STUDENTS METACOGNITIVE AWARENESS FROM THE PERSPECTIVE OF PROBLEM BASED LEARNING APPROACH

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Introduction:

Learning is enhanced when it occurs between individuals and within small groups. Vygotsky "concerned with how such mental functions can occur on the 'intermental' (i.e., socially distributed) as well as 'intramental' (i.e., individual) plane of functioning. Wertsch, 2002, was also concerned with how and when individuals become aware of their own learning and memory processes; which we would call it as metacognition (Crain, 2005). For socio-cultural theorists, one of the most powerful teaching tools is interaction with peers and the discussion of problem solving techniques and ideas. Miller, 2002 suggested "experiences within a more equal relationship may provide opportunities to learn how to take the perspective of others and how to resolve conflicts". At times, students may feel more comfortable discussing and comparing ideas with peers than with an expert, allowing and providing opportunities to collaborate with peers can be a very effective learning strategy.

Learning and interacting with peers allows for novel concepts to be introduced and for novel ways of solving problems to be experienced and learned. These intermental processes allow for communication, collaboration, and perspective taking (e.g., seeing how others see the same situation). Peer interaction allows one to see how others solve problems and can even add insight into how others' intramental processes work. Noticing how others think could also play a role in better understanding how one's own thinking processes unfold.

Problem Based Learning (PBL) is based on the theory that views learning as a process in which the learner actively constructs knowledge (Gijselaers, 1996). Students solve problems that serve as a stimulus to learning in small groups guided by a tutor whose role is to facilitate the learning process by asking questions and monitor the process. In order to use PBL effectively, it

is important to understand how it is grounded in current theories of teaching and learning, so that insights from these theories can be applied to refine the practice of PBL. A theoretical basis for improving teaching in general and PBL in particular is provided by findings from cognitive psychology. According to Glaser 1991, learning is a constructive and not a receptive process, cognitive processes called metacognition affect the use of knowledge, and social and contextual factors affect learning. Until twenty or thirty years ago, it was believed that learning involves filling students' heads with information (Bruer, 1993). The aim of teaching was to lead students to store knowledge in memory, and the successful retrieval of information was a function of the effectiveness of the classification of the information. However, according to modern cognitive psychology theories, the most important feature of memory is its associative structure (Bruer, 1993; Brunning, Schraw, & Ronning, 1995). Knowledge is structured as networks of related concepts known as semantic networks.

Learning occurs by associating new information with existing networks and depending on how this is done by learners; the new information can be easily retrieved for problem solving, recognition of situations, or recall of factual knowledge. Therefore, when educating students, explicit attention should be paid to their existing knowledge to provide the structure for learning. A basic requirement of learning is the activation of existing knowledge to facilitate processing of new information. A second important principle, according to Bruner (1993), is that learning is quicker when students possess self monitoring skills known as metacognition (also known as "knowing about knowing" or "thinking about thinking"). Possessing an extensive body of knowledge does not in itself guarantee that a problem will be successfully solved; good use of problem solving methods is also required. Metacognition is the student's ability to analyze, reflect on, and understand his or her own cognitive and learning processes. It involves: goal setting (What should I do?), strategy selection (How do I do it?), and goal evaluation (Did it work?). If students are aware of their cognitive strengths and weaknesses, they can adjust and compensate them by using the appropriate learning strategies in the right context. Metacognitive skills allow students to monitor their own learning. According to Bruning, Schraw, and Ronning (1995), metacognitive skills are teachable through such strategies as: (a) focusing on understanding (deep learning) rather than surface memory; (b) promoting elaboration of ideas; and (c) demonstrating the types of questions that students should ask themselves during the

problem solving process.

A third important principle for teaching and learning is that learning must be contextualized in order to be effective. There are many cases in the literature which criticize the ineffectiveness of traditional education. For example, students do not have an enhanced understanding of physics problems despite being formally taught physics theories (Clement, 1983). Two models that advocate contextualized learning are: cognitive apprenticeship (Collins, Brown, & Newman, 1989) and anchored instruction (Bransford, Sherwood, Hasselberg, Kinzer, & Williams, 1990). These models emphasize the fact that teaching should occur within the context of real-world problems or professional practice. In cognitive apprenticeship, students learn in the context they will work after they graduate, while in apprentice learning students are able to see how experts use subject knowledge and metacognitive skills for solving problems. Thus, when content is linked with con-text, knowledge is more accessible when confronted with new problems (Schmidt, 1993). Social factors also affect learning (Glaser, 1991) since in small group work students evolve their problem-solving methods and conceptual knowledge. They express different views on the problem, share ideas and responsibilities in managing the situation.

In order to use PBL effectively, it is important to understand how it is grounded in current theories of teaching and learning so that insights from these theories can be applied to refine the practice of PBL. Findings from cognitive psychology suggest that learning is constructive and not a receptive process. Learning is quicker when students possess self-monitoring skills known as metacognition (i.e. the student's ability to analyze, reflect on, and understand his or her own cognitive and learning processes). Metacognitive skills allow students to monitor their own learning, which they can be taught. When using the PBL approach, it is necessary for students to follow a carefully planned process to guide them through the complex tasks of brainstorming, identifying useful knowledge, formulating appropriate research questions, and working out strategies for finding solutions.

Pupils need to understand what is metacognition and they have to practice it to regulate their cognitive performances. Teachers can explicitly describe metacognition and model it for pupils. Pupils can be encouraged to "think aloud" and explain their approaches to problem-solving as

they work. A few minutes of class time should be set aside regularly to discuss the metacognitive approaches to learning.

Teachers should take time to explain the concept of thinking about our own thinking, introduce the two strands of metacognitive knowledge and self regulation, and familiarize the pupils with the ideas of planning, monitoring and evaluation. Presenting the concept in an explicit way is likely to resonate with at least some of the pupils, who will be intrigued by the possibilities. One of the most powerful ways that one can show students how valued metacognitive skills are, is to model them ourselves. Very often the teacher should discuss and model how to do something, without modeling the thinking behind it. One should allow our pupils to see the final, polished version of our thinking without showing them the decisions that made the revisions, the dead ends once went down, the ideas changed or threw away. Consider thinking out loud for the pupils, discuss the stages one should **go** through as they solve a problem (prove a maths theorem, polish an opening sentence for an essay, figure out which tense of a French verb to use). Other students can also use very powerful models in explaining the rationale for their thinking in a way that others can relate to.

Methodology:

Sample:

The target population of the study includes eleventh standard biology with maths group students in the selected schools in Chennai. The researcher has adopted purposive cluster sampling method in selecting the samples. One government school, one private school and one aided school from Ambattur, Chennai have been chosen for the study. The total sample of the study comprises 106 which include 31 students in private School, 41 from Government Aided School and 34 from government school.

Instrument:

Metacognitive Awareness Inventory, (MAI), was used as an instrument to measure the metacognitive awareness of eleventh standard students and was administered to the students before the treatment and after the treatment. The students were asked to answer all the responses with yes or no response.One mark is given for “yes” and zero to “no”. The MAI designed by

Schraw and Dennison in 1994 and has been used in measuring metacognitive awareness. The MAI has got 52 statements representing two dimensions of metacognition; knowledge and regulation. Knowledge of metacognition have three sub dimensions namely declarative knowledge (knowledge about self and strategies), procedural knowledge (knowledge about how to use strategies) and conditional knowledge (knowledge about when and why to use strategies). Regulation of metacognition have five sub dimensions which includes planning (goal setting), information management (organizing), monitoring (assessment of one's learning and strategy), debugging (strategies used to correct errors) and evaluation (analysis of performance and strategy effectiveness after learning episode). The total scoring was calculated to find out the overall metacognitive awareness, knowledge of cognition and regulation of cognition. The Cronbach's alpha reliability coefficient was established for overall metacognitive awareness and reliability coefficient for Metacognitive awareness was 0.962.

Data Analysis:

Hypotheses

There is a significant difference between the pretest and post test score of eleventh standard student's metacognitive awareness.

Results of the paired sample t test to compare the mean score between the pre test and post test of the dimensions of Metacognitive Awareness (n=106)

Dimensions of Metacognitive Awareness	Pre test		Post test		Df	't'	P
	Mean	SD	Mean	SD			
Declarative Knowledge	3.51	1.80	6.83	0.94	105	16.039	<.001**
Procedural Knowledge	1.57	0.92	3.36	0.86	105	16.014	<0.001**
Conditional Knowledge	2.00	1.28	4.24	0.81	105	14.945	<0.001**
Overall Knowledge	7.08	2.63	14.42	1.86	105	23.483	<0.001**
Planning	2.69	1.40	5.62	1.26	105	16.212	<0.001**
Information Management Strategies	3.75	1.99	8.42	1.65	105	18.367	<0.001**
Comprehension	1.42	1.36	5.90	1.18	105	24.111	<0.001**

monitoring							
Debugging strategies	0.72	0.92	4.18	0.87	105	25.066	<0.001**
Evaluation	1.46	1.22	5.05	1.03	105	20.765	<0.001**
Overall Regulation	10.03	3.53	29.16	4.16	105	35.404	<0.001**
Overall M A I	17.10	4.94	43.58	5.62	105	35.606	<0.001**

**** - denotes significance at 0.01 % level**

The paired sample t-test was used to determine the effect of problem based learning on the metacognitive awareness levels of eleventh standard students, and the analysis revealed that there was a significant difference between the metacognitive awareness levels in their pre test and post test after implementation of problem based learning.

The paired sample *t*-tests showed that there was a significant difference between the pre and post test score of the eleventh standard students in all the dimensions of metacognition, information management strategies (M=8.42, SD=1.65),declarative knowledge (M=6.83, SD=0.94),comprehension monitoring (M=5.90, SD=1.18), planning (M=5.62, SD=1.26), evaluation (M=5.05, SD=1.03), conditional knowledge (M=4.24, SD=0.81), debugging strategies (M=4.18, SD=0.87) and procedural knowledge (M=3.36, SD=0.86) , $t(105)=35.606$, $p<0.01$. The post test scores shows the significant effect in increasing the metacognitive awareness among the eleventh standard students in all its dimensions, which infers that the problem based learning had enhanced their cognition and regulation of cognition to adopt the learning strategies in a sequential manner.

The value of 't' is less than 0.01 in all the eight dimensions of metacognitive awareness and the hypothesis is accepted at 1% level of significance. Hence it is concluded that there is a significant difference between the pretest and posttest score of eleventh standard students' metacognitive awareness after the use of problem based learning.

It indicates that among the knowledge of cognition, highest mean score (6.83) was found in the declarative knowledge, whereas the results of the regulation of cognition revealed that information management strategies of students found to have the highest mean score (8.42) among all other dimensions of metacognitive awareness. Their posttest score indicates that the students used the strategies to process the information more efficiently in learning.

Results and Discussion:

This study aimed to reveal the effect of Problem Based Learning (PBL) that had produced significant metacognitive development among the higher secondary students. After an analysis of the data, it was observed that PBL had a positive effect on the metacognitive awareness levels among the higher secondary students. Overall pretest and posttest score revealed that metacognitive awareness was found to be high in the posttest score when compared to their pretest score. Among the dimensions of metacognitive awareness knowledge of cognition and regulation of cognition, overall regulation of cognition found to have the highest mean score when compared to the knowledge of cognition. When individuals face a new problem, metacognitive strategies play an important role in achieving the successful result. By using these strategies, individuals can evaluate themselves whether they will be successful or not in their tasks. After confirmation of their status they will move to the next task. Results of the present study correlate with the findings of Gourgery,(1998) which reveal that processes proceed and transfer the experiences to the next process. Result reveal that significant differences were found between the pre test and posttest metacognitive awareness of the students exposed to PBL. Increase in the mean scores of all the sub dimensions revealed that it may be due to the exposure and experience of problem based learning. Problem Based Learning had enhanced their cognition and regulation of cognition to adopt the learning strategies in a sequential manner.

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