: A META-COGNITIVE MODEL OF LEARNING

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ABSTRACT

Traditionally learning is defined as relatively permanent modification of desired covert and overt behavior of learners through training, experiences and exercises. Nowadays learning may be redefined as accumulation, assimilation and internalization of a set of process based skills. Process based skills include observation, classification, estimation, measurement, communication, interpretation, inference, prediction and also higher order cognitive skills such as establishing cause-effect relationship, formulation of hypothesis, problem solving etc. The higher order process based skills may be developed through thoughtful integration of lower order process based skills. With time the philosophy of thinking of an individual gets changed. This is attributed to the change in meta-cognitive behavioral components of an individual. Accordingly the individual learner has to change his/her process based skills in order to strengthen learning. Here we are to investigate such process oriented skills, which are responsible for individual's complete meaningful learning on the basis of metacognitive thinking topology.

Keywords: ***Traditional learning, Process based skills, Philosophy of thinking, Meta-cognition.***

INTRODUCTION

Education is expected to become a vehicle for students to learn about themselves and the environment, as well as prospects for further development in applying it in our daily lives. The learning process emphasizes to provide direct experience to develop competencies in order to explore and understand the universe around us. In fact, sometimes the learning that has been implemented at schools has presented verbally through lectures and text books with low students' involvement, less attracted the attention of students and tedious. As a result, students' understanding of the concept is minimal. The process skills and scientific attitude of students are not growing and student learning outcomes is low and learning has not achieved optimally as the demands of the

curriculum. It is necessary to improve the quality of learning in order to enhance the activity of the students' process skills, while improving students learning outcomes. Traditionally Learning has been defined functionally as changes in behavior that result from training, experiences and exercises or mechanistically as changes in the organism that result from training, experiences and exercises. Nowadays learning redefined as accumulation, assimilation and internalization of a set of process based skills. Process based skills include observation, classification, estimation, measurement, communication, interpretation, inference, prediction and also higher order cognitive skills such as establishing cause-effect relationship, formulation of hypothesis, problem solving etc.

PRODUCT VS PROCESS SKILLS

The body of knowledge, which is the result of the quest for comprehension and explanation through the development of fundamental principles, is called the 'content' or 'major concepts' or 'products'. Earlier teachers taught following traditional strategies with thorough understanding of the teaching content and they tried to link the body of knowledge in verities of different way while disseminating the information to students. With the advent of technology, new educational theories and modern resources specifically multimedia oriented resources, the traditional teaching strategies are no longer appropriate and adequate in this new situation to support the classroom teaching learning process as well as the mass education system. For meaningful and joyful learning it is necessary for a teacher to possess not only sound knowledge of the teaching content to be taught but also well developed understanding of how students learn i.e. the new pedagogical approaches or the process skills. The Process skills are intellectual skills and can be practiced, learned and developed by children through the learning process (Balfakiha, 2010) making the student better able to meet the challenges of the 21st century. Thus now the basis for acquiring the body of knowledge is process oriented skills for developing conceptual schemes. The development of conceptual schemes by experiment and observation and the premise that these conceptual schemes lead to further experimentation and observation are considered as the fundamental aspects of learning.

THE TYPES OF PROCESS SKILLS

The shift in teaching pedagogy from content-based learning to process-based learning implies that the approaches adopted by teacher are changing as well. There are six basic process skills:

- Observation: using the senses to gather information about an object or event.
- Communication: using words or graphic symbols to describe an action, object or event.
- Classification: grouping or ordering objects or events into categories based on properties or criteria.

- Measurement: using either standard and non standard measures or estimates to describe the dimensions of an object or event.
- Inference: making an "educated guess" about an object or event based on previously gathered data or information.
- Prediction: stating the outcome of a future event based on a pattern of evidence.

Applying these skills one can conduct objective investigation and reach at conclusions, based on the results. These are integrated together when scientists design and carry out experiments. All the six basic skills are important individually as well as when they are integrated. These basic process skills are integrated together thoughtfully to design higher order process skills establishing cause-effect relationship, formulation of hypothesis, problem solving, critical thinking, information processing, experimenting etc and with the help of which scientists can design and carry out experiments or in everyday life when we all carry out fair test experiments. Integrating the process skills with classroom lessons and field investigations will make the learning experiences richer and more meaningful for students.

MEANS OF NURTURING PROCESS SKILLS

The teacher plays a pivotal role in providing children with experiences, which nurture the process skills among them. The teacher may consider the following points:

1. Children should be given various opportunities to develop process skills of science. Action provides the practical basis for thinking, e.g., simply telling what it means to observe, investigate, experiment and interpret have no meaning until given an opportunity to try these.
2. Opportunities for discussion in small or large groups and in the whole class may be provided. These allow children to listen to others, explain, argue, express and share their ideas, thus involving them in thinking what they have done, relating to the evidence and considering multiple ways of approaching a problem.
3. To help children develop process skills, it is important for the teacher to know how children are using those skills. The teacher can observe their work and listen to their discussions to pick up information on how children have collected and used the evidence.
4. The children need to realise the area of the skills in which they need improvement. For this, they may be allowed to discuss their investigation and critically reflect on it. The teacher can encourage them to try alternative courses of action for improvement.

5. For increasing accuracy in acquisition of some skills, there may be a need for introducing new techniques and tools. For example, for measurement of different quantities children require various instruments such as balance, vernier calipers, screw gauge, thermometers, graphs, etc

Scientific inquiry and innovation in teaching provides the opportunity for children to develop a range of process skills, either explicitly or implicitly. The following is one such list:

- Explore objects, materials, and events.
- Raise questions.
- Make careful observations.
- Engage in simple investigations.
- Describe (including shape, size, and number), compare, sort, classify, and order.
- Record observations using words, pictures, charts, and graphs.
- Use a variety of simple tools to extend observations.
- Identify patterns and relationships.
- Develop tentative explanations and ideas.
- Work collaboratively with others.
- Share and discuss ideas and listen to new perspectives.

LEARNING, COGNITION AND METACOGNITION

Learning and cognition are central concepts in educational psychology. There are distinct traditions in educational theories and practices that derive from three different prospective on the phenomenon of learning and understanding. viz. Empiricist, rationalist, pragmatist-sociohistoric. Empiricism typified by Locke and Thorndike emphasizes consistency of knowledge with experience. Rationalism-cognitive view typified by Descartes and Piaget emphasizes conceptual coherence and formal criteria of truth. Pragmatism typified by Dewey and socio-historicism typified by Vygotsky emphasizes that knowledge is constructed in practical activities of groups of people as they interact with each other and their material environment.

According to behavioristic view learning is the overt behavioral change. While cognitive view states that learning is a mental process of information processing – association, assimilation, accommodation, storing and recalling. Here learning occurs by the constructing understanding of concepts and principles through different process oriented skills. Another important theme in the cognitive view of learning is the concept of meta-cognition, the capacity to reflect upon one's own thinking and thereby to monitor and manage it. This theme was

introduced by developmental psychologist (A.L. Brown 1978, Flavell & Wellman 1977) who noted that reflective, self-monitoring capacity discriminated developmentally by advanced children from their less advanced peers.

Cognitive strategies are used to help an individual achieve a particular learning goal (e.g., understanding a text) while meta-cognitive strategies are used to ensure that the learning goal has been reached (e.g., quizzing oneself to evaluate one's understanding of that text). Meta-cognitive 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 meta-cognitive 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). 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 for learning.

MODELS OF META-COGNITION

Flavell, the foundation researcher of metacognition, introduced the first model of metacognition in 1979. According to Flavell, the monitoring of a wide variety of cognitive enterprises occurs through the actions and interactions among four classes of phenomena

a) Meta-cognitive knowledge b) Meta-cognitive experiences
c) Goals (or tasks) and d) Actions (or strategies)

Flavell assumed that meta-cognitive knowledge and meta-cognitive 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.

According to Flavell 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. Again 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. Finally, metacognitive experiences can activate strategies aimed at either cognitive or metacognitive goals.

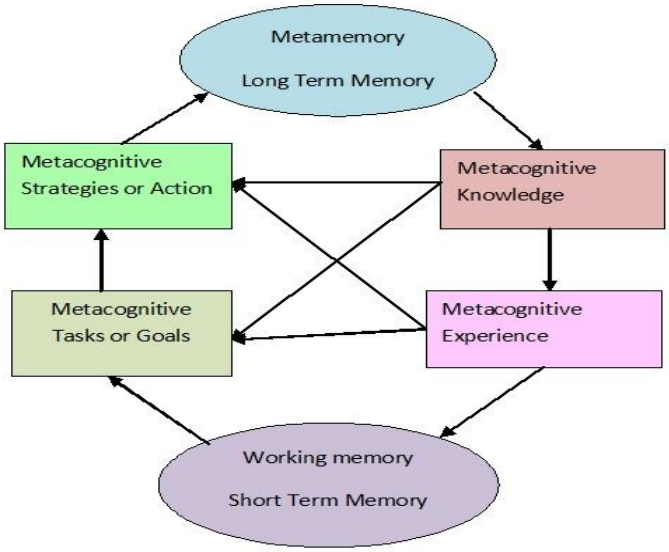

Figure 1 Favell's model of metacognition

An alternative model of metacognition was suggested by Nelson & Narens (1990) containing 'control' - 'monitoring' processes. This model has two critical features, shows a simple metacognitive system containing two interrelated levels that Nelson and Narens' 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".

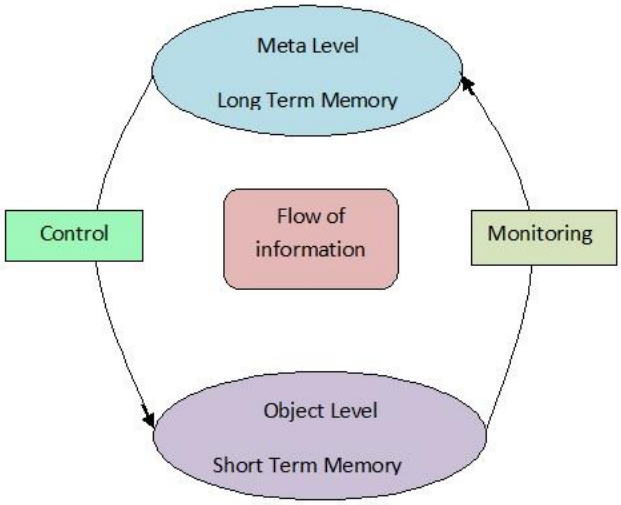

Figure 2 Nelson & Narens's Model of Metacognition

Their research on metacognitive framework organizes the different judgments of monitoring and measures of control in to three stage of learning: acquisition, retention and retrieval. Their theory has been limited primarily to metamemory and the phenomena of Feeling-of-knowing and Judgment-of-learning.

According to Nelson and Narens' model the meta-level monitors the object-level; for example, it makes judgments of how easy an item will be to learn(Ease-of-Learning), whether an item has been learned (Judgment-of- Learning), whether an item not currently recalled is nevertheless known (Feeling-of-Knowing), and how likely it is that a retrieval answer is correct. The meta-level also exerts control over the object-level; for example, it selects strategies and allocates time for learning or for search.

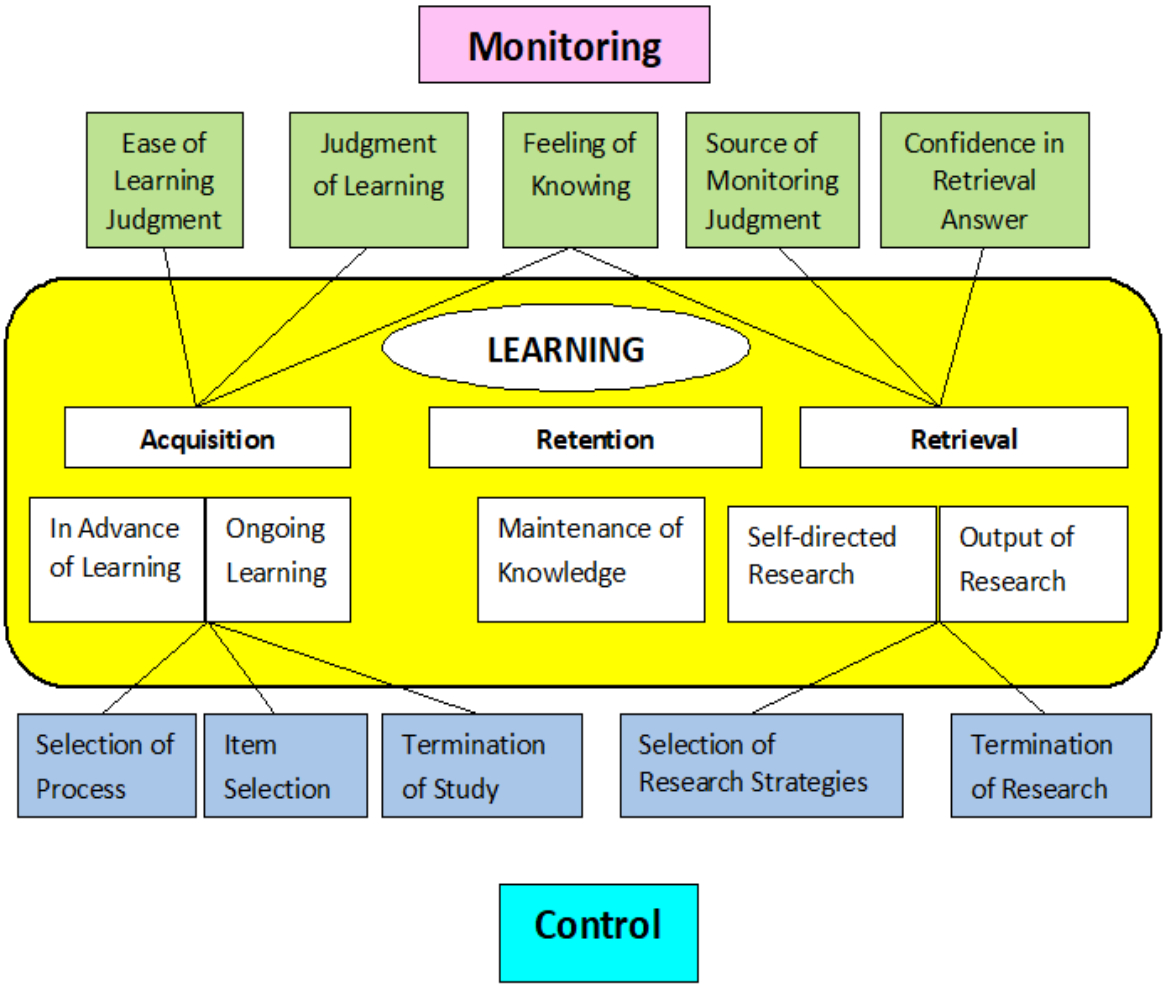

Figure 3 Monitoring judgments and control processes, and their relationships to the three stages of learning

Gregory Schraw (1998) presented a model of metacognition as a multidimensional phenomenon. Here he made a distinction between two components of metacognition, knowledge of cognition and regulation 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.

Regulation of cognition refers to a set of activities that help students control their learning. 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: enterprise, execution and evaluation.

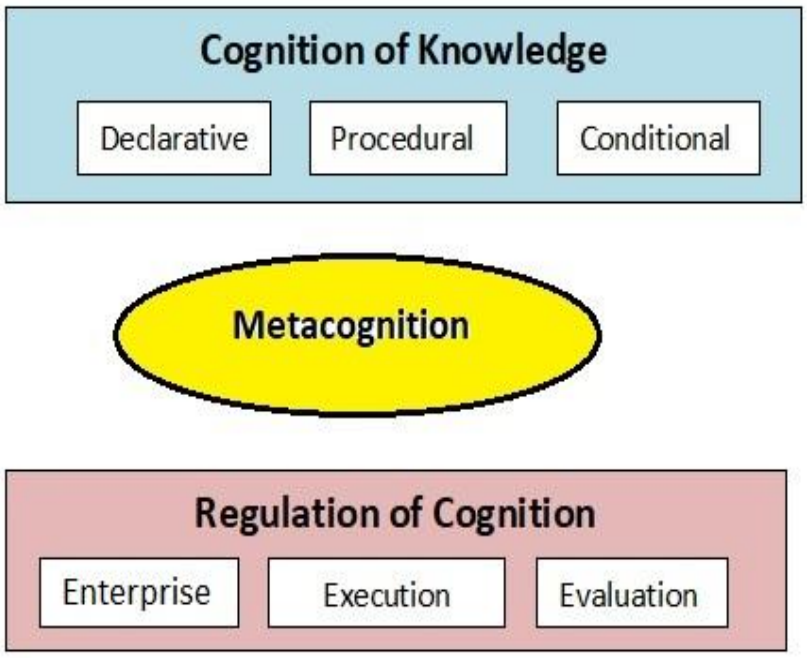

Figure 4 Components of Metacognition

A complex multifaceted contour model of metacognition has been developed by the authors of this article. This model of metacognition can be applied to explain most of events related to metacognition and in future this model may help to assess metacognitive developments in children.

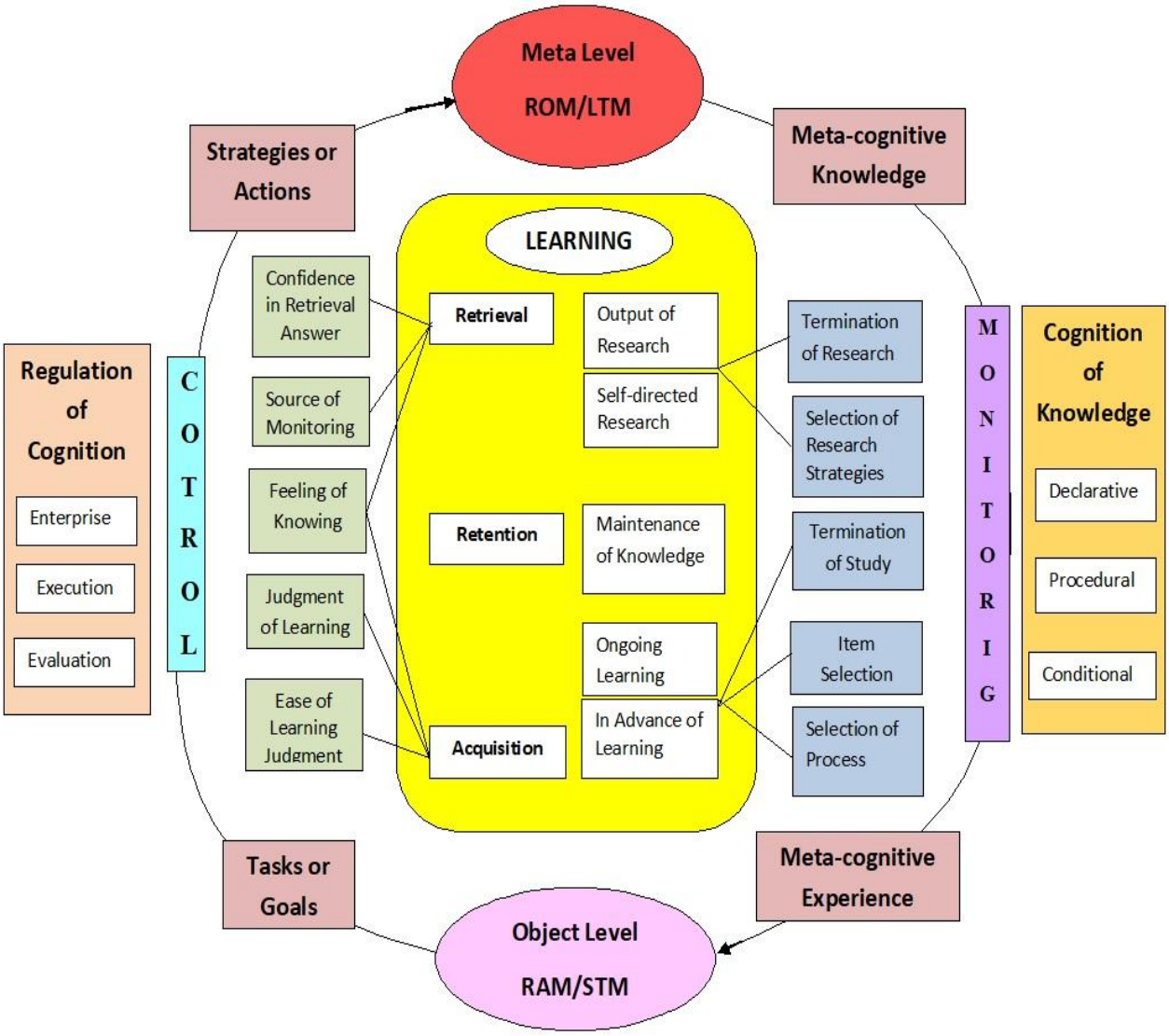

Figure 5 Complex multifaceted contour model of metacognition

IMPROVING METACOGNITIVE SKILLS

Metacognition was originally referred to as the knowledge about and regulation of one's cognitive activities in learning processes (Flavell, 1979; Brown, 1978). Metacognition has been defined as an "awareness of one's own cognitive processes rather than the content of those processes together with the use of that self awareness in controlling and improving cognitive processes" (Biggs & Moore, 1993). Other researchers have referred to metacognition as "cognitive strategies", (Paris and Winograd, 1990) "knowledge about executive control systems" (Hedberg, Harper and Brown, 1994), "monitoring of cognitive processes" (Flavell, 1976), "resources and self-regulating learning" (Osman and Hannafin, 1992) and "evaluating cognitive states such as self appraisal and self management" (Brown, 1987). These are broad terms that are all equally important depending on

the characteristics of the learner and their approach to learning. The following strategies recommended by Blakey and Spence (1990) to improve metacognitive skills:

1. Define what you know and what you do not know: Students determine their levels by asking themselves 'What is my relevant information about the subject?' What do I know? What do I want to learn? What do I not know?
2. Talk about what you are thinking: This includes the loud thinking in the process of making plan or problem solving. This study can be performed in peer groups or in small groups, that one student assumes the role of a teacher. These students talk and ask questions by telling and making explanations and abstraction.
3. Keeping a diary of thinking: Students can write difficulties and their interpretations about problems in that notebook. They also note the process and methods used to solve the problem. Thus, students have the idea about experience and methods of thinking.
4. Planning and self-control: It is students' plan to control the process that is relevant to the subject that is going to be learnt. However, students must have earned some characteristics in advance such as adjusting time, identifying and using materials.
5. Thinking process of briefing: This strategy covers, develops and uses the metacognitive and thinking skills that the students acquired. It involves a three-step method. Primarily, the teacher needs to guide the students about how they gained information by thinking in class and how they took part in activities. In the next stage, students need to group ideas and define which thinking strategies they used, and in the final stage, students should evaluate their own achievements and make assessments about their election in relation to future strategies.
6. Self-assessment: It is the determination of the metacognitive skills of the students by the pre-prepared individual checklist in the form of assessment. Metacognitive strategies are the sequential processes used to provide control in learning and in reaching one's goal. They help individuals significantly to make regulations and take control of their learning. For example, after reading a text, a student can query himself about the concepts discussed in the paragraph. This self evaluation is a monitoring metacognitive strategy and at this stage, the cognitive purpose of students is to understand texts. If a student fails to answer his own question, he must determine what he needs to perform his cognitive purpose which is to understand the text.

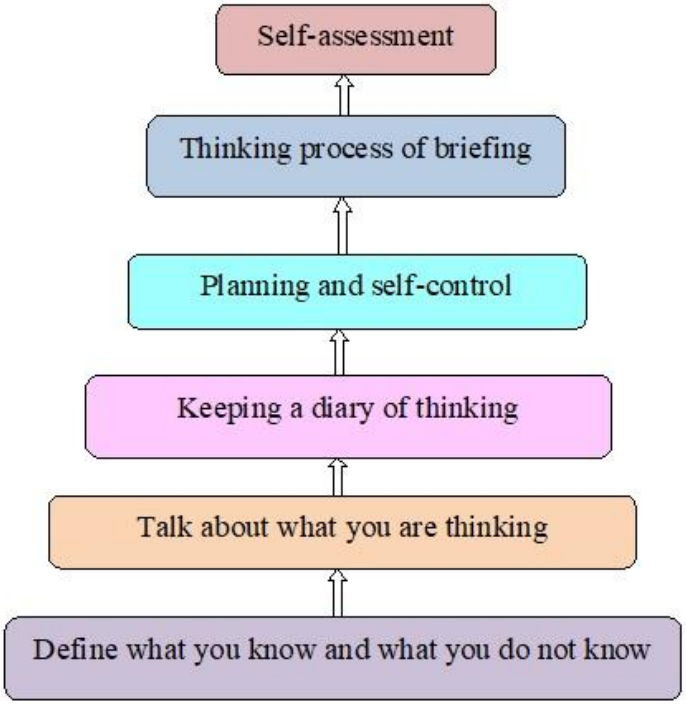

Figure 6 Blakey and Spence's Model for improving Metacognitive Skill

CONCLUSION

Learners need to know how to monitor and regulate their own learning processes when solving problems. The metacognition helps learners' exhibit cognitive processes that analyze and manage their own thinking in pursuit of knowledge acquisition in order to solve problems, gain insight and become critical thinkers. Cognitive tools should be readily accessible to learners to support reflective thinking on what they have learnt and how they came to know it, supporting internal negotiation of meaning making and constructing personal representations of meaning making within the context of learning. "Cognitive tools provide an environment and vehicle that often requires learners to think harder about the subject matter domain being studied while generating thoughts that would be difficult without the tool" (Jonassen, 1996). Thus learning occurs through various cognitive strategies by improving and integrating different process skills which is the consequence of change in meta-cognitive behavioral components or process oriented skills. Metacognition is a set of strategies that enable learners to become aware of how they learn and to evaluate and adapt and integrate the basic process skills to become increasingly effective at learning. In a world that demands lifelong learning, providing people with new and improved metacognitive strategies by restructuring process based skills is a gift that can last forever.

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