'Knowing about Knowing and Learning about Learning'

Metacognitive Awareness as a Predictor of Academic Achievement

Kathryn Rai* and Rajinder Singh**

Abstract

This paper studied the metacognitive awareness and academic achievement of science and humanities students. Metacognitive awareness has been investigated with special reference to its components, i.e., knowledge of cognition and regulation of cognition, which are further divided into three and five subcomponents, respectively. Data has been collected from 490 Grade 12 school students. The major findings indicated that metacognitive awareness varies significantly between males and females with respect to the sub-components declarative knowledge, procedural knowledge, information management strategies, debugging strategies and planning but not on the overall MAI scores. Also, the results revealed that science students possess better metacognitive awareness than humanities students, with their scores being significantly higher in procedural knowledge and planning. The correlation analysis showed that there is a strong association between metacognitive awareness and academic achievement and the prediction analysis showed that metacognitive awareness can be a significant predictor of academic achievement. This study alerts the teaching community to the necessity of helping students develop metacognitive components and teaches them how to recognise themselves as learners. In order to frame teaching-learning settings appropriately, more study on the metacognitive awareness of students from various academic streams is also necessary.

Keywords: *Metacognition, metacognitive awareness, cognition, academic achievement, school students*

**Research Scholar,* Department of Education, Tezpur University, Napam, Tezpur, Assam.
***Assistant Professor,* Department of Education, Central University of Himachal Pradesh, Dharamshala, Himachal Pradesh.

Introduction

Ever since the idea of metacognition was introduced into the field of educational psychology by John Flavell in the late 1970s, it has attracted a lot of attention from researchers. The concept's role in the teaching and learning process is still being investigated from various angles across a variety of disciplines (Feiz, 2016). The major goals of research in metacognition are to understand how learners monitor and regulate their cognition and what they know about their own cognition (regulation of cognition). Flavell (1976) states that it is "the knowledge one has of their own cognitive processes and products or anything related to them." It is a self-regulatory mechanism that encourages people to consider the what, how and why of their actions. In simple words he refers to it as 'thinking about thinking' or 'cognition about cognition'.

Different psychologists and researchers present the definitions of metacognition according to their understanding of it. For Cross and Paris (1988) it is "the knowledge and control children have over their own thinking and learning activities". Paris and Winograd (1990) refer to it as "reflections about what you know, how you think and when and why to apply those knowledge strategies". Schraw and Moshman (1995) refer to it as "an individual's ability to know and regulate cognitive processes". For McLeod (1997) it is "a form of executive control involving monitoring and self-regulation".

Indian researchers like Balya and Khimnani (2011); Narang and Saini (2013); Tali and Dar (2014); Najar and Baliya (2015); Sawhney and Bansal (2015); Jaleel and Premachandran (2016); Taleker and Fernandes (2016); Gharial et al. (2017); Gupta (2017); Sarwer and Govil (2017); Nadaf et al. (2019); Sindhwani and Rakhi (2019); Rasool and Bhat (2020); Pradhan and Das (2021); Acharya (2021); Basu and Dixit (2022); Mir and Peerzada (2022); Hossain and Chowdhury (2023) have also worked in the field of metacognition taking participants from schools and colleges. Despite the presence of numerous researchers working on this area of cognition, it is important to recognise that there is still a dearth of research on metacognition in India in comparison to other nations.

Research conducted in the field of metacognition posits that the first step in fostering metacognition in students is making them aware of its existence that it is higher level thinking that differs from cognition and that it can help them to perform better in class. This awareness encourages students to plan, manage and direct their learning (Wenden, 1998). Students who are metacognitively aware are more strategic and achieve better than those who are not (Pressley and Ghatala, 1990) and can plan and track their learning better (Schraw and Dennisson, 1994). Additionally, it assists individuals in controlling their learning progress, diagnosing and understanding when and why they are not learning effectively, and determining whether a change in

learning strategy is necessary and if so, which strategy to use in order to enhance their learning results (Alexander, 2008). Not only that, metacognitive awareness was also found to be related with decision making in Basu and Dixit's (2022) study, wherein knowledge of cognition component was positively associated with intuitive and spontaneous decision-making styles, and regulation of cognition with rational decision-making style. Metacognitive thinking also has a chief impact on moral reasoning and emotional maturity of adolescents as shown in Negi et al.'s (2022) study, wherein they found that as metacognitive levels become higher, so do moral reasoning and emotional maturity.

All of these studies lead us to understand that metacognition along with its two components are very important in the learning process and development of an individual. Knowledge about cognition refers to individuals' understanding of their own cognitive processes as well as cognition in a broader sense, including the strategies they employ and the optimal situations under which these strategies are most effective. On the other hand, regulation of cognition encompasses their ability to regulate and monitor their learning processes (Flavell 1987). According to Schraw and Dennison (1994) planning, information management strategies, comprehension monitoring, debugging strategies and evaluation are all sub-components of regulation of cognition while declarative knowledge (knowledge about oneself and about strategies), procedural knowledge (knowledge about how to use strategies) and conditional knowledge (knowledge about when and why to use strategies) are sub-components of knowledge of cognition. These two key elements are cited as constituting metacognition in contemporary studies. In actuality, the Schraw and Dennison (1994) two-component model has been widely acknowledged and approved in a number of research. It is utilised in this study as well.

Rationale of the Study

We know that the National Educational Policy (NEP) 2020 marks the most recent and significant advancement in India's educational system (Kumar, 1998). The main goal of the NEP-2020 is to place India as a 'global knowledge superpower'. The document mentions that it is essential that kids not only learn but more crucially, understand 'how to learn', given how swiftly the employment environment and the global ecology are changing. By saying that children need to know how to learn, the NEP-2020 is demonstrating a recognition and appreciation for the significance of metacognitive awareness in education. The statement is suggesting that children must be taught and trained on how to regulate their learning hence, enhancing their overall learning capabilities.

The NEP-2020 also mentions that the main goal of curriculum and pedagogy reform at all educational

levels and in all subject areas should be to shift the focus of the education system towards meaningful understanding and helping students to become autonomous and independent learners, while moving away from the prevalent practise of memorisation. This means that teachers are just facilitators in the learning process and students are the key constructors of knowledge. They should be able to plan, monitor and evaluate their learning processes by themselves such that, they can utilise these abilities in the long run and understand themselves as learners not now, not just today but as long as they live. Even existing literature agrees with the fact that metacognition is a core competency that students in Grades XI and XII should acquire. This skill is important as it integrates various foundational competencies, including attitudes, skills and knowledge, which are essential for students to learn at the school, class and subject level (Kemendikbud, 2013).

Given this information, the present study was formulated with the aim of contributing to the existing body of research on the benefits of metacognition and to examine, if at all, it has any influence on students' academic achievement. Through this study, the individual learners themselves may benefit by knowing how well they know about their own learning processes. Teachers may also benefit by recognising that these variances might have an impact on training, instruction and knowledge acquisition. If metacognition has a positive influence on students' academic achievement then it can surely assist educators in establishing a highly effective learning environment by incorporating metacognitive strategies in the classroom.

Objectives

(i) To identify the metacognitive awareness and academic achievement levels of senior secondary students.

(ii) To find out if metacognitive awareness differs across gender and stream of study.

(iii) To find out if academic achievement differs across gender and stream of study.

(iv) To investigate the relationship between metacognitive awareness and academic achievement.

(v) To investigate if metacognitive awareness can be a significant predictor of academic achievement.

Materials and Methods

Research Method

The descriptive survey method was adopted to study the metacognitive awareness of senior secondary students. In addition, this study adopted a correlational research design, which helps to uncover the connections between independent and dependent variables as well as assess the independent variables' ability to predict the dependent variable (Creswell, 2012).

Population

The total population consisted of 980 senior secondary students of Grade XII only from 17 schools in the Gangtok and Gyalshing districts of Sikkim. Out of 980 students, 410 are science students and 570 are humanities students.

Sample and Sampling Technique

The participants for the survey consisted of 490 senior secondary school students selected by stratified random sampling technique (non-proportional). In non-proportional stratified sampling technique, the exact proportion of the strata to the total population is not considered. In this case, to ensure adequate representation of population, 50 per cent of the students from each strata were selected for the study because the population is around 1000 only (Gay and Mills, 2019). The flowchart showing the sampling technique and determination of final sample size is as shown below:

Research Instrument

The metacognitive awareness questionnaire by Schraw and Dennison (1994) was administered to the students. The questionnaire consists of a total of 52 items— 17 items assessing the knowledge of cognition and 35 items assessing the regulation of cognition. The 3 sub-dimensions for knowledge of cognition include declarative knowledge (8 items), procedural knowledge (4 items) and conditional knowledge (5 items) while the 5 sub-dimensions for regulation of cognition include planning (7 items), information management (9 items), debugging (5 items), monitoring (8 items) and evaluation (6 items). The statements are scored either as 1 or 0. A total score for metacognitive awareness is obtained by adding the scores of all 52 items. For each metacognitive dimension, the scores on the dimensions are totalled.

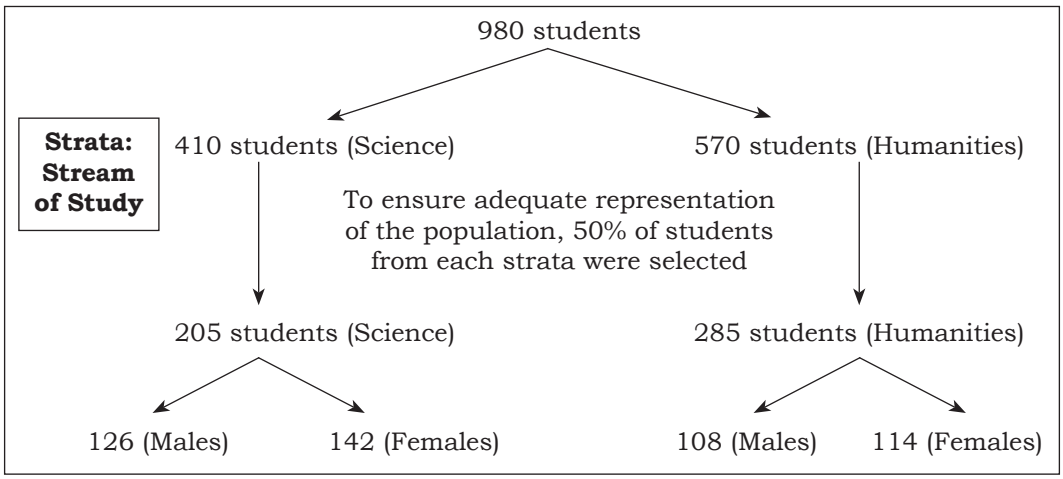

Fig. 1: Sample and Sampling technique

Table 1: Showing Dimension of Metacognitive Awareness, its Sub-dimension and the Corresponding Item Numbers

Dimension of Metacognitive Awareness	Sub-dimension	Items
Knowledge of cognition	Declarative knowledge	5,10,12,16,17,20,32,46
	Procedural knowledge	3,4,27,33
	Conditional knowledge	15,18,26,29,35
Regulation of cognition	Planning	4,6,8,22,23,42,45
	Information management	9,13,30,31,37,39,41,43, 47,48
	Monitoring	1,2,11,21,28,34,49
	Debugging strategies	25,40,44,51,52
	Evaluation	7,19,24,36,38,50

The internal consistency of the instrument was found to be 0.815, which indicates high internal consistency. The reliability coefficient of the metacognitive awareness inventory by test-retest method was found to be 0.865 for knowledge of cognition, 0.878 for regulation of cognition and 0.885 for the overall metacognitive awareness inventory, indicating that the MAI in Sikkim's context has high reliability. The academic achievement scores of the students were taken from their mid-term unit test reports. The total marks of the test was 50.

Findings

Objective 1: To find out the metacognitive awareness and academic achievement levels of senior secondary students.

Table 2 shows that majority of the students despite their gender and stream of study possess high metacognitive awareness with very less students showing low metacognitive awareness, while Table 3 shows that majority of the students fall in the average category of academic achievement. However, when we look at the descriptive numbers on high

Table 2: Metacognitive Awareness Levels of Senior Secondary Students

Metacognitive Awareness	Gender				Stream of Study			
	Males	%	Females	%	Science	%	Humanities	%
High	193	82.48	220	85.94	176	85.85	237	83.16
Average	40	17.09	35	13.67	28	13.66	47	16.49
Low	2	0.85	0	0	1	0.49	1	0.35
Total	234	100	256	100	205	100	285	100

Table 3: Academic Achievement Levels of Senior Secondary Students

Academic Achievement	Gender				Stream of Study			
	Males	%	Females	%	Science	%	Humanities	%
High	19	8.12	50	19.53	48	23.41	21	7.37
Average	179	76.50	196	76.56	156	76.10	219	76.84
Low	36	15.38	10	3.91	1	0.49	45	15.79
Total	**234**	**100**	**256**	**100**	**205**	**100**	**285**	**100**

academic achievement, we find that the number of females who show high achievement are more than that of males. Similarly, science students who show high achievement are more in number than the humanities students.

Objective 2: To find out if metacognitive awareness differs across gender and stream of study.

The descriptive statistics on the available data show that the means of metacognitive awareness scores and academic achievement scores are centred around 39.66 and 28.10, respectively. The skewness values of both the variables lie between the accepted values of −1 to 1. The kurtosis values also lie within the accepted range of −3 to 3.

Table 5 compares the metacognitive awareness scores according to gender and the result shows that there is no significant difference between the mean scores of males and females in the case of knowledge of cognition and regulation of cognition components

Table 4: Descriptive Statistics

	Metacognitive Awareness	Academic Achievement
Mean	39.66	28.10
Skewness	−0.524	0.277
Kurtosis	0.378	0.268

Table 5: Comparison of Metacognitive Awareness Scores According to Gender

	Gender	Mean	SD	*p* value
Knowledge of cognition	Females Males	12.28 12.47	2.91 2.71	**0.45**
Regulation of cognition	Females Males	27.64 26.90	4.09 4.52	**0.06**
Metacognitive awareness	Females Males	39.92 39.37	5.71 6.50	**0.32**

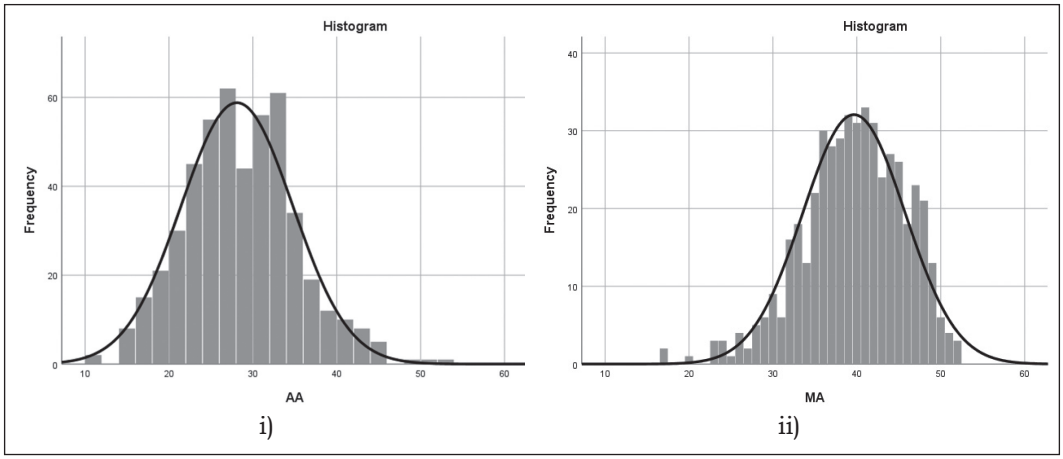

Fig. 2: Normality curves of
i) Metacognitive awareness scores ii) Academic achievement scores

and also on the overall metacognitive awareness scores.

Table 6 compares the metacognitive awareness scores between the students of two academic streams and the result shows that science students possess a significantly higher metacognitive awareness than humanities students. The former also have significantly better regulation of cognition than the latter.

Table 7 compares the subcomponent scores of each metacognition component (knowledge of cognition and regulation of cognition) between the males and females. The results show that there is significant difference between males and females with reference to declarative knowledge and procedural knowledge subcomponents of knowledge of cognition and with reference to information management strategies, debugging strategies and planning of regulation subcomponents of regulation of cognition.

Table 6: Comparison of Metacognitive Awareness Scores According to Stream of Study

	Gender	**Mean**	**SD**	***p* value**
Knowledge of cognition	Science Humanities	12.45 12.31	2.75 2.87	0.57
Regulation of cognition	Science Humanities	28.17 26.65	3.75 4.58	0.01**
Metacognitive awareness	Science Humanities	40.62 38.96	5.29 6.53	0.01**

***Significant at 0.01 level of significance*

Table 7: Comparison of Subcomponent Scores of Knowledge of Cognition and Regulation of Cognition According to Gender

Metacognitive Awareness Component	Sub-component	Gender	Mean	SD	*p* value
Knowledge of cognition	Declarative knowledge	Females Males	6.26 5.50	1.16 1.06	**0.001****
	Procedural knowledge	Females Males	3.70 4.02	0.76 0.65	**0.027***
	Conditional knowledge	Females Males	4.48 4.22	0.97 0.86	**0.161**
Regulation of cognition	Information Management strategies	Females Males	7.32 8.38	1.93 1.32	**0.002****
	Debugging strategies	Females Males	4.38 4.04	0.75 0.78	**0.029***
	Planning	Females Males	5.70 4.82	1.04 1.21	**0.001****
	Comprehension monitoring	Females Males	5.58 5.90	1.01 1.15	**0.14**
	Evaluation	Females Males	4.72 5.08	0.93 0.97	**0.06**

**Significant at 0.05 level of significance*
***Significant at 0.01 level of significance*

Table 8 compares the subcomponent scores of each metacognition component (knowledge of cognition and regulation of cognition) between the two streams of study. The results show that there is significant difference between science and humanities students with reference to procedural knowledge subcomponent only of knowledge of cognition and planning subcomponent only of regulation of cognition.

Table 8: Comparison of Subcomponent scores of Knowledge of cognition and Regulation of Cognition According to Stream of Study

Metacognitive Awareness Component	Subcomponent	Gender	Mean	SD	*p* value
Knowledge of cognition	Declarative knowledge	Science Humanities	6.02 5.74	1.12 1.21	**0.23**
	Procedural knowledge	Science Humanities	4.14 3.58	0.61 0.73	**0.001****
	Conditional knowledge	Science Humanities	4.44 4.26	0.91 0.94	**0.33**

Regulation of cognition	Information management strategies	Science Humanities	8.02 7.68	1.72 1.74	**0.33**
	Debugging strategies	Science Humanities	4.08 4.34	0.67 0.87	**0.097**
	Planning	Science Humanities	5.60 4.92	0.99 1.31	**0.004****
	Comprehension monitoring	Science Humanities	5.84 5.64	1.13 1.05	**0.36**
	Evaluation	Science Humanities	5.04 4.76	0.81 1.08	**0.145**

***Significant at 0.01 level of significance*

Objective 3: To find out if academic achievement differs across gender and stream of study.

Table 9 reveals that the academic achievement scores of females are significantly higher than that of males and Table 10 reveals that the academic achievement scores of science students are significantly higher than that of humanities students.

Objective 4: To investigate the relationship between metacognitive awareness and academic achievement.

Table 11 shows a significant positive correlation between metacognitive awareness and academic achievement

Table 9: Comparison of Academic Achievement Scores According to Gender

	Gender	Mean	SD	*p* value
Knowledge of cognition	Females Males	29.84 26.19	6.03 6.78	0.001**

***Significant at 0.01 level of significance*

Table 10: Comparison of Academic Achievement Scores According to Stream of Study

	Stream of study	Mean	SD	*p* value
Knowledge of cognition	Science Humanities	31.12 25.92	5.55 6.53	0.001**

***Significant at 0.01 level of significance*

Table 11: Correlation between Metacognitive Awareness and Academic Achievement

		Metacognitive Awareness	Academic Achievement
Metacognitive awareness	Pearson Correlation	1	0.691
	Sig. (2-tailed)		0.000**
Academic achievement	N	490	490
	Pearson Correlation	0.691	1
	Sig. (2-tailed)	0.000**	
	N	490	490

***Correlation is significant at the 0.01 level (2-tailed)*

with a pearson correlation coefficient of 0.691 that is significant at the 0.01 level of significance.

Objective 5: To investigate if metacognitive awareness can be a significant predictor of Academic achievement among senior secondary students.

Table 12 shows that our regression model can predict 47.8 per cent variance in the academic achievement scores of the subjects under study, which means that metacognitive awareness is a significant predictor of academic achievement.

Table 13 shows the regression coefficients of the model which

Table 12: Regression Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.691	0.478	0.477	4.809

Table 13: Regression Coefficients[a]

Model		Unstandardised Coefficients		Standardised Coefficients	t	Sig.
	B	Std. Error	Beta			
1	(Constant)	-1.796	1.432		-1.255	0.210
	Metacognitive Awareness	0.754	0.036	0.691	21.126	0.000

[a]*Dependent variable: Academic achievement*

predict that there can be a 0.75 unit increase in academic achievement scores with every one unit increase in metacognitive awareness scores of the students.

Discussion

This study shows that:

1. There is no significant difference between male and female students in the metacognitive awareness scores.
2. Science students show significantly higher scores than humanities students in total metacognitive awareness and in the regulation of cognition component.
3. Females show significantly better academic achievement than males.
4. Science students show significantly better academic achievement than humanities students.
5. There is a significant positive correlation between metacognitive awareness and academic achievement.
6. Metacognitive awareness can be a significant predictor of academic achievement.

There are no significant differences between male and female students in the mean scores of total metacognitive awareness and its components. This result resonates with the findings of Veloo et al. (2015); Limueco and Prudente (2018); Bakkaloglu (2020) who concluded the same. Studies conducted in India by Rani and Govil (2013); Devi (2014); Jaleel and Premachandran (2016) also show that metacognitive awareness is not affected by gender. In the case of recent studies conducted by Bulut (2021), Yuksel et al. (2021) and Asy'ari et al. (2022) on school students, there are no significant differences but the mean scores of the females are higher than their counterparts. Gunes's (2021) study, on the contrary, shows that females in upper secondary schools have significantly higher metacognitive awareness than males, while Sevgi and Karakaya (2020) report that males have significantly better metacognition awareness than females.

The sub-component scores of knowledge of cognition show that that there is significant difference between the two genders with reference to declarative knowledge and procedural knowledge. Also, the sub-component scores of regulation of cognition show that there is significant difference between the two genders with reference to information management strategies, debugging strategies and planning. Declarative knowledge means having an idea about what to learn, procedural knowledge means to know the procedure of how to do a given task and conditional knowledge means knowing in which condition what information to use (Schraw and Moshman, 1995). This means that according to this study, females significantly know better than males what to learn and how to learn but

the knowledge of conditions in which to utilise the information learnt is the same for both genders. Sukarelawan and Sriyanto (2019) reinforce this finding by predicting that female students have a more dominant metacognitive knowledge than male students. Also, the results for regulation of cognition component show that females are significantly better at utilising information management strategies to achieve their cognitive goals, in debugging their strategies according to their cognitive needs and in planning. Nunaki et al. (2019) also indicated that female students can self-monitor and plan better as compared to male students. In contrast to this, Aljaberi and Gheith's (2015), and Alghamdi et al. (2020) found out that males scored significantly higher in procedural knowledge, conditional knowledge, planning, comprehension monitoring and information management strategies. This leads to the conclusion that metacognitive awareness for different genders may or may not differ and this finding might motivate educators or teachers to treat all students equally in terms of classroom activities and assignments, regardless of gender.

The other significant finding is that science students have considerably better cognitive regulation and overall metacognitive awareness than humanities students. This explains that the knowledge of cognition related to thinking processes such as self-concept of knowledge, self-memory, attention, etc., is the same for both groups and regulation of cognition that includes mechanisms through which a person regulates thinking such as, planning, orientation, testing, monitoring, reflecting and evaluating, etc., is higher among science students than humanities students. This may be because science incorporates more practical activities, demonstrations, model-making, discussions and debates, experiments, and reflections in their pedagogy, which improves students' metacognition (Baird, 1986).

Significant disparities between science and humanities students were seen in procedural knowledge and planning sub-components. This might be because science students are noticeably more adept at approaching and completing tasks (Aljaberi and Gheith, 2015). Also, they are better able to plan out their approaches to activities and problem-solving. This result is similar to the results of a study conducted by Taran and Nalla (2019) on high school students majoring in science. Jahangard et al. (2016), made a similar observation, predicting that improving students' capacity to organise, manage and assess their own learning would have a positive impact on their ability to learn science. This is further explained by Chan et al. (2021), who claims that students who use metacognitive regulation techniques like planning, monitoring and assessing do so in a way that enhances their

attitudes towards all cognitive tasks. Additionally, according to Sukarelawan and Sriyanto (2019), science students would approach projects as problems and attempt to solve them using their problem-solving skills, which in turn requires them to strategically prepare their solutions. This could be one of the factors that contributed to the high metacognitive awareness scores among science students.

The analysis also shows that a significant positive correlation exists between metacognitive awareness and academic achievement. Also, metacognitive awareness is shown to predict 47.8 per cent variance in the academic achievement scores. There are very limited number of prediction studies on metacognitive awareness and academic achievement. However, this finding can be discussed in light of the fact that there is a strong positive association between them (Abdellah, 2015; Bogdanovic et al., 2017) and that metacognitive training can increase their learning abilities and greatly raise their academic accomplishment (Nbina, 2012). Some studies, like those done by Narang and Saini (2013), Ibrahim et al. (2017), Pradhan and Das (2021); Mir and Peerzada (2022); Hossain and Chowdhury (2023) revealed that metacognitive strategies are one of the key foundations of academic performance and that metacognition is significantly and positively associated with academic achievement.

Conclusion

The development of effective, lifelong learners is one of the chief objectives of education in schools. Students must also be taught to recognise their own growth as learners in addition to this. This will enable them to govern and regulate their own learning. They will be able to assess themselves more accurately. To improve their academic achievement, students from all disciplines should become more aware of who they are as learners and learn how to control and organise their learning activities.

In the light of the results obtained from the study, the following educational implications have been derived:

(i) Females showed better declarative knowledge, procedural knowledge, information management strategies, debugging strategies and planning than males. These were the components among all the eight components that showed a significant difference between the two genders, leading us to understand that females are metacognitively more aware than males. This finding warrants the need for strengthening these cognitive aspects in males.

(ii) Science students showed better regulation of cognition than humanities students. Hence, a very important educational implication arising out of this finding is that even though both groups know what to learn, science students know

better how to learn. Humanities students thus, need more attention and assistance on this aspect. Teachers should observe and interact and design metacognitive activities for students accordingly.

(iii) This research has shown us that different students have different levels of metacognitive awareness. Hence, the teaching learning environment should be such that it is agnostic to students having all levels of metacognitive awareness and to students belonging to different streams.

(iv) Development of metacognition helps students to become self-regulators of learning, which further helps them to achieve better academically. Hence, teachers should mandatorily be exposed to the concept of metacognition and the vital role it plays and learn how to design metacognitive activities that they can be practically incorporated in the classroom.

(v) Pre-service and in-service teachers ought to be trained on various metacognitive strategies like the IMPROVE method, Predict–Observe–Explain (POE) tasks, reflective journal writing, etc., that can be incorporated in the classroom. We all engage in metacognitive activities every day. Proper orientation of the concept is imperative towards fostering an optimum environment where students can become better learners.

(vi) This research warrants the need for cognition among students because these metacognitive knowledge and skills help students to understand how tasks are performed. Therefore, providing a quality feedback structure is essential, as it helps to regulate, monitor and direct students.

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