Metacognitive Awareness among Higher Secondary School Students

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Abstract

Metacognition is a process of knowing and regulating one's own cognition. It helps learners to achieve success in their learning. A metacognitively aware learner can better plan and apply his learning strategies. The objectives of the study were to assess the level of metacognitive awareness among higher secondary school students, and to compare their metacognitive awareness in relation to gender and their stream of study. A sample of 86 higher secondary students was selected using simple random technique. An inventory developed by Schraw and Dennison (1994) was used to measure the metacognitive awareness level of students. Descriptive survey method was adopted by the researchers to conduct the study. Researchers employed percentage, t-test and ANOVA to accomplish the objectives of the study. Findings reveals that majority of higher secondary students were found to possess high level metacognitive awareness. It was identified that boys and girls do not differ significantly in their metacognitive awareness. It indicates that gender does not affect the metacognitive awareness. Higher secondary students differ significantly on their metacognitive awareness in reference to their stream of study. Post hoc analysis (Scheffe test) showed that students of Mathematics and Biology were having higher metacognitive awareness than students of Commerce stream. No significant difference was found in between metacognitive awareness of students with Mathematics and Biology. Metacognitive awareness should be encouraged in the classroom to improve learning outcome of the students. Metacognitive awareness of students can be enhanced using innovative learning strategies such as, cooperative learning, reflective learning, and team learning.

Keywords: *Metacognitive awareness, higher secondary school students, metacognition.*

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Introduction

In this dynamic world merely acquiring knowledge is not enough for success. Success requires awareness, and regulation of self-knowledge and understanding, i.e., controlling self-cognition. Regulating self-cognition requires metacognitive skills. Metacognition is the ability to think about and regulate one's own thoughts. It is a process of awareness and regulation of one's own thinking. It is important for enhancing learning and developing higher order thinking skills in students. It encourages problem solving ability, critical, and reflective thinking among students. It is also helpful in building self-confidence and enabling learner to make quick decisions. It also enable learners to know about their learning strategies, and regulate the when and how of their strategies, the goal, and requirements of the task. It helps learners in becoming aware of their knowledge, and how to employ their knowledge and skills effectively in order to achieve better outcomes. Kuiper (2002) as cited in Memnuna and Akkaya (2009) stated that a learner who has certain level of self-regulation and strategies of metacognition gets better academic achievement (pp. 1919).

Metacognition is a process of thinking about one's own thinking process such as, knowing about own capabilities, study skills, memory and ability to monitor own learning, i.e., knowing and regulating own cognition. The structure of metacognition has two components—knowledge of cognition and regulation of cognition. Knowledge of cognition means how much an individual knows about own cognition, i.e., learning methods, memory, skills, goals, etc. Regulation of cognitions refers to how an individual uses skills and strategies to monitor and control own knowledge, and thinking to achieve objective successfully. By developing metacognition students can enhance their awareness and skill of monitoring cognition to improve their learning, and academic achievement.

Literature Review

Previous studies on metacognition have shown that metacognition plays an important role in improving students' learning outcome and the imperativeness to focus on students' level of metacognition. Students' academic performance is positively correlated with their metacognition and hence, recommended encouragement of more number of metacognitive activities in the classroom to improve their academic performance (Zulkiply, 2006). Higher secondary students were having high level of metacognitive awareness (Vaijayanthi,

2012) and it was suggested to use reflective strategies to encourage awareness of metacognitive strategies among students. Students who were taught through cooperative learning approach had higher metacognitive awareness (Jayapraba and Kanmani, 2013) and recommended to use cooperative learning approach to increase the metacognitive awareness of students. Students' metacognition was found as positively related with their achievement in Mathematics (Mareesh, 2015; Dhyani, 2019), achievement in Commerce (Singh, 2018), achievement of Arts stream students (Sonowal and Kalita, 2019), self-esteem (Singh, 2014), attitude towards Mathematics (Mareesh, 2015), and problem solving ability (Singh, 2014; Behera, 2009; Alindra, Fauzan and Asmar, 2019; Madanagopal, 2019). Problem solving ability of students can be improved if their level of metacognitive awareness is raised. Secondary school students had average level of metacognitive awareness (Jaleel and Premachandran 2016; Talekar and Fernandes, 2016). Higher secondary students were found to have average level of metacognitive awareness (Sabna and Hameed 2016; Kaur, 2017) and also observed that metacognition has positive influence on academic resilience. Students with good academic performance possess a high level of metacognition awareness (Guzman, 2017; Rangannavar and Shahapur, 2018). Metacognition has strong association with academic achievement of students (Nongtodu and Bhutia, 2017; Madanagopal, 2019; Ward and Butler, 2019) and students can perform better in their academic if metacognition will be encouraged among them. Use of metacognition in the classroom should be encouraged to improve the academic achievement of the students (Singh, 2018). Intelligence and achievement of students can be improved using metacognitive strategies in the classroom (Bala, 2019). Use of metacognition helps students to understand concepts clearly and solve problem efficiently and effectively (Dhyani, 2019). Students' metacognition was positively associated with self-concept, decision making, self-regulation and interpersonal skills (Madanagopal, 2019), and it was recommended that metacognition among students can improve through mindful-based cognitive training. Metacognitive awareness of students had a positive correlation with their motivation to learn (Siqueira et al., 2020) and indicated that if students are more metacognitively aware then they will be motivated to their learning. Students' writing style has a strong positive relation with metacognitive awareness (Ramadhanti and Yanda, 2021) and it was suggested

that students' writing skills can be improved by enhancing their level of metacognitive awareness. There was a poor correlation between metacognitive skills of students and their academic scores (Hassan et al., 2022), and it was suggested that there is a need to incorporate metacognitive awareness in students so that they can make use of metacognitive skills effectively. It will help them improve their academic scores.

After reviewing the above literature, it was found that metacognitive awareness of students plays an important role in improving their academic achievement. Metacognitive awareness makes students better problem solvers, improving their self-concept and enhancing their self-esteem. It helps them in becoming more regulated and a reflected learner. Most of the studies are co-relational in nature, and are conducted to know the relationship of metacognition with academic performance and other variables, but a few studies are there on assessing the level of metacognition. There is a scarcity of studies on understanding students' awareness about knowledge and the use of metacognition. Most of the studies on metacognition were conducted on science stream students. There was a scarcity of studies on commerce students. It is important to know the students' level of metacognitive awareness as a metacognitive aware student can plan and apply strategies more effectively, and are more motivated to learn. This in turn improves their academic performance. Therefore, it is crucial to know the level of metacognitive awareness of students. It helps in taking appropriate measures to enhance the level of students' metacognitive awareness and to improve the learning outcome.

Objectives

- To investigate the level of metacognitive awareness among higher secondary school students.
- To compare boys and girls of higher secondary school students on their metacognitive awareness.
- To compare metacognitive awareness of higher secondary school students in accordance to their stream of the study.

Hypotheses

- There is no significant difference between boys and girls of higher secondary school students on their metacognitive awareness.

- There is no significant difference among metacognitive awareness of higher secondary school students in accordance to their stream of study.

Sample

The Central Board of Secondary Education (CBSE) board English medium higher secondary schools that offer science and commerce stream were selected purposively from Bareilly city. The sample of the study comprised of 86 Class XII students. Both male and female students from mathematics, biology and commerce stream were selected randomly to accomplish research purpose. The simple random sampling method was adopted for selection of sample.

Tool Used

Metacognitive Awareness Inventory developed by Schraw and Dennison (1994) to assess the level of metacognitive awareness was applied to collect the data. The inventory measures metacognitive awareness on all aspects of metacognition—its knowledge and regulation. The inventory consists of 52 items to assess eight factors of two main components of metacognition, i.e., knowledge about cognition and regulation of cognition. Out of eight factors the 'knowledge' component consists of three factors—declarative knowledge, procedural knowledge and conditional knowledge, whereas the rest of five factors are classified into 'regulation' component which are planning, information management strategies, comprehension monitoring, debugging strategies, and evaluation.

Findings and Discussion

The first objective of the study was to know the level of metacognitive awareness among higher secondary students. In order to achieve the objective of the study, percentage and mean analysis were performed. The detail description of the data was given in Table 1.1.

Table 1.1: Level of Metacognitive Awareness of Higher Secondary Students (N=86)

S. No.	Level of Metacognitive Awareness	Range of Raw Score	Number of Students	Percentage
1.	High	192 and above	68	79.1
2.	Average	122–191	15	17.4
3.	Low	121 and below	3	3.5

The Table 1.1 shows the level of metacognitive awareness among higher secondary students. From Table 1.1, it was revealed that out of total 86 students from higher secondary schools, 68 students (79.1 per cent) had high, 15 students (17.4 per cent) had average, whereas only 3 students (3.5 per cent) had low level of metacognitive awareness. After analysis it was found that majority of students were having high level of metacognitive awareness. It means students are aware of their thought process and knows about regulating their learning strategies. It might be due to teachers adopting innovative teaching practices that encourage students to think, plan and evaluate their strategies. Also, in National Council Educational Research (NCERT) books some practice questions are given at the end of each chapter related to higher order thinking skills which encourage learners to use metacognition. The findings resemble with the findings of Vaijayanthi (2012), who also found a high level of metacognitive awareness among higher secondary students. But an average level of metacognitive awareness among higher secondary students was identified by Kaur (2017), and Sabna and Hameed (2016).

The Table 1.2 shows distribution of mean scores on different factors of metacognitive awareness inventory. They scored high on declarative knowledge component of knowledge about cognition dimension of metacognitive awareness. It indicates that students are more aware of self as a learner, i.e., skills, learning process, abilities, etc. Students obtained highest score on Information

Table 1.2 Dimension-wise Statistics of Metacognitive Awareness

S. No.	Awareness Factor	Mean	Standard Deviation
Knowledge about Cognition			
1.	Declarative knowledge	31.56	5.76
2.	Procedural knowledge	15.65	3.01
3.	Conditional knowledge	19.64	3.85
Regulation of Cognition			
4.	Planning	27.15	4.92
5.	Information management strategies	39.42	6.89
6.	Comprehension monitoring	27.28	4.32
7.	Debugging strategies	19.8	3.51
8.	Evaluation	23.38	4.31
Metacognitive awareness		**203.88**	**32.25**

management strategies component of regulation about cognition domain. It suggests that students are well aware of about how to manage information that they are receiving in the classroom. It was observed that higher secondary students were representing a high level of metacognitive awareness. It might be due to encouragement of metacognitive strategies, and use of innovative teaching strategies by the teachers of English medium schools in the classroom.

The second objective of the study was to compare boys and girls of higher secondary schools in relation to their metacognitive awareness. To achieve the objective t-test was employed.

The Table 2 reveals comparison of metacognitive awareness of higher secondary students on the basis of their gender. It was inferred that girls and boys do not differ significantly at 0.05 level of significance, on both the components of metacognitive awareness, i.e., Knowledge about cognition and regulation of cognition. Also no significant difference was observed on metacognitive awareness in terms of their gender. Hence, null hypothesis "there is no significant difference between boys and girls of higher secondary school students on their metacognitive awareness" was accepted. It indicates that girls and boys of English medium schools are equally aware of their metacognition. It might be because both girls and boys of English medium schools are provided with equal opportunities and encouragement to become more competent in using their metacognition, and to achieve the success. One more reason might be that in urban families both the genders are provided with equal availability of learning resources, and opportunities to explore their skills. Vaijayanthi (2012) also identified that higher secondary students do not differ significantly on metacognitive

Table 2: Comparison between Boys and Girls on Metacognitive Awareness

Factors of Metacognitive awareness	Boys (N=45)		Girls (N=41)		Level of Significance	t-value	Remark
	Mean	S.D.	Mean	S.D.			
Knowledge about cognition	68.64	11.2	64.88	12.15	0.05	1.49	NS
Regulation of cognition	139.33	21.67	134.51	20.49		1.06	NS
Metacognitive awareness	207.98	32.32	199.39	31.97		1.24	NS

NS=Non-Significant

Table 3.1: Comparison of Metacognitive Awareness of Students with Regard to Stream (Mathematics, Biology and Commerce)

Source of Variation	Sum of Square	Df	Mean Sum of Square	F-value	F critical
Between group	11512.07	2	5756.037	6.212**	4.87
Within group	76908.76	83	926.6116		
Total	88420.84	85			

***Significant at 0.01 level of significance*

awareness level on the basis of gender. Contradictory result was obtained by Sabna and Hameed (2016), and Singh (2014) where Sabna and Hameed found that girls had higher metacognitive awareness than boys of higher secondary school. Singh found that male students scored better on metacognition than female senior secondary school students.

The third objective of the study was to compare metacognitive awareness of higher secondary school students in accordance to their stream of the study. In order to compare the metacognitive awareness of students the analysis was done by adopting ANOVA.

The Table 3.1 clearly shows that the calculated F-value (6.212) was significant at 0.01 significance level. It was inferred that the mean scores of students differs significantly in relation to their stream of study. Therefore, the null hypothesis was not accepted. It indicates that the choice of subjects is related to metacognitive awareness of students. Maneesha and Ahmad (2021) identified that metacognition had significant effect on choice of subjects. Since a significant F-value was obtained, Post hoc test (Scheffe) was performed for further analysis.

From Table 3.2, it is inferred that the students with Mathematics and Commerce differ significantly at 0.01 level of significance.

Table 3.2: Comparison of Metacognitive Awareness in Relation to their Stream of Study (Scheffe test)

Mean Scores			Mean Difference	F-value
Mathematics	**Biology**	**Commerce**		
210.12	209.92	-	0.2	0.00068
210.12	-	182.16	27.96	10.96**
	209.92	182.16	27.76	9.13*

***Significant at 0.01 level of significance*

Mean value indicates that Mathematics students scored better than Commerce students on metacognitive awareness. Mean values of both groups indicates that Mathematics students were having high level while Commerce students were having average level of metacognitive awareness. Students with Biology and Commerce also differs significantly at 0.05 level of significance. Mean scores interpretation signified that Biology students were possessing high metacognitive awareness while Commerce students were having average metacognitive awareness level. No significant difference was found between mean scores of higher secondary students of Mathematics and Biology. Both were having high level of metacognitive awareness. Nongtodu and Bhutia (2017) also found that science stream students had high metacognition than Commerce students. It might be due to use of learning approaches used by Mathematics and Biology students such as, problem solving, project-based, and inquiry-based that enhance their cognitive skills and abilities. Mathematics and Biology students might have high cognitive abilities. The choice of subjects might influence metacognitive skills of students. Maneesha and Ahmad (2021) found that students with high metacognition prefers science stream more than commerce stream.

The Table 4.1 shows stream-based comparison of metacognitive awareness of higher secondary students on knowledge about cognition. After analysis a significant value of F (5.09) was obtained at 0.01 level of significance. It was inferred, that mean scores of students differs significantly in relation to their stream of study. It suggests that students with Mathematics, Biology and Commerce vary in their knowledge of cognitive abilities.

Since a significant F-value was obtained, further analysis was performed through Post hoc analysis (Scheffe test).

Table 4.1: Comparison of Students with Regard to their Stream (Mathematics, Biology and Commerce) on Awareness to Knowledge of Cognition

Source of Variation	Sum of Squares	Df	Mean Sum of Squares	F-value	F critical
Between group	1282.17	2	641.0851	5.09**	4.87
Within group	10450.86	83	125.914		
Total	11733.03	85			

***Significant at 0.01 level of significance*

Table 4.2: Scheffe Test to Compare Students on Knowledge about Cognition in Relation to Stream

Mean Scores			Mean difference	F-value
Mathematics	Biology	Commerce		
68.561	69.423	-	0.862	0.094
68.561	-	59.632	8.929	8.222*
-	69.423	59.632	9.791	8.359*

**Significant at 0.05 level of significance*

The Table 4.2 demonstrates mean scores of higher secondary students on knowledge about cognition component of metacognitive awareness with respect to their stream of study. It was inferred from the table that the mean score of higher secondary students of Mathematics and Biology were found significantly higher than that of students with Commerce stream at 0.05 level of significance. No significant difference was recognised in between mean scores of higher secondary students with Mathematics and Biology. It shows that students of Mathematics and Biology are more aware of their cognitive abilities, skills, goals, etc., than Commerce students. It might be because Science students have more opportunities to explore their knowledge and skills, as science is practical subject included experimentation and analysis.

The Table 5.1 shows stream-based comparison of metacognitive awareness of higher secondary students on regulation of cognition. After investigation the calculated F-value (6.52) was found to be significant at 0.01 significance level. It was concluded that Biology, Mathematics and Commerce students differ significantly on their metacognitive awareness. It indicates that the aptitude of students

Table 5.1: Comparison of Students with Regard to their Stream (Mathematics, Biology and Commerce) on Awareness to Regulation of Cognition

Source of Variation	Sum of Squares	Df	Mean Sum of Squares	F-value	F critical
Between group	5151.561	2	2575.78	6.52**	4.87
Within group	32811.33	83	395.3173		
Total	37962.9	85			

***Significant at 0.01 level of significance*

Table 5.2: Comparison among Mathematics, Biology and Commerce Students in Terms of Regulation of Cognition

Mean Scores			Mean difference	F-value
Mathematics	Biology	Commerce		
141.561	140.5	-	1.061	0.045
141.561	-	122.526	19.035	11.9**
-	140.5	122.526	19.974	8.971*

***Significant at 0.01 level of significance*

affect their metacognition. Students of Mathematics, Biology and Commerce vary in their approaches of planning, comprehending and managing information.

Since a significant F-value was obtained, Post hoc test (Scheffe test) was performed.

The Table 5.2 exhibits comparison of higher secondary students on regulation of cognition component of metacognition with regard to stream of study. It was investigated that mean scores of higher secondary students with Mathematics were significantly higher than that of Commerce stream. The difference was found significant at 0.01 level of significance. Students with Biology and Commerce differ significantly at 0.05 level of significance. No significant difference was identified in between mean scores of higher secondary students with Mathematics and Biology. It means that students with Mathematics and Biology are more aware of managing and regulating their thought process and learning strategies than Commerce students. This might be because students of higher academic scores prefer Mathematics and Biology more than Commerce. Many studies found a positive relationship between academic performance and metacognition (Zulkiply, 2006; Mareesh, 2005; Guzman, 2017; Nongtodu and Bhutia, 2017; Rangannavar and Shahapur, 2018; Sing, 2018; Dhyani, 2019; Madanagopal, 2019). One of the reasons might be the aptitude of students. Students with high metacognitive skills prefer Mathematics and Biology than Commerce. Maneesha and Ahmad (2021) found that students with high metacognition prefer Science stream more than Commerce stream. Learning strategies adopted by Mathematics and Biology students involves exploration of their skills, and cognitive abilities which also improve their level of metacognitive awareness.

Conclusion

The present study explored the metacognitive awareness among higher secondary students. The data revealed that students were having high level of metacognitive awareness. It means that students are aware of self-thought process and cognition. They are aware on how to regulate their learning strategies. It was identified after analysis that metacognition is independent of gender. No statistical difference was found in metacognitive awareness of boys and girls of higher secondary schools. A higher metacognitive awareness was observed among Mathematics and Biology students in comparison to Commerce students. No statistical difference was obtained in between metacognitive awareness of Mathematics and Biology students. Metacognitive awareness of students could be improved using innovative learning strategies that stimulate higher order thinking among students. Level of metacognitive awareness can also be improved by encouraging metacognitive activities and metacognitive modeling in the classroom. According to Kuiper (2002), learner who has a certain level of self-regulation and strategies of metacognition gets better academic achievement (Memnuna and Akkaya, 2009).

Educational Implications of the Study

Metacognitive awareness enables student to be more aware of what, why and how of they are doing. They will be well aware of what strategies to apply to achieve the goal efficiently. Metacognitive awareness enables students to regulate their learning. So that they can plan, monitor, evaluate and modify their learning strategies. Students will perform better in their academics if metacognition among them will be encouraged (Nongtodu and Bhutia, 2017). Findings of the present study have its educational implications for students, teachers and other stakeholders.

Implications for Student

It was identified in the study that students of Science stream are more metacognitive aware than Commerce students. All students need to understand the importance of metacognition in improving their academic performance. They need to use metacognitive learning strategies like concept mapping to understand concept more clearly. The findings indicated no significant difference in level of metacognition on the basis of gender but mean scores show that boys were having high score on knowledge of cognition, regulation

of cognition and on metacognitive awareness. Metacognition is equally important for both girls and boys, and hence, needed by all to do activities and problems based on application of higher order thinking skills.

Implications for Teachers

The findings showed no significant difference in level of metacognition on the basis of gender but it indicated that metacognition is equally important for all irrespective of gender. On observing mean scores it was identified that boys scored higher on knowledge of cognition, regulation of cognition and on metacognitive awareness. Therefore, it is necessary to make girl students more aware about the concept of metacognition. Their knowledge and regulation of cognition can be enhanced by demonstrating the use of metacognition by the teachers in the classroom. Metacognitive awareness can be encouraged in the classroom using innovative strategies which encourages reflection among students. Teaching strategies that encourage reflection among students might be used in the classroom to enhance their metacognitive awareness.

In the present study, it was found that Commerce students were having low metacognitive awareness than Science stream students. In this way, there is a need to make Commerce students aware about metacognition. They could be facilitated by the teachers to use metacognitive strategies in their learning. About 20.9 per cent students were found to have average and low level of metacognitive awareness. There is need to use techniques to improve students metacognitive awareness. Students could be provided with curricular and co-curricular experiences to improve their metacognitive awareness. Teachers can demonstrate use of metacognitive strategies to encourage use of metacognition by students. Teachers could use approaches to deliver curriculum that incorporates metacognitive awareness by students in their learning. Use of innovative strategies like concept mapping, scaffolding, thinking aloud, flipped classroom, etc., should be encouraged in the classroom to enhance use of metacognition by the students. Students should be provided with the understanding of use of metacognition and its importance in learning. Metacognitive awareness encourages students to use their metacognitive abilities and skills for better achieving learning goals, and to improve their learning outcome.

Implications for Other Stakeholders

About 20.9 per cent higher secondary students were found to have average and low level of metacognitive awareness. Curriculum makers are needed to put more focus on including more content, practice questions and activities in the curriculum that encourage use of metacognition in the classroom. The activities which encourage use of higher order thinking skills by both teachers and students should be included in the curriculum. It is important to raise the level of teachers' metacognitive awareness to enhance the metacognitive awareness of students. Hence, it is needed to organise orientation programmes, seminars, and workshops for teachers on metacognition and metacognitive strategies. Commerce students were found to have low metacognitive awareness than Science stream students. It is needed to incorporate metacognition based content and activities in Commerce curriculum. More activities involve reflection and critical thinking could be added into the curriculum.

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