Scholarly Research Journal for Humanity Science & English Language,
Online ISSN 2348-3083, SJ IMPACT FACTOR 2019: 6.251, www.srjis.com
PEER REVIEWED & REFEREED JOURNAL, OCT-NOV, 2020, VOL- 8/42

CULTURAL CONTROL ON METACOGNITIVE KNOWLEDGE IN SCIENCE AT ELEMENTARY LEVEL

Priyaranjan Dash[1] & Prof B. N. Panda[2]

[1]Research Scholar, Regional Institute of Education (NCERT) Bhubaneswar Odisha,

Email Id- dpriyaranjan90@gmail.com

[2]Professor of Education and Dean of Research, Regional Institute of Education (NCERT) Bhubaneswar Odisha, Email Id- bnpanda38@hotmail.com

Abstract

Deeper understanding of any subject in general and science in particular is controlled and coordinated by some affective and reflective processes which are even beyond simple cognitive operations. The present study makes an attempt to analyze the influence of culture on metacognition. For this purpose the sample in this study are having ethnic variation i.e. one group of the sample student is from tribal community where as the other one from non tribal community. Further for the better understanding and assessment in the present study the metacognitive knowledge is divided in to three categories such as declarative knowledge, procedural knowledge, conditional /strategic knowledge. The present study is an exploratory study conducted in a mixed method (QUAN-QUAL) design. One hundred seventeen learners who have completed class VIII were purposively selected. Out of two objectives of the research study first objective was investigated through quantitative approach. For the exploration of second objective qualitative approach was followed. This included in-depth analysis of the observation and results of the tasks or questions assigned to the learners in the investigation of first objective. Statistical analysis of data revealed a significant quantitative difference in the score of metacognitive knowledge of tribal and non tribal learners in science. The qualitative analysis of the answers provided a more comprehensive understanding of tribal and nontribal learners' understanding of science as well as their knowledge about their own cognitive abilities which are due to the interplay of ethnic culture and metacognition.

Key words- *Metacognition, Declarative knowledge, Procedural knowledge, Conditional knowledge, Culture*

Introduction

Since the time of immemorial the significant response of human beings towards the happenings of nature includes the cautious observation of physical and biological surroundings for identification of relations and patterns, finding out and using new instruments to interact with nature and construction of conceptual models for better understanding of the nature **(NCF-2005).** Modern Science is the synthesized product of these human experience and efforts of centuries. In a more general way, the basic constituents of

science can be understood as the summation of interconnected scientific phenomenon like meaningful observations, searching of patterns and relations, making and testing of hypothesis, designing of empirical and rational models for verifying or falsifying the theories on the basis of observations and controlled observations, inferring the consequences of different actions, and finally formulation of theories, principles and laws which govern the nature. Due to this the mental act or phenomena of knowledge acquisition and construction of understanding using attention, reflection, individual experience, and also by the use of senses i.e. cognition, occupies a principal component in learning science at each and every level. In Indian context the science education is believed to enable the learner to shape his/her intellectual ability in a multi-polarised way which includes, acquisition of knowledge from different sources along with the ability of application of different scientific facts and principles, attainment of skills, techniques and procedure for generalization, simplification and corroboration of scientific information, facts as well as knowledge. The objective of science teaching also includes building up of a mental/cognitive picture to view science as an enterprise of this human society, development of a positive reception of the daily life issues at the interface of science and technology, acquisition of theoretical and practical knowledge and skills to live the life, improvement of creativity, inquisitiveness, inventiveness, and sense of aesthetics, and finally to imbibe the values of honesty integrity and attitude cooperation. **(National Focus Group Report on Teaching of Science 2006).** Though most of the processes for attaining these objectives are cognitive in nature; there also exist affective and reflective processes which are even beyond simple cognitive operations. In common term these higher order thinking and reflecting process are known to be ***metacognitive (Flavell, 1976, Brown, 1980)*** in nature.

Metacognition and its Functional Categories

The term Metacognition first emerged from the works of American developmental psychologist *J H Flavell*. According to ***Flavell (1976, 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." In order to understand and assess metacognition the four aspects of metacognition (knowledge, regulation, belief and awareness,) are further sub-categorized in to nine major Metacognitive parameters **(Nayak& Mohanty 2017).** The present study is concerned with metacognitive knowledge only and this can be divided into following three Metacognitive parameters

Table 1: Description of the Functional Categories of Metacognitive Knowledge

Broad Category	Components	What does it imply?
Metacognitive Knowledge (*knowledge and deeper understanding of cognitive processes and products)*	Declarative knowledge	What is known in a propositional manner.
	Procedural knowledge	Knowledge of processes of thinking.
	Conditional/strategic knowledge	Knowledge of the conditions that influence learning.

Metacognitive Knowledge

Metacognitive knowledge may be understood as the knowledge of any individual about his/her own cognition. Metacognitive knowledge includes knowledge of common approach or strategy of any individual that might be used for performing a different type of activities, knowledge of the situation or condition in which these strategies might be used, knowledge of the individual about extent to which the strategies are effective, and his/her knowledge of the self (**Flavell, 1979; Schneider & Pressley, 1997; Pintrich et al., 2000**). Simply this is the knowledge of a learner about different approaches of solving a scientific problem along with consciousness regarding the required strategies to supervise and examine their conception when they solve that scientific problem. It includes knowledge of the learners about their own strengths and weaknesses for doing any task and their inspiration for carrying out that task. Metacognitive can be divided in to three different types of constructs for its better understanding as well as assessment.

Declarative knowledge

Declarative knowledge is also called as person knowledge which is the understanding of any individual of his/her own potentialities and competence. However unreliable self assessment of individual makes declarative metacognitive knowledge a little bit less accurate. When the scientific task is concerned the extent of objectivity in the task as well as involvement of factual information it the task enhances the reliability of self assessment by minimizing the subjectivity in response.

Strategic knowledge (conditional knowledge)

Strategy knowledge is “conditional knowledge," or one’s ability to use strategies to learn information, as well as for adapting these strategies to new situations. This is related to the age or developmental stage of the individual. For example, a kindergartener can be taught strategies, but needs to be reminded to use them, such as sounding out words when learning to read. In contrast, an upper elementary learner understands this strategy and knows when it will be effective under different circumstances.

Procedural knowledge: This component of metacognitive knowledge may also be called as task knowledge as it includes the knowledge of the mental operations or procedures of doing any task. Task knowledge is can be connected to the experience of difficulty or easiness that an individual perceives while doing any task. During scientific task performing it can also be comprehended as learner's epistemic foundation behind the procedures, methods or operations exercised in the completion task.

Rationale of the Study

Though metacognitive practicees along with belief are regarded as the significant characteristics of thinking **(Schoenfeld, 1987, 1992),** to some extent young learners are limited in the knowledge about their own cognitive experiences i.e. in their metacognition. They do a little monitoring of their own remembrance, understanding, and other cognitive endeavors **(Flavell, 1979).** In our classes we find different types of learners, those reflect and self-regulate, and those that do not use these skills to improve their learning **(Soto, 2016).** Metacognition has strong influence on thinking, problem solving and sense making in mathematics. **(Schoenfeld,1987).** These skills are also required for **science** learning as scientific thinking is not much distinct from mathematical thinking due to the interdependence of these two subjects. **Laistner (2016)** also reposted that there is a benefit to teaching learners metacognitive strategies in order to increase mathematical achievement. The development of scientific thinking and the relations between scientific thinking and everyday thinking is closely associated with the development of metacognitive skill (**Kuhn, D.et al. 1988).** Modern **science** education is not confined with only knowing the scientific facts; rather it intends to generate higher order thinking skills among the learner at every stage. Successful higher order thinking in **science** necessitates metacognitive knowledge as well as metacognitive skills **(Zohar, A., & Barzilai, S. 2015).** Most of the scientific problems are creative in nature; hence to solve these problems a learner needs creative problem solving skill. Research study suggests that metacognition strongly influence creative problem solving **(Jaušovec, N. 1994**). **Kristiani. N. et al. (2015)** found metacognitive skills and scientific attitudes contributed learners' academic achievements to a considerable extent.

In science learning perception and sensitivity of learner on scientific facts and knowledge plays a vital role. Culture, the sum total of individual's social experience, is one of the major factor which influence cognition. Research study of **Gutchess (2011)** points out the strong influence of culture on information processing, cognition and memory. The influence of culture on cognition is due to difference in cultural schema which is the comprehensive

assortment of awareness of past experiences prearranged into connected knowledge clusters **(Garro, 2000).** Cultural Schemas are shared by group of individuals as they are constructed from individual as well as from variety of common experiences that the member of a particular social group experience in his/her society **(Nishida, 1999).**

So we can conclude that, metacognition strongly influence the academic achievement, critical thinking, creative thinking and problem solving skill of learner. Cultural experiences are having a significant role in cognition. As metacognition is the control and coordination of individual's own cognitive processes, culture might influence. Tribal learners are lagging behind the non tribal learners in terms of academic achievement and hence also in other cognitive aspects. Absence of biological backdrop for the low achievement of tribal learners indicates the presence of some individual, social or cultural cause for it.. In view of the above it was planned to undertake the present study to answer the following questions.

Research questions-

- How different Metacognitive parameters are being operated in science?
- How different Metacognitive parameters are influenced by culture?
- Are tribal and non tribal learners different in terms of different aspects of metacognition?

Objective

To examine the difference in Metacognitive Knowledge of tribal and non tribal learners in science at elementary level.

To explore the influence of culture in metacognitive knowledge in science at elementary level.

Hypothesis

The mean score of metacognitive knowledge of tribal and non tribal learners in science at elementary level will not differ significantly.

Methodology:

Besides the cognitive consequences, the objectives and tools of Science learning at the latter stages in elementary level across the county is supposed to have metacognitive consequences and Meta-cognitive Knowledge (Declarative, Procedural and Conditional) is one of the expected metacognitive consequences of schooling. The study is limited to Meta-cognitive knowledge of children in elementary stages of schooling in Mayurbhanj district of Odisha. The learners reading in classes VIII in the Government ST SC department schools state

targeted population of the study. The present study is an exploratory study which is conducted in embedded QUAN-QUAL design with Survey method was employed for data collection. Initially quantitative data was collected followed by qualitative data then was mixed and analyzed.

Population- Mayurbhanj district was taken as the sample district due to its rich tribal culture. With approximately sixty percent of its population consisting of scheduled tribes, the study area is regarded as the capital of tribal culture of the state and it demonstrates a unique physical as well as socio-economic diversity. According to 2019 census data the contribution of scheduled tribe population to the total population of this district constitute almost triple as the contribution of the state tribal population to the population of the state. The present study was conducted on the class VII students of Mayurbhanj district studying ST SC department schools which are residential in nature. As these schools are having day-scholar facility for the non tribal learners, it was easy to have the requisite number of learners from both the categories is the population of the study which is rich in tribal culture.

Sample

Two ST SC department residential Government High School were selected purposively for the research as those were fulfilling the other requirements of this study (i.e. a ST & SC department residential school where non tribal learners also study). Both the schools are in same block, same administrative as well as academic structure, similar qualification of teachers, same criteria and process of admission, hence the learners of both the schools can be equated with each other in terms of academic exposure and experience. Those learners which sound reading and writing ability were identified for the study. In the first phase all the learners were given a simple MCQ based academic achievement test and on the basis of results of the test 117 learners were selected for this study among which 62 learners are tribal learners where as rest 55 are non tribal learners. In order to get similar groups the scores of individuals were matched. The following table describes the distribution of sample.

Table 2 : Gender and ethnicity wise Distribution of sample

Class	**School 1**			**School 2**			**Total**
	Boys	**Girls**	**Total**	**Boys**	**Girls**	**Total**	
Tribal	20	17	37	11	14	25	62
Non Tribal	18	14	32	13	10	23	55

Tools for data collection

A Metacognitive Knowledge Assessment Test (MKAT) was developed to access the Metacognitive Knowledge of class VIII and IX learners. In each item there were three sub components for Declarative Metacognitive Knowledge, Conditional Metacognitive Knowledge and Procedural Metacognitive Knowledge. The items were developed from class VIII Science text book to test the basic level of understanding of the learners. From eighteen chapters of class VIII science textbook total twenty four questions were made. Among these twenty four questions twelve questions each were from biological science and physical science. The questions were intended to examine learner's level of understanding on different science concepts. The items were of following types.

Q: Which of the following statement is correct?

(a) no metal reacts with oxygen (b) no non metal is good conductor of electricity

(c) no non metal is good conductor of heat (d)None of these

- **Declarative Metacognitive Knowledge** : Which of the above answer is correct?
- **Conditional Metacognitive Knowledge** : Why do you think that this answer is correct ?
- **Procedural Metacognitive Knowledge**: While thinking about the answer of this question which concepts came to your mind that you have studied earlier, known or seen in your daily life?

Each sub question was of one mark, and the tool was of 72 marks having similar no of sub questions. The learners were advised to go through all the questions thoroughly and carefully before answering them. The response from learners in these tools was taken in individual interview mode. After collection of data, those were arranged in tabular form and were analyzed and interpreted to arrive at conclusion in respect of the objectives of the study.

Data Analysis

Metacognitive knowledge of elementary grade learners in Science: In metacognitive knowledge assessment test learners were given 24 items in each of the three categories of metacognitive knowledge. The summary of learners' performance is described in the following table.

Table 3: Comparative Score of Metacognitive Knowledge of tribal and non-tribal Learners

Category	Metacognitive Skill Assessment Scores		
	Tribal	**Non-Tribal**	**All Learners**
N	62	55	117
Full Mark	72	72	72
Minimum	2	2	2
Maximum	41	46	46
Range	39	44	44
Mean	16.3	20.8	18.5
Standard Deviation	8.34	9.57	9.18

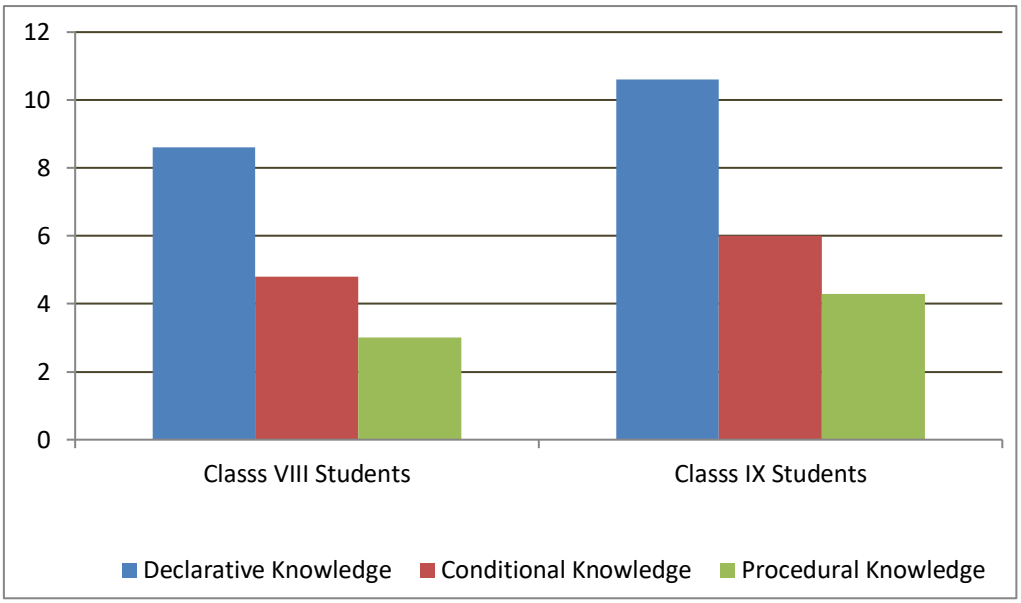
From the above table it is evident that metacognitive knowledge scores of tribal and non-tribal learners are close to each other. When the standard deviation is concerned, it is seen that the standard deviation of tribal learners is less than that of non-tribal learners. The comparatively low standard deviation indicates that the tribal learners' scores are less scattered from the mean score as compared to their non-tribal counter parts. This indicates that the intra group variation in metacognitive knowledge scores of tribal learners are less than that of non tribal learners and are hence more reliable than the non-tribal learners in terms of standard deviation. But in terms of average score non tribal learners are superior than that of tribal learners.

The metacognitive knowledge is composed of three different sub components such as declarative metacognitive knowledge, conditional metacognitive knowledge and procedural metacognitive knowledge l. In order to have an in-depth understanding the learners scores is each of the components is described in the following table.

The mean score of metacognitive knowledge of class learners are presented in the following table and is also represented graphically.

Table 4: Comparative Mean Score of three components of Metacognitive Knowledge of tribal and non tribal Learners

Category	Mean Scores		
	Declarative Knowledge	**Conditional Knowledge**	**Procedural Knowledge**
Tribal learners	8.6	4.8	3
Non Tribal Learners	10.6	6	4.3



When we compare the mean score of metacognitive knowledge of Tribal and Non tribal it is clear that Non tribal learners are superior to the Tribal learners in all the three components of metacognitive knowledge i.e. declarative metacognitive knowledge, conditional metacognitive knowledge and procedural metacognitive knowledge.

Table5: Summary of t- Test Showing Effects of ethnicity on Meta-cognitive knowledge in Science

Metacognitive Knowledge	Category	N	Mean	Std. Deviation	Mean Difference	t	df	Sig. (2-tailed)
Declarative Knowledge	Tribal	62	8.58	3.322	-2.056	-3.167	115	.002
	Non Tribal	55	10.64	3.699				
Conditional Knowledge	Tribal	62	4.81	3.420	-1.175	1.740		.087
	Non Tribal	55	5.98	3.885				
Procedural Knowledge	Tribal	62	2.98	3.262	-1.271	-2.083		.040
	Non Tribal	55	4.25	3.329				

From the above table we concluded that there is significant difference in the mean score of metacognitive knowledge of tribal and non tribal learners in science. This indicates an influence of ethnicity in the metacognitive knowledge with class.

Reasons of Difference in Metacognitive knowledge

The qualitative analysis of the answers provided a more comprehensive understanding of tribal and nontribal learners' understanding of science as well as their knowledge about their own cognitive abilities which are due to the interplay of ethnic culture and metacognition. To understand the cultural influence on metacognitive knowledge participant observation was done with the tribal community which enlightens the cultural distinctness of tribal community. One has to love tribal culture to understand the uniqueness of their culture.

Warm hospitality, simple ways of living and sincere judgment of the opinions are some of the traits that mark the tribal cultures of India. Their custom depicts their belief in simplicity. It is well known that expectations of stakeholders' from the learner have impact on learners educational accomplishment may be in either direction. From the analysis of scores and discussions among parents of the learners it is seen that due to low level of education among the tribal people, parental aspiration and expectation of educational performance is also less. Regarding the perception on education, the parents are saying that, they want their children to make some study so that s/he can see the world and stand with their own legs in future. None of them are saying that they want their child should get government job, but education will enable him to get a driving license or to be an assistant in any shop. When it was inquired that do they ask their children to study at home, many of them say that they seldom ask so. Further they say that their children never make any study at home. The analysis of interaction among family members reveals that there is less interaction among the family members. Many a time learners are afraid of the male members of the family and due to this they avoid them. As a result, possibility of discussion, reflection and argumentation among the family members is reduced. This is expected to be the reason of low cognitive development of learners of tribal community which is the prerequisite of metacognition in general and metacognitive knowledge in particular.

Findings and Conclusion

The major findings of the study are stated bellow

- All the three components of metacognitive knowledge i.e. declarative metacognitive knowledge, conditional metacognitive knowledge and procedural metacognitive knowledge are not found to be equal when all the sample of the study is concerned.
- Conditional metacognitive knowledge and procedural metacognitive knowledge of all the learners are comparatively lower than declarative metacognitive knowledge.
- Metacognitive knowledge of non tribal learners is superior to tribal learners in all the three components of metacognitive knowledge i.e. declarative metacognitive knowledge, conditional metacognitive knowledge and procedural metacognitive knowledge.

Educational Implication

Proper attention must be given to development of all components of metacognition in general and metacognitive knowledge in particular.

There is a need to change the school culture, by introducing of 3 Ds i.e. Dialogue, discourse and discussion.

Learners are to be given situation where s/he can be more and more inquisitive andask questions to himself or herself.

Conclusion

Metacognition is a much needed skill for twenty first century learners. it is the responsibility of the schooling system to make our learners metacognitive. Addressing the cultural issues in the instructional process can help the learners to cross the cultural barrier of learning, meaning making and reflecting. Finally to produce metacognitive learners our teachers must be reflective and metacognitive

References

Brown, A. L. (1980). Metacognitive development and reading. Theoretical issues in reading comprehension. R. J. Spiro, B. Bruce and W. Brewer. Hillsdale, NJ, Lawrence Erlbaum Associates.

Flavell, J. H. (1976). Metacognitive aspects of problem solving. In L. B. Resnick (Ed.), The nature of intelligence (pp. 231–235). Hillsdale, NJ: Erlbaum

Flavell, J. H. (1979). Metacognition and cognitive monitoring: A new area of cognitive-developmental inquiry. American Psychologist, 34, 906-911. http://psycnet.apa.org/record/1980-09388-001

Garro, L.C. (2000). Remembering what one knows and the construction of the past: A comparison of Cultural Consensus Theory and Cultural Schema Theory. Ethos, 28.3, 275-319.

Gutchess A.H., Schwartz A.J., Boduroğlu A. (2011) The Influence of Culture on Memory. In: Schmorrow D.D., Fidopiastis C.M. (eds) Foundations of Augmented Cognition. Directing the Future of Adaptive Systems. FAC 2011. Lecture Notes in Computer Science, vol 6780. Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-642-21852-1_9

Jaušovec, N. (1994). Metacognition in creative problem solving. *In M. A. Runco (Ed.),* Creativity research. Problem finding, problem solving, and creativity *(p. 77–95). Ablex Publishing*

Kristiani, N.et al.(2015) The contribution of learners' metacognitive skills and scientific attitude towards their academic achievements in biology learning implementing Thinking Empowerment by Questioning (TEQ) learning integrated with inquiry learning (TEQI). International Journal of Educational Policy Research and Review Vol.2 (9), pp. 113-120

Kuhn, D. & Dean, D. (2004). A bridge between cognitive psychology and educational practice. Theory into Practice, 43(4), 268-273.

Nayak, T.K., & Mohanty, M.M. (2016).Assessment of Meta-cognition in mathematics problem solving: Trends and issues. Prangnya, 6(1 & 2), 5-20.

NCERT (2006) National Focus Group on Teaching of Science. National Council of Educational Research and Training (NCERT), New Delhi

Nishida, H. (1999). Cultural Schema Theory: In W.B. Gudykunst (Ed.), Theorizing About Intercultural Communication, (pp. 401–418). Thousand Oaks, CA: Sage Publications, Inc.

Pintrich, P.R. (2004). A conceptual framework for assessing motivation and self-regulated learning in college students. Educational Psychology Review, 16, 385-407.

Schoenfeld, A. H. (1987). What's all the fuss about metacognition? In A. H. Schoenfeld (Ed.), Cognitive science and mathematics education (pp. 189-215). Hillsdale, New Jersey: Lawrence Erlbaum Associates.

Schoenfeld, A.H. (1992). Learning to think arithmetically; problem solving, metacognitive, and sense making in arithmetic's. In D.A. Grouws (Ed.), Handbook of research on arithmetic teaching and learning: A project of the National council of Teachers in Arithmetic (pp. 334-370). New York; Simon & Schuster.

Schneider, W. (2008). The development of meta-cognitive knowledge in children and better thinking: Developing student's meta-cognitive abilities. Journal of College Reading and Learning, 30 (1), 34ff.

Soto, N. E. (2016). The role of metacognition in promoting science learning and self regulation (masters dissertation, University of California). Retrieved from https://pqdtopen.proquest.com/doc/1821357677.html?FMT=AI

Zohar, A., & Barzilai, S. (2015). Metacognition and teaching higher order thinking (HOT) in science education: Learners' thinking, teachers' knowledge, and instructional practices. In R. Wegerif, L. Li & J. Kaufman (Eds.), Routledge international handbook of research on teaching thinking (pp. 229-242). Oxon, UK: Routledge