

# The Role of Metacognitive knowledge in Improving Cognitive Skills and Academic Achievement of IX Standard School Students

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## Abstract

The results obtained in the analyzed group showed that metacognitive skills can be successfully developed in students. Some of the students may have already been using metacognitive strategies intuitively. We may conclude this 120 days training programme, with weekly meetings focused on strategies to improve students' cognitive skills and the strategies of regulating their cognitive activity, embedded in the course specific content can improve their metacognitive awareness level. Under the circumstances of nowadays changing society, we consider Metacognition to be the essential skill that teachers should develop both in themselves and their students. Therefore, Metacognition should be first learned and used by teachers and applied in teaching and learning methods and in writing textbooks and practiced every day in classrooms, in all subjects. This study revealed that metacognitive training is effective in improving learning and performance outcomes. Teachers should be given orientation as to how a learning packages based on metacognitive process can be developed by making use of the resources locally available to teach biology both at school and college level. This will pave the way for optimum human resources development.

## Introduction

During the last 30 years metacognition has become one of the major fields of cognitive development research. Research activity in metacognition began with John Flavell, who is considered to be the father of the field and there after a considerable amount of empirical and theoretical. Moreover, a number of strategies aiming to enhance children's metacognitive abilities have been suggested, which teachers through all educational levels can apply in their instruction. (Eleonora, 2003)

'Metacognition' is a concept that has been used refers to a variety of epistemological process. Metacognition essentially means cognition about cognition; that is, it refers to second –order cognition: thought about thought, knowledge about knowledge or reflections about actions. So if these various cognitions about cognitions can be labeled meta perception, "Meta Comprehension" and "Meta Memory' with ' Metacognition' remaining the super ordinate term. According to Ronald.T.Kettogg, (2007) metacognition is defined as thinking about another thought process in which the object of a mental representation.

Flavell (1978) referred to it as 'knowledge that takes as its object or regulates any aspect of any cognitive endeavor. Moore (1982) defines it as 'an individual's knowledge about various aspects of thinking'

and it has also been described as the abilities of individuals to adjust their cognitive activity in order to promote more effective comprehension.

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 or someone else's emotions or motives. This can be considered metacognitive. Flavell (1979) when trying to all those conscious cognitive or affective experience that accompany and pertain to an intellectual enterprise. According to Broekkamp and Van Houtwolters, (2007) metacognition refers to the selection of strategies for processing information such as the selection of study strategies to prepare for exams. Study strategies include such activities as determining the expectations of the teacher, managing time, interacting with the teacher and fellow students, selecting learning strategies, setting goals and monitoring progress.

### **TITLE OF THE PROBLEM**

The title of the problem is ***“Improving Cognitive Skills through Metacognitive Strategies among IX Standard Students.”***

### **DEFINITION OF THE TERMS**

#### **Improving**

The word ‘Improving’ is defined as to enhance in value or quality (Webster dictionary, 2013). The definition of the term Improving means to bring into a more desirable or excellent condition. It means that the act of enhancing or making better in terms of quality, value, or usefulness. In this study ‘improving’ refers to enhancing the cognitive skills through innovative strategies such as Metacognitive Knowledge training, Yoga training and Nutritional Supplementation.

#### **Cognitive Skills**

Cognitive skills are defined as the brain-based skills to carry out any task from the simplest to the most complex. They have more to do with the mechanisms of how we learn, remember, problem-solving and pay attention (Pascale Michdon, 2006). ‘Cognitive skills’ involved in this study refers to Sustained Attention, Expressive Speech, Verbal Fluency, Design Fluency, Verbal Working Memory, Visuo-Spatial Working Memory, Visuo-Perceptual ability.

#### **Innovative Strategies**

The word Innovative is defined as Introducing or using new ideas or methods, having new ideas about how something can be done (Merriam Webster Dictionary, 2013). Strategy is defined as a careful plan or method for achieving a particular goal usually over a long period of time (Merriam Webster Dictionary, 2013). The strategy is defined as a plan or method for achieving a goal (Webster, 1999) and a particular method used to

be successful (Hein Mann, 2002). The word Strategy is defined as the act of planning how to achieve something. Strategy means a plan that use to achieve something (Cambridge learner's dictionary, 2011).

## Objectives

- To find out the Metacognitive Awareness of Participants before intervention
- To find out the relationship between Metacognitive Knowledge and Academic Achievement in pre and post Assessement

## Hypothesis

- What is the Metacognitive Awareness of Participants before Intervention?
- Is there any difference between Metacognitive Knowledge and Academic Achievement in pre and post Assessment?
- Did Metacognitive strategies Intervention enhance cognitive skills of Participants? If so what level?
- Is there any relationship between Metacognitive Knowledge and Cognitive Skills in Post Assessment?

## DESCRIPTIVE ANALYSIS ON METACOGNITIVE KNOWLEDGE

**Ho:** What is the Metacognitive Awareness of Participants before Intervention?

**Table – 1**  
**Metacognitive Awareness among Participants**

Metacognitive Knowledge	No. of Students (N =90)	Percentage (100%)
Recall regularly what they have studied	20	22%
Planning the time for study	40	44%
Using strategies for study	30	33%
Selecting appropriate strategies	20	22%
Self-motivation	30	33%
Generating self-examples for understanding	35	39%
Knowing simple and complex concept	55	61%
Clarifying doubts from teachers or friends	10	11%
Memory without understanding	70	78%
Knowledge about their own understanding	55	61%
Help others to understand the concept	50	55.5%
Using diagrams to understand the relationship	35	39%

Spilt the concept for easy understanding	30	33%
Using dictionaries regularly	15	17%
Using Self - explanation	10	11%
Thinking about simplest way for studying	30	33%
Self – evaluation	15	17%
Writing the concept after studying	10	11%
Changing the strategies if needed	25	28%
Discussing the difficult concept among friends	35	39%

The above table discussed that only 39% of the students discussing the difficult concepts among friends and Generating self - examples for understanding, 28% of the students change the strategies if needed, 11% of the students write the concept after studying and using self-explanation, 17% of the students evaluate themselves and using dictionaries while studying, 33% of the students thinking simple way of studying, and split the concepts for easy understanding. 39% of the students use diagrams to understand and use strategies, 55% of the students help others to understand the concept, 61% of the students know their own ability of understanding, majority of the students i.e. 78% of the students memorize the concepts without understanding. Only 11% of the students clarify their doubts from teachers, 61% of the students know simple and complex concept, minimum of students i.e. 22% of the students were found that recall regularly and select appropriate strategies, 33% of the students regularly use strategies and using self-motivation for study.

## INFERENCE ANALYSIS OF METACOGNITIVE INTERVENTION

**H<sub>0</sub>:** Is there any difference between Metacognitive Knowledge and Academic Achievement in pre and post Assessment?

**Table – 2.**

### Paired ‘t’ test for Pre and Post Assessment of Metacognitive Knowledge and Academic Achievement

Variables		Pre Assessment	Post Assessment	‘t’ Value	‘p’ value	Effect Size
Metacognitive Knowledge	Mean	20.13	22.06	4.82	.000	0.44
	SD	2.50	3.09			
Academic Achievement	Mean	41.29	75.23	11.63	.000	0.82
	SD	10.01	11.50			

It is noted that the calculated value 4.82 is significant at .01 level, Hence it is concluded that there is significant difference between pre – assessment and post – assessment of Metacognitive Knowledge. The Result indicate a significant improvement in Metacognitive Knowledge of IX standard students due to

metacognitive training assessed through posttest ( $M=22.06$ ,  $SD=3.09$ ) than before taking training of metacognitive strategies ( $M=20.13$ ,  $SD= 2.50$ ),  $t(30)=4.82$ ,  $p=.000$ .

It is noted that the calculated value 11.63 is significant at .01 level. Hence it is concluded that there is significant difference between pre and post assessment of Academic Achievement of IX standard students. Result indicate a significant improvement Academic Achievement of IX standard students due to metacognitive training assessed through posttest ( $M= 75.23$ ,  $SD= 11.50$ ) than before taking training of metacognitive strategies ( $M= 41.29$ ,  $SD= 10.01$ ),  $t(30)=11.63$ ,  $p=.000$ .

**Ho:** Did Metacognitive strategies Intervention enhance cognitive skills of Participants? If so what level?

**Table – 3.**

**Paired ‘t’ Test for Pre and Post Assessment of Eight Cognitive Skills After Metacognitive Intervention**

Cognitive Skill		Pre Assessment	Post Assessment	‘t’ Value	‘p’ value	Effect Size
Verbal Fluency Skill	Mean	13.71	21.10	14.94	.000	0.33
	SD	2.10	2.11			
stained Attention	Mean	43.55	52.67	5.39	.000	0.68
	SD	8.48	4.06			
Design Fluency	Mean	3.65	5.61	6.15	.000	0.56
	SD	1.90	1.80			
Verbal-Working Memory	Mean	10.32	14.22	7.42	.000	0.16
	SD	2.22	2.92			
Visuo-Spacial-Working Memory	Mean	7.71	23.96	14.99	.000	0.64
	SD	1.77	6.46			
Perceptual Ability	Mean	24.77	25.06	.296	.000	0.97
	SD	5.56	5.22			
Auditory Verbal Learning	Mean	7.23	6.35	1.753	.000	0.37
	SD	2.44	.950			
Visual Learning and Memory	Mean	9.10	25.06	16.51	.000	0.10
	SD	1.83	5.22			

From the above table the calculated ‘t’ value 14.94 is significant for 30 degrees of freedom at .01 level of significance. Hence it is concluded that there is significant difference between pre and post assessment of verbal fluency skills of IX standard students. Result indicate a significant improvement in verbal fluency skill

of IX standard students due to metacognitive training assessed through posttest ( $M=21.10$ ,  $SD=2.11$ ) than pre-test ( $M=13.71$ ,  $SD= 2.10$ ),  $t(30)=14.94$ ,  $p=.000$ .

It is noted that the calculated 't' value 5.39 is significant for 30 degrees of freedom at .01 level of significance. Hence it is concluded that there is significant difference between pre and post assessment of sustained attention skill of IX standard students. Result indicate a significant improvement in sustained attention of IX standard students due to metacognitive strategy training assessed through posttest ( $M=52.67$ ,  $SD=4.06$ ) than pre-test ( $M=43.55$ ,  $SD= 8.48$ ),  $t(30)=5.39$ ,  $p=.000$ .

It is noted that the calculated 't' value 6.15 is significant for 30 degrees of freedom at .01 level of significance. Hence it is concluded that there is significant difference between pre and post assessment of design fluency skill of IX standard students. Result indicate a significant improvement in design fluency of IX standard students due to metacognitive strategy training assessed through posttest ( $M=5.61$ ,  $SD=1.80$ ) than pre-test ( $M=3.65$ ,  $SD= 1.90$ ),  $t(30)=6.15$ ,  $p=.000$ .

It is noted that the calculated 't' value 7.42 is significant for 30 degrees of freedom at .01 level of significance. Hence it is concluded that there is significant difference between pre and post – assessment of verbal working memory skill of IX standard students. Result indicate a significant improvement in verbal working memory of IX standard students due to metacognitive strategy training assessed through posttest ( $M=14.22$ ,  $SD=2.92$ ) than pre-test ( $M=10.32$ ,  $SD= 2.22$ ),  $t(30)=7.42$ ,  $p=.000$ .

It is noted that the calculated 't' value .296 is significant at .01 level of significance. Hence it is concluded that there is significant difference between pre and post assessment of Visuo-spacial Working Memory skill of IX standard students. Result indicate a significant improvement in Visuo-spacial Working Memory skill of IX standard students due to metacognitive strategy training assessed through posttest ( $M=23.96$ ,  $SD=6.46$ ) than pre-test ( $M=7.71$ ,  $SD= 1.77$ ),  $t(30) =14.99$ ,  $p=.000$ .

It is noted that the calculated 't' value 14.99 is significant at .01 level of significance. Hence it is concluded that there is significant difference between pre and post assessment of Perceptual Ability of IX standard students. Result indicate a significant improvement in Perceptual Ability of IX standard students due to metacognitive strategy training assessed through posttest ( $M=25.06$ ,  $SD=5.22$ ) than pre –test ( $M=24.77$ ,  $SD= 5.56$ ),  $t(30) =.296$ ,  $p=.769$ .

It is noted that the calculated 't' value 1.753 is not significant at .01 level of significance. Hence it is concluded that there is significant difference between pre and post – assessment of Auditory Verbal Learning of IX standard students. Result indicate a no significant improvement in Auditory Verbal Learning of IX standard students due to metacognitive strategy training assessed through posttest ( $M=6.35$ ,  $SD=.950$ ) than pre-test ( $M=7.23$ ,  $SD= 2.44$ ),  $t(30) =1.753$ ,  $p=.090$ .

It is noted that the calculated 't' value 16.51 is significant for 30 degrees of freedom at .01 level of significance. Hence it is concluded that there is significant difference between pre and post assessment of Visual Learning and Memory skill of IX standard students. Result indicate a significant improvement in Visual Learning and Memory of IX standard students due to metacognitive strategy training assessed through posttest ( $M=25.06$ ,  $SD=5.22$ ) than pre -test ( $M=9.10$ ,  $SD= 1.83$ ),  $t(30)=16.51$ ,  $p=.000$ .

From the above table it is concluded that the Metacognitive Strategy Training has larger effect on improving Cognitive Skills such as Verbal Fluency, Sustained Attention, Design Fluency, Verbal Working Memory, and Visuo-Spatial Working Memory, Perceptual ability and Auditory Verbal Learning such as 0.33, 0.68, 0.56, 0.16, 0.64, 0.97 and 0.37 respectively. The Effect Size of Visual Learning and Memory of IX standard Students is 0.10 which denotes Medium Effect

**Ho:** Is there any relationship between Metacognitive Knowledge and Cognitive Skills in Post Assessment?

**Table – 4.**  
**'r' Value Showing Correlation between Metacognitive Knowledge and Cognitive Skills in Post Assessment**

Cognitive Skills	Metacognitive Knowledge	Significance
Verbal Fluency	.368*	S
Sustained Attention	.568**	S
Design Fluency	.684**	S
Verbal Working Memory	.816**	S
Visuo-Spatial Working Memory	.232	NS
Perceptual Ability	.213	NS
Auditory Verbal Learning	.723**	S
Visual Learning and Memory	.953**	S

\*\* correlation is significant at the 0.01 level (2 tailed)

It is noted that the calculated 'r' Value is .368\* which is significant at 0.05 level of significance. Hence it is concluded that there is a strong positive correlation between Metacognitive Knowledge and Verbal Fluency Skill.

The Coefficient of correlation obtained between Sustained Attention and Metacognitive knowledge is 0.568\*\*, which is greater than the table value at 0.01 levels. Hence there is a strong correlation between metacognitive knowledge and sustained attention.

It is inferred from the table that co-efficient of correlation obtained between metacognitive knowledge and Design Fluency is .684\*\*, which is greater than table value at 0.01 level. Hence, there is a strong relationship between metacognitive knowledge and Design Fluency Skill.

Results in the table shows that the co-efficient of correlation obtained between Metacognitive Knowledge and Verbal Working Memory is .816\*\*, which is greater than table value at 0.01 levels. Hence, there is a strong relationship between Metacognitive Knowledge and Verbal Working Memory.

It is appears from the table that the co- efficient of correlation obtained between Metacognitive Knowledge and Visuospatial Working Memory is .232, which is less than table value at 0.01 level. Hence, there is no significant relationship between Visuo-spacial Working Memory and Metacognitive Knowledge.

Results in the table showed that co-efficient of correlation between Metacognitive Knowledge and Visual Perceptual Ability is .213, which is less than table Value at the 0.01 level. Hence, there is no relationship between Visual Perceptual Ability and Metacognitive Knowledge.

From the above table, it can be seen that the co-efficient of correlation obtained between Metacognitive Knowledge and Auditory Verbal Learning is .723\*\*, which is greater than table value at 0.01 level. Hence, there is a significant relationship between Auditory Verbal Learning and Metacognitive Knowledge.

It appears from the table that the co-efficient of correlation obtained between Metacognitive Knowledge and Verbal Learning and memory is .953\*\*, which is greater than table value at 0.01 level. Hence, there is a significant relationship between Verbal Learning memory and Metacognitive Knowledge.

## Result and Analysis

**Metacognitive Practices of the Participants:** The result only 39% of the students discussing the difficult concepts among friends and Generating self - examples for understanding, 28% of the students change the strategies if needed, 11% of the students write the concept after studying and using self-explanation, 17% of the students evaluate themselves and using dictionaries while studying, 33% of the students thinking simple way of studying and split the concepts for easy understanding. 39% of the students use diagrams to understand and use strategies, 55% of the students help others to understand the concept, 61% of the students know their own ability of understanding, majority of the students i.e. 78% of the students memorize the concepts without understanding. Only 11% of the students clarify their doubts from teachers, 61% of the students know simple and complex concept, minimum of students i.e. 22% of the students were found that recall regularly and select appropriate strategies, 33% of the students regularly use strategies and using self-motivation for study.



## Metacognitive Intervention

1. The Result indicate a significant improvement in Metacognitive Knowledge of IX standard students due to metacognitive training assessed through posttest ( $M=22.06$ ,  $SD=3.09$ ) than before taking training of metacognitive strategies ( $M=20.13$ ,  $SD= 2.50$ ),  $t(30) = 4.82$ ,  $p=.000$ .
2. Result indicate a significant improvement Academic Achievement of IX standard students due to metacognitive training assessed through posttest ( $M= 75.23$ ,  $SD= 11.50$ ) than before taking training of metacognitive strategies ( $M= 41.29$ ,  $SD= 10.01$ ),  $t(30) =11.63$ ,  $p=.000$ .
3. Result indicate a significant improvement in verbal fluency skill of IX standard students due to metacognitive training assessed through posttest ( $M=21.10$ ,  $SD=2.11$ ) than pre- test ( $M=13.71$ ,  $SD= 2.10$ ),  $t(30)=14.94$ ,  $p=.000$ .
4. Result indicate a significant improvement in sustained attention of IX standard students due to metacognitive strategy training assessed through posttest ( $M=52.67$ ,  $SD=4.06$ ) than pre-test ( $M=43.55$ ,  $SD= 8.48$ ),  $t(30)=5.39$ ,  $p=.000$ .
5. Result indicate a significant improvement in design fluency of IX standard students due to metacognitive strategy training assessed through posttest ( $M=5.61$ ,  $SD=1.80$ ) than pre-test ( $M=3.65$ ,  $SD= 1.90$ ),  $t(30)=6.15$ ,  $p=.000$ .
6. Result indicate a significant improvement in verbal working memory of IX standard students due to metacognitive strategy training assessed through posttest ( $M=14.22$ ,  $SD=2.92$ ) than pre-test ( $M=10.32$ ,  $SD= 2.22$ ),  $t(30)=7.42$ ,  $p=.000$ .
7. Result indicate a significant improvement in Visuo-Spatial Working Memory skillof IX standard students due to metacognitive strategy training assessed through posttest ( $M=23.96$ ,  $SD=6.46$ ) than pre-test ( $M=7.71$ ,  $SD= 1.77$ ),  $t(30) =14.99$ ,  $p=.000$ .
8. Result indicate that there is no significant improvement in Perceptual Ability of IX standard students due to metacognitive strategy training assessed through posttest ( $M=25.06$ ,  $SD=5.22$ ) than pre -test ( $M=24.77$ ,  $SD= 5.56$ ),  $t(30) =.296$ ,  $p=.769$ .
9. Result indicate a no significant improvement in Auditory Verbal Learning of IX standard students due to metacognitive strategy training assessed through posttest ( $M=6.35$ ,  $SD=.950$ ) than pre-test ( $M=7.23$ ,  $SD= 2.44$ ),  $t(30) =1.753$ ,  $p=.090$ .
10. Result indicate a significant improvement in Visual Learning and Memory of IX standard students due to metacognitive strategy training assessed through posttest ( $M=25.06$ ,  $SD=5.22$ ) than pre -test ( $M=9.10$ ,  $SD= 1.83$ ),  $t(30) =16.51$ ,  $p=.000$ .
11. It is concluded that the Metacognitive Strategy Training has larger effect on improving Cognitive Skills such as Verbal Fluency, Sustained Attention, Design Fluency, Verbal Working MemoryandVisuo-Spatial Working Memory, Perceptual ability and Auditory Verbal Learning such as 0.33, 0.68, 0.56,

0.16, 0.64, 0.97, 0.10 and 0.37 respectively. The Effect Size of Visual Learning and Memory of IX standard Students is 0.10 which denotes Medium Effect.

### Correlation between Metacognitive Training and Cognitive Skills

1. The Coefficient of correlation obtained between Verbal Fluency Skill and Metacognitive knowledge is 0.368\*. There is a strong positive correlation between Metacognitive Training and Verbal Fluency Skill.
2. The Coefficient of correlation obtained between Sustained Attention and Metacognitive knowledge is 0.568\*\*. There is a strong positive correlation between sustained attention and Metacognitive Training.
3. It is inferred from co-efficient of correlation obtained between metacognitive knowledge and Design Fluency is .684\*\*, Hence, there is a strong relationship between metacognitive knowledge and Design Fluency Skill.
4. Results show that the co-efficient of correlation obtained between Metacognitive Knowledge and Verbal Working Memory is .816\*\*, Hence, there is a strong relationship between Metacognitive Knowledge and Verbal Working Memory.
5. The co-efficient of correlation obtained between Metacognitive Knowledge and Visuo-Spatial Working Memory is .232, which is less than table value at 0.01 level. Hence, there is no significant relationship between Visuo-Spatial Working Memory and Metacognitive Knowledge.
6. Results in the table showed that co-efficient of correlation between Metacognitive Knowledge and Visual Perceptual Ability is .213. Hence, there is no relationship between Visual Perceptual Ability and Metacognitive Knowledge.
7. It can be seen that the co-efficient of correlation obtained between Metacognitive Knowledge and Auditory Verbal Learning is .723\*\*, Hence, there is a significant relationship between Auditory Verbal Learning and Metacognitive Knowledge.
8. It appears from the table that the co-efficient of correlation obtained between Metacognitive Knowledge and Verbal Learning and memory is .953\*\*. Hence, there is a significant relationship between Verbal Learning memory and Metacognitive Knowledge.

### Conclusion

This study revealed that metacognitive training is effective in improving learning and performance outcomes. Teachers should be given orientation as to how a learning packages based on metacognitive process can be developed by making use of the resources locally available to teach biology both at school and college level. This will pave the way for optimum human resources development.

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