# METACOGNITION THROUGH TECHNOLOGY AND TEACHING

By

**ANNAMMA GEORGE \***                                **MINI DEJO KAPPAN \*\***

*\* Lecturer, Department of Physics, Princess Noura Bint Abdul Rahman University, Riyadh, Kingdom of Saudi Arabia.*
*\*\* Professor, Depatment of Education, Karunya University, Coimbatore, Tamil Nadu, India.*

### ABSTRACT

*Effective learning merely does not imply manipulation of information, which is integrated into an existing knowledge base, but rather, directing attention to what one has assimilated, understanding relationship between new information and what is already known, understanding the process which facilitated this and being aware that something new has actually been learnt. This article deals with the influence of technology in the development of Meta cognition in learners. At the beginning of any learning activity, students need to list their Pre-requisite knowledge and the knowledge to be constructed. As they delve into their investigation, they will verify, clarify and expand or replace their pre-requisite knowledge with more accurate information. Meta cognition significantly contributes to academic performance and the content may be taught through educational procedures that include provision of Meta cognitive knowledge and facilitate Meta cognitive experiences. This article will help to understand how both Meta cognition and web based instruction play a major role in the new generation instruction strategy.*

*Keywords: Meta cognition, Inquiry Based Learning, Didactic Teaching, Directed Discovery, Meta Teaching, Reciprocal Teaching, Paired Problem Solving, Web Based Instruction.*

## INTRODUCTION

Today, technology is being used to support teachers in designing interesting and stimulating learning environments for students. In recent years, institutions of higher learning have begun a move towards incorporating technology into the classroom to promote a better student learning environment. Technology used in the classroom acts as a support tool for the teacher to enhance student's learning processes. With the availability of inexpensive and powerful computers, the task of delivering information has become simpler. However, the fundamental characteristic of web-based instructional systems are their non-sequential arrangement of information content, and their facility for allowing the linking of information, which is conceptually related. Teachers must incorporate the following strategies in their instruction to improve the delivery of instruction and enable the learners to make use of the web technological resource available to them.

- Meta cognition
- Inquiry Based Learning
- Learning cycle

These are the series of activities that increases student attention and improves effectiveness of teaching.

## Metacognition

A "meta" was one of the conical columns set in the ground at each end of the circus in Rome to mark the turning point in the race. Similarly, the concept of meta-cognition can be seen as a turning point in our understanding of the mind. The term Meta cognition was introduced by Flavell in 1976, to refer to the individual's own awareness and consideration of his or her own cognitive processes and strategies (Flavell 1979)[1]. It refers to the unique human capacity to be self- reflexive, not just to think and know, but to think about their own thinking and knowing. To put it more accurately, during this process, we are examining our brain's processing.

"An appreciation of what one already knows, together with a correct apprehension of the learning task and what knowledge and skill it requires combined with the ability to make correct inference about how to apply one's strategic knowledge to a particular situation, and to do so efficiently and reliably" (Taylor 1999)[20].

Psychologists such as William James[2] (1890) had

emphasized the importance of introspective observation, but Vygotsky[3](1962) was one of the first to realize that conscious reflective control and deliberate mastery were essential factors of school learning. Accordingly, there were two factors in the development of knowledge.

- Automatic unconscious acquisition

- Gradual increase in active conscious control over that knowledge

This marked a separation between cognitive and Meta cognitive aspects of performance. According to Flavell et.al[4](1995),

"If we can bring the process of learning to a conscious level, we can help children to be more aware of their own thought process and help them to gain control or mastery over the organization of their learning."

Hence, effective learning merely does not imply manipulation of information, so that it is integrated into an existing knowledge base, but rather, directing attention to what one has assimilated, understanding relationship between new information and what is already known, understanding the process which facilitated this and being aware that something new has actually been learnt.

### Teaching For Meta Cognition - Meta Teaching

Teaching strategies can be broadly divided into three categories

- Didactic Teaching

- Directed discovery

- Teaching for meta cognition/ Meta Teaching

Didactic Teaching is in which the educator assumes authority. Instructor sets tasks, prescribes procedures and evaluates results. However, this limits the scope of the learner to benefit from the experience.

Directed Discovery is where the teacher facilitates transfer of learning by guiding students through investigation, discovery and problem solving.

Meta Teaching aims to mediate Meta cognition and to make their thinking and learning explicit for self appraisal and self management Fisher R.[5](1995).

When thinking Meta cognitively, individuals consider ways in which they acquire, organize and retain information. Science teachers must encourage meta cognition in their students which may aid them to repeat the process in future. This process may be easily integrated into any lesson, by asking students to explain their thought process, by contemplating on what they actually did.

### Meta Cognitive Strategies

A thinking person is in charge of their behavior, and they are hence responsible to manage their thinking. Basic Meta cognitive strategies include

- Connecting new information to former knowledge

- Selecting thinking strategies deliberately

- Planning, monitoring and evaluating thinking process.

Dirkes[6](1985).

Learning how to learn, develop a repertoire of thinking process which can be applied to solve problems is a major goal of education. The school library media centre as the hub of the school is an ideal place to integrate skills into subject areas or student's own areas of interest. When our life encounters situations where habitual responses do not become successful, Meta cognitive behavior is brought into play. The learner selects strategies to define a problem situation and researches alternative solutions. Guidance in recognizing and practice in applying Meta cognitive strategies help students successfully solve problems throughout their lives.

### Strategies For Developing Metacognitive Behaviours

### *Identifying Pre Requisite Knowledge and Objectives*

At the beginning of any learning activity, students need to list their Pre-requisite knowledge and the knowledge to be constructed. As they delve into their investigation, they will verify, clarify and expand or replace their pre-requisite knowledge with more accurate information.

### *Talking about Thinking*

Students need a thinking vocabulary and

- Teachers should think aloud so that students can follow the same.

- Labeling thinking process when students use them.

- Paired problem solving in which one student talks

about the problem, describing his thinking process. The partner listens and asks questions that helps to clarify thinking.

- Reciprocal teaching – where small groups of students take the role of teacher, asking questions, clarifying and summarizing the material being studied (Palinscar et.al.[8] 1986).

### Keeping a Thinking Journal/Learning Log

Students list their thinking, note their thinking and ambiguities and inconsistencies and comment on how they have dealt with difficulties in this learning log.

### Planning and Self-regulation

Students must assume responsibility for planning and regulating learning and develop criteria for evaluation themselves.

### Debriefing Thinking Process

- Teacher guides to review the activity, gathering data on thinking process.
- Students classify related ideas identifying thinking strategies used.
- Evaluation of their success.

### Self - Evaluation

On recognizing that learning activities in different disciplines are similar, students begin to transfer learning strategies to new situations Elaine Blakey and Shiela Spence[7] (1990).

### Research Results in Meta Cognition

Various researches were conducted in this field notably – Grant Proposal for 2010 Summer Institute: Developing Meta Cognition by Joycetheriot[9] (2010) and a Case study for Cognitive Acceleration through Science Education Project by Adley et. al [10](1998). The former was a Grant Proposal for 2010 Summer Institute, where the researcher studied the development of meta cognition and concluded that as long as the educator created a model of instruction to fit the educator's expectations, students would be constrained to express themselves within the model. To bring them out of the constraints and to allow them to think freely, the free doodle technique was used, whereby, the students could research on the topic of their interest and choice. However, this didn't do much good as they were accustomed to the constraints set in the beginning. Later on, the researcher changed the style and studied the next batch of students in the summer institute of 2010 where students in the summer institute of 2010 were asked to develop a story about their understanding of a science concept. It would take the students throughout the following steps

- Understanding Partner's Story
- Understanding Team's story
- Class consensus

This strategy seemed to work on more understanding of students thinking and what students think about other's ideas and how their own ideas could be better understood.

The latter study was on Improving Science Education through Practical activities and hence understanding Meta cognition.

The Cognitive Acceleration through Science Education Project produced a set of curriculum materials between 1984 and 1987 to help pupils develop the thinking skills required in science. Their intended use is as enrichment to the regular science curriculum. Each lesson or activity has five phases – called the Five Pillars of Meta Cognition

### Concrete Preparation

Teacher introduces the new vocabulary and task.

### Cognitive Conflict

When students make an unexpected finding, that is when observations do not fit into their expectations, cognitive conflict occurs.

### Social construction

New reasons are discovered by the learners from their observations. A teacher mediated class discussion enhances the effectiveness of this strategy.

### Meta Cognition

This involves discussion about

- "How did you solve this problem?"
- "What was difficult about this activity?"
- "Why was it difficult?"

*Bridging*

The new reasoning patterns are applied to different contexts.

The phases do not always occur in sequence as pupils can move back and forth between phases during the lesson. This program proved to be effective as various skills namely

- Control of variables
- Classification
- Conservation
- Causality
- Proportionality
- Correlation
- Probability
- Seriation
- Compensation and equilibrium
- Time sequence
- Spatial Perception
- Relationship between variables

and the like were developed.

## Why Teach For Meta Cognition

Most students are unaware of Meta cognitive process. Yet, only through "Thinking about thinking" do they actually learn and realize what they actually need to learn and explore. The primary reasons to teach Meta cognitive strategies (Figure 1) according to Fogarty[11] (1994) are

### To develop in students a deeper understanding of text

The learners must "construct knowledge" and understand what they lack, based on which apt tools must be selected to rectify the lack.

### To take student's thinking to a higher level

It's a tedious and daunting task to explain the thought process. However, small group activities with the supervision of the teacher aids to a great extent.

### To steer students into adulthood

Acquire Transfer of Learning-Hence, to be successful thinkers, Forgarty[11](1994) puts students must

- Develop a plan before reading

- Monitor understanding of text
- Evaluate thinking after reading

## Web Based Instruction In Meta Cognition

Through its visual and interactive delivery of instruction, diverse internet resources and no restriction on time and space, Web Based environments enhance learning and potential of learners.

Meta Cognition depicts learner's cognitive sense of how they understand the given information and what should be done to control or regulate their cognitive processes (Puntambekar[12] 1995).

There are two important aspects of Meta cognition accordingly (Brown[13] 1987).

- Awareness about cognition and learning
- Regulation of cognitive processes

Hence, online environments and computer resources can scaffold the acquisition of Meta cognition skills and efficient problem solving (Mc Loughlin[14]2001).

A major challenge for educational technologists is to go beyond information access and provide tools and scaffold for complex problem solving and Meta cognition. Research on Meta cognitive skills development and technology based scaffolding is converging (White[15] et. al. 2000)

Students need to be given complex ill-defined problems, strategy training and a social environment that aids
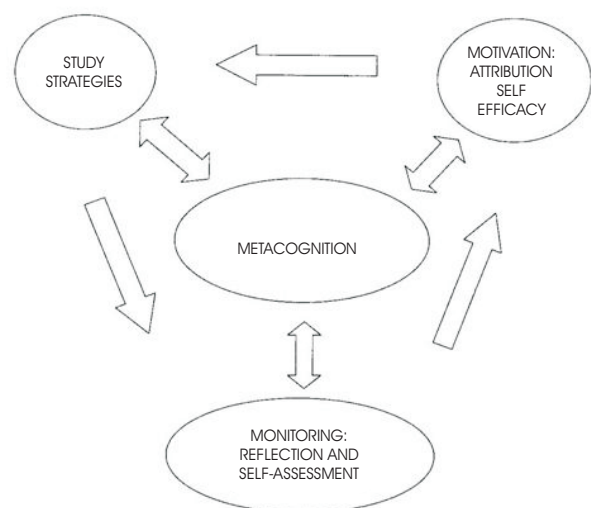


Figure 1. Meta Cognitive Study Strategies

reflection and self-knowledge. The design developed by Lin[16] et. al (1999) for technology supported learning environments aiding meta cognition are –

- Provide multiple models of real performance
- Prompt learners to investigate their own thinking while problem solving
- Provide visual displays of the processes students have utilized as they solve problems
- Provide students with multiple perspectives on process through reflective social dialogue
- Scaffold adoption of expert strategies by providing examples and context for application
- Develop a strong sense of self as learner and problem solver by enabling goal setting
- Create a social setting online with support for interaction and communication.

It is hence the instructional strategy and not the technology that influences quality of learning.

Constructivist strategy works well in the development of Meta cognition. In constructivist model, information is received from outside and the learner interprets and processes it to create true knowledge. This can be aided by good interactive online instruction. When learning online, students have enough time to reflect and internalize the information. Embedded questions on the content may be used throughout the lesson to encourage learners to reflect and process the information in a relevant and meaningful manner, hence develop their Meta cognitive abilities. This is because, learners receive the learning materials through the technology, process the information, and then personalize and contextualize the information. In the transformation process, learners interact with the content, with other learners and with the instructors to test and confirm ideas and to apply what they learn.

Garrison[17] (1999) claimed that it is the design of Educational Experience that includes the transactional nature of the relationship between instructor, learners and content that is of significance to the learning experience.

A research attitude can be developed among the learners through this Indirect Instruction and Meta Cognition. The following four categories of Meta cognitive knowledge are considered as important for this. (White[18], 1999).

*Self Knowledge* – Individual's Capacity to determine their strengths and weaknesses and hence conduct a self – evaluation.

*Task Knowledge* – Understanding the requirements (aims and understanding) of study.

*Strategic Knowledge* – Knowledge of usefulness of strategies available to achieve goals.

*Knowledge of plans and goals* – Learner's ability to set goals, maintain them and record what they observe that helps them in their study.

## Implications

For effective Transfer of Learning, which is the primary goal in the process of learning, Meta cognitive strategies must be made use of. Instructional designers must be cognizant of what is being transferred in what way, to what extent and how to effect. Transfer should no longer be considered as the side effect of teaching.

## Recommendations

- Social interaction must be encouraged through blogs, discussion forums and the like where they can exchange information with many people.
- Reciprocal teaching must be promoted to allow self regulation through natural dialogue, questioning and predicting.
- Guidelines of how to comprehend and how to assess comprehension can improve meta cognition must be elaborated initially.
- Encourage independent activation of meta cognitive strategies.

## Criticism

There are various sites that help in the development of Meta cognitive abilities through research based activities. However, various studies have proved that they make very little progress towards developing Meta cognitive abilities. Recent Meta cognitive research emphasizes the need to balance cognitive and social competence and the need

to create social, interactive and reflective environments with a holistic approach to supporting Meta cognition. (Lewis[19], 1998).

## Conclusion

Meta cognition significantly contributes to academic performance and the content may be taught through educational procedures that include provision of Meta cognitive knowledge and facilitate Meta cognitive experiences. Academic achievement, due to the employment of Web Based instruction and hence Meta cognitive abilities, motivates the learners.

Hence Web Based Instruction has proved to enhance Meta cognitive abilities as the learners wade through the plethora of information available on the internet. Moreover, assessment of learner's Meta cognitive knowledge level is crucial when developing such web based programs.

It may be concluded that both Meta cognition and web based instruction play a major role in enhancing each other. Web Based Instruction must hence be accepted as the new generation instruction strategy that develops researchers in all learners.

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## ABOUT THE AUTHORS

*Annamma George is a Lecturer in the Department of Physics, Princess Noura Bint Abdul Rahman University, Riyadh, Saudi Arabia. She has experience in training the student teachers and teaching physics at the school and college level. She is currently pursuing research in Karunya University, Coimbatore, Tamil Nadu, India, under the guidance of Dr. Mini Dejo Kappan in Effectiveness of Web Based Instruction in Learning Scientific Skills among Higher Secondary Students.*

*Mini Dejo Kappen,Ph.D, is a Professor in the Department of Education, Karunya University, Coimbatore. She is specialized in the areas of Educational Management and Educational Technology. She has more than eighteen years of experience in teaching and ten years of experience in educational administration in addition to accreditable academic record. Currently, she is working in the area of web based instruction. She is guiding scholars of post graduate & doctoral levels. She has been a resource person for various National & International Conferences.*