Examining impact of metacognitive interventions on self-efficacy of higher secondary school students: A quasi-experimental study

(ID) **Venkateswar Meher**[1]○

(ID) **Rajashree Baral**[2]

(ID) **Sanjukta Bhuyan**[3]

(○Corresponding Author)

[1]*Faculty of Education, Anchal Degree College Padampur, Bargarh-768036, Odisha, India.*
Email: venkatesmeher90@gmail.com
[2]*Govt. Women's College, Sambalpur-768001, Odisha, India.*
Email: rajashreebaral5@gmail.com
[3]*School of Education, Gangadhar Meher University, Sambalpur, Odisha, India.*
Email: drsanjuktabhuyan@gmail.com

ABSTRACT

This study examines the the impact of metacognitive interventions on self-efficacy of higher secondary school students. Metacognition and self-efficacy are critical factors in educational psychology influencing that influence students' academic performance and entire learning experience. Metacognition is the knowledge and control of one's cognitive processes. Understanding and improving these components can result in better educational achievements and personal development for children. Inextricably linked, metacognition and self-efficacy significantly influence each other. In the present study, an attempt was made to examine the impact of metacognitive interventions on self-efficacy of higher secondary school students. The study used a non-equivalent control group design for quasi-experimental research. The study randomly selected two government-aided higher secondary schools from the Sambalpur locality. The treatment was assigned randomly, where the experimental group students (n=41) were taught using metacognitive interventions, i.e., thinking aloud, brainstorming, concept mapping, and self-assessment, and the control group students (n=38) were taught by following the traditional approach. The self-efficacy scale of Scherer and Maddux was culturally adapted and used. The collected data was analysed with the help of Analysis of Covariance. The study's findings demonstrated that metacognitive treatments had a considerable favourable influence on higher secondary school students' general and social self-efficacy. There was no significant interaction effect of teaching technique, gender, and caste on student self-efficacy. The current study has implications for policymakers seeking to include metacognitive components in curriculum, teaching, and evaluation.

Keywords: *General self-efficacy, Higher secondary school students, Metacognition, Metacognitive interventions, Self-efficacy, Social self-efficacy.*

Highlights of this paper

- The main purpose of the present study was to examine the impact of metacognitive interventions on self-efficacy, of higher secondary school students using a non-equivalent control group design of quasi-experimental research.
- Metacognitive interventions, i.e., thinking aloud, brainstorming, concept mapping, and self-assessment, were used for experimental group, and traditional approach for control group.
- The results demonstrated that metacognitive treatments had a considerable favourable impact on higher secondary school students' general and social self-efficacy, but there was no significant interaction impact of teaching technique, gender, and caste on student self-efficacy.

1. INTRODUCTION

In terms of self regulation, students' metacognition is closely associated with the concept of self-efficacy. Research studies showed that students having high self-efficacy become able to apply metacognitive strategies effectively (Bouffard-Bouchard, Parent, & Lavirée, 1993; Kanfer & Ackerman, 1989). Both 'self-efficacy and metacognition' foster the capacities of the students and help in increasing students learning. The students with strong monitoring of their cognitive activities and deep beliefs in their capabilities get success in the academic field (Alcı & Yüksel, 2012). It is a fact that the metacognition of students involves their abilities to understand, control, and monitor their thinking processes, while self-efficacy refers to the student's ability to produce desired results. So, the students cannot produce desired results without knowing, understanding, and regulating their thinking, it shows that metacognition and self-efficacy are closely associated.

The use of metacognitive interventions in the teaching-learning process fosters the self-efficacy beliefs, which help them achieve their desired results (Ellis & Sinclair, 1989; Nunan, 1995a, 1995b). It is crucial to assist students in understanding their metacognitive awareness and self-efficacy beliefs, enabling them to apply various strategies in their academic activities (Alhaqbani & Riazi, 2012). The research studies concerned with the metacognition and constructs/dimensions of self-efficacy of students, i.e., anxiety for academic achievement, proper use of study strategies, issues in completing tasks, interest, and identification of learning objectives, revealed strong relationships (Åge, 2011; Aydin, Uzuntiryaki, & Demirdöğen, 2011; Coutinho, 2008; Legg & Locker Jr, 2009; Tella, Tella, & Adeniyi, 2009). The self-efficacy beliefs of students greatly affect their learning and thinking as well as information processing, as revealed from the literature.

Along with the metacognitive skills of students, self-efficacy beliefs help the students to organize the learning environment and promote motivation among themselves (Bandura, 2008). Students with strong self-efficacy beliefs select challenging tasks and give their best to achieve with the greatest efforts (Locke & Lathan, 1990). Here also the students need some kinds of metacognitive skills to achieve success. As the students feel certain obstacles in learning, their metacognition helps them to succeed (Prat-Sala & Redford, 2010).

Students' metacognition is concerned with the affective domain of knowledge, as it has a close relationship with the cognitive domain, where the absence of self-efficacy beliefs results in students' depression (Zhu, Zhang, & Wu, 2011). The results of the research also revealed that the beliefs of the students have a strong influence on their abilities to regulate their learning, in the case of teachers, their beliefs also help to promote their teaching (Den Brok, Brekelmans, & Wubbels, 2004; Houtveen, Van De Grift, & Creemers, 2004; Thoonen, Sleegers, Peetsma, & Oort, 2011). Cera, Mancini, and Antonietti (2013) proved that the link between self-efficacy and metacognitive skills allows students to cultivate a high degree of confidence in their abilities, encourages them to have a positive attitude toward learning, and regards problems as challenges rather than threats to be avoided. The analysis of the above makes it clear that there is a strong relationship between the components of metacognition and self-efficacy.

The social cognitive theory of Albert Bandura plays a vital role in education, psychology, and communication, which is based on knowledge acquisition, social interaction, and experiences. This theory was created as an extension of the social learning theory. Bandura (1986) as well as Bandura (2008) report that "when individuals encounter a model performing a behaviour and the consequences of that behaviour, they remember the sequence of events and use this information to guide subsequent behaviour, which engages them in practicing the behaviour they already learned." This theory focuses on cognitive, behavioral, personal, and environmental elements that influence motivation and behavior interaction (Crothers, Hughes, & Morine, 2008). Bandura claimed that all of the aforementioned three components contribute to human functioning and interaction. This concept is based on four key components that work together to achieve goals: self-observation, self-evaluation, self-reaction, and self-efficacy (Bandura, 1982). Individuals' self-efficacy characterizes their feelings, thinking, motivation, and behavior, including cognitive, motivational, affective, and selecting processes (Bandura, 1986). Individuals with higher levels of self-efficacy do better in terms of achieving their desired objectives and overall well-being. On the other side, the influence of the metacognition method on the self-efficacy of the students was also evaluated and it was shown to be beneficial. (Goli, Omidi, & Momeni, 2016; Landine & Stewart, 1998; Liu & Shen, 2011; Noghabaee, 2016; Othman & Abdullah, 2018; Tavakoli & Koosha, 2016). The present study was conducted at a higher secondary level, taking into account the research gaps in terms of findings, methodology, knowledge gap, etc., as well as also the relevance of studying metacognitive interventions and self-efficacy.

Metacognition and self-efficacy are critical factors in educational psychology, influencing students' academic performance and overall learning experience. Metacognition is the knowledge and control of one's cognitive processes (Jaleel & Premachandran, 2016). Understanding and improving these components can result in better educational achievements and personal development for children. Inextricably linked, metacognition and self-efficacy significantly influence each other. A student's metacognitive abilities can influence their self-efficacy views. For example, pupils who are aware of their cognitive strengths and shortcomings and can successfully manage their learning processes are more likely to develop high levels of self-efficacy. They understand their power to manage their learning outcomes, which gives them confidence in confronting academic problems.

In contrast, pupils with high self-efficacy are more likely to participate in metacognitive tasks. When individuals believe in their abilities to achieve, they are more likely to plan, monitor, and assess their learning techniques. This reciprocal link implies that treatments aiming at enhancing metacognition or self-efficacy might have a mutually reinforcing impact, resulting in a more complete improvement in students' learning processes and results. Integrating metacognition and self-efficacy into educational procedures can provide considerable results. Teachers can use a variety of ways to foster these constructs. To help students develop metacognition, educators may offer them specific skills for planning, monitoring, and assessing their learning. Self-assessment, reflective journaling, and think-aloud activities can help students gain a better understanding and control over their cognitive processes.

Most of the available literature revealed that metacognition and metacognitive interventions have been investigated from various perspectives, and their effect on academic performance, learner engagement, acquiring skills, etc. has been examined in several studies (Chung, Hwang, & Lai, 2019; Lee & Wallace, 2018; O'Flaherty & Phillips, 2015), and these studies show positive results. Metacognition has also been investigated from writing self-efficacy perspectives in some studies (Sun & Wang, 2020; Zabihi, 2018; Zhou, Chen, & Hou, 2022), and these studies revealed significant influences on writing self-efficacy, self-regulation, narrative writing, self-efficacy in writing performance, etc. The analysis of related literature revealed a scarcity of studies on self-efficacy, encompassing both general and social aspects, particularly within the context of upper secondary education. Considering the significance

of studying metacognition and self-efficacy among students, the present study was intended to answer the following research question:

Q. What is the impact of metacognitive interventions on self-efficacy of the higher secondary school students?

In this study, a quasi-experimental study at the higher secondary level examined the effects of metacognitive interventions (brainstorming, thinking aloud, self-assessment, and concept mapping) on the students' general and social self-efficacy.

1.1. Objectives of the Study

1. To investigate the effect of metacognitive treatments on self-efficacy among higher secondary school students in education.

2. To examine the interaction effect of instructional technique, gender, and caste on self-efficacy among higher secondary school students.

1.2. Hypotheses of the Study

1. There is a significant positive impact of metacognitive interventions on self-efficacy of higher secondary school students.

2. There is a significant interaction effect among strategies of teaching, gender, and caste on self-efficacy of higher secondary school students.

2. MATERIALS AND METHODS

In the study, the metacognitive intervention was the independent variable, and the self-efficacy of the students was the dependent variable. Pre-test scores, stress, and intelligence of the higher secondary school students were taken as covariates. However, to control the effect of intervening variables, essential efforts were taken.

Method: "In the present study, the quasi-experimental method was employed by forming an experimental group and control group. The students of the experimental group were taught by using metacognitive interventions, and the students of the control group were taught through traditional approach" (Meher, Baral, & Bhuyan, 2024).

Design: A non-equivalent control group design of a quasi-experimental design was followed in the study. Here, two existing groups were pretested, administered treatment, and post-tested (Gay, 1990). A factorial design was also used for studying the interaction effect among strategy of teaching, gender, and caste on the self-efficacy of higher secondary school students. There were two levels of the strategy of teaching, i.e., the metacognitive approach and traditional approach two levels of gender, i.e., boys and girls and three levels of caste, i.e., general, scheduled caste, and scheduled tribe. So, 2*2*3 factorial design was followed" (Meher et al., 2024).

Participants: "All students studying Class-XII, Arts stream in Govt.-aided higher secondary schools or junior colleges of Sambalpur and affiliated to Council of Higher Secondary Education (CHSE), Odisha of 2020-2021 academic year were the population of the study" (Meher et al., 2024). "As the present study was quasi-experimental in nature, Sambalpur district was selected purposefully based on the feasibility of experimentation. Two government-aided higher secondary schools/junior colleges affiliated with CHSE and nearer to Sambalpur city were selected randomly through a lottery method. As a result, Hirakud Higher Secondary School and Burla Notified Area Council (N.A.C.) Higher Secondary School of Sambalpur district, Odisha, were taken for experimentation in the present study. The present study used all the standard-XII Arts students from the selected schools as the sample. Out of these two, one school was randomly assigned as an experimental group and the other as a control group by tossing a coin method. As a result, Hirakud Higher Secondary School was the experimental group, and Burla N.A.C. Higher

Secondary School was the control group in the present study. (Meher et al., 2024) pre- and post-tested both the groups.

Table 1. Sample size of the study.

Groups	Schools	Sample size (N)
Experimental	Hirakud higher secondary school	41
Control	Burla N.A.C. higher secondary school	38
Total		79

Table 1 provides information about the sample size of the present study. It reveals the sample size of experimental group as 41 and control group as 38. So, in total, 79 samples were taken into account in this study.

The present study used the following instruments to collect primary data.

a) 5E Lesson Plans with Metacognitive Interventions: "Lesson plans by following the 5E approach were developed for experimentation. The students of experimental groups were taught 40 lesson plans. The 5E plans were prepared taking into account the relation between metacognition and constructivism (Baird, Fensham, Gunstone, & White, 1991; Gunstone, 1994; Paris & Winograd, 1990; Paris & Winograd, 1990). The lesson plans were prepared considering the education syllabus of CHSE, covering Unit-I (contributors of education), Unit-II (learning and motivation), Unit- III (current issues in education). Thinking aloud, brainstorming, concept mapping, and self-assessment metacognitive interventions were used" (Meher et al., 2024).

b) Lesson Plan in Herbartian Approach: "Herbartian lesson plans were prepared for teaching the students of the control group. For that purpose, 40 Herbartian lesson plans were prepared to cover Unit-I (Contributors of Education), Unit-II (Learning and Motivation), and Unit-III (Current Issues in Education) of the Education subject as per the syllabus of CHSE" (Meher et al., 2024).

c) Self-efficacy Scale: "The Sherer et al. (1982) Self-efficacy Scale (SES) was translated into Odia language using normal data gathering techniques. The measure has 23 items in total, including two parameters: general self-efficacy (17 items) and social self-efficacy (06 items). Both forward and backward translations were completed, and expert opinions were sought on the translated materials.

The Odia version of SES underwent pre-piloting and piloting to explore its psychometric properties. Cronbach's alpha reliability and split-half reliability of the translated version of SES were 0.85 and 0.79, respectively, indicating that the inventory has good internal consistency (Meher & Baral, 2020). The opinion of the experts showed high 'comparability of language','similarity of interpretation', and 'degree of understandability' between the English and Odia versions of the scale. Face validity and content validity of the translated version of SES were also determined through expert's suggestions" (Meher et al., 2024).

d) Group Test of General Mental Ability: "Intelligence was taken as a covariate in the present study. For this purpose, the Group Test of General Mental Ability developed and validated by Dr. S. S. Jalota was used. It was implemented once during the experimentation. The test consisted of 100 items in total. In the test, some sorts of problems were given for the students related to reasoning, synonyms, antonyms, and odd points out, etc." (Meher et al., 2024).

e) Stress Scale: "Stress was also included as a covariate in the current study. Dr Vijaya Lakshmi and Dr Shruti Narain's stress scale, which they designed and validated, was employed. The trial employed the stress scale only once. The stress scale comprised 40 items, with four main components: pressure (14 items), physical stress (04 things), anxiety (13 items), and annoyance (09 items)." (Meher et al., 2024).

3. DATA ANALYSIS AND RESULTS

3.1. Analysis of Pre-Test Scores

In the present study, self-efficacy was based on two important components, i.e., general self-efficacy and social self-efficacy. So, self-efficacy along with its components in both experimental and control groups were compared with the help of an independent sample t-test. Along with that, the scores of stress and general mental ability were also compared.

Table 2. Component and Group wise N, Mean, SD, df, and t-value of pre-self-efficacy of students.

Unit	Groups	N	Mean	SD	df	t-value	Sig.	Remark
Pre-self-efficacy	Experimental	41	79.15	9.04	77	1.52	0.133	Ns
	Control	38	82.11	8.20				
Pre-general self-efficacy	Experimental	41	58.85	8.05	77	0.63	0.533	Ns
	Control	38	59.89	6.59				
Pre-social self-efficacy	Experimental	41	20.02	3.42	77	2.92**	0.005	P<0.01
	Control	38	22.21	3.21				
Stress	Experimental	41	18.71	5.10	77	1.45	0.152	Ns
	Control	38	17.24	3.78				
General mental ability	Experimental	41	58.22	7.54	77	5.52**	0.000	P<0.01
	Control	38	49.21	6.93				

Note: **Significant at 0.01 level.
NS: Not significant.

Table 2 makes it clear that the t-values of pre-self-efficacy, pre-general self-efficacy, and stress of secondary school students were found to be 1.52, 0.63, and 1.45, respectively, which were insignificant at 0.05 level with df=77. Thus, it was concluded that the pre-test scores of students in this regard did not differ significantly between the experimental and control groups. The t-values of students' pre-social self-efficacy and general mental scores were 2.92 and 5.52, respectively, and were significant at the 0.01 level (df=77). Thus, it was evident that the pupils in the experimental and control groups differed considerably. Furthermore, the experimental group's mean scores in terms of pre-social self-efficacy and general mental ability were significantly higher than the control group, implying that there was a significant difference in pre-social efficacy and general mental ability among higher secondary school students. Therefore, the current investigation used these two variables as covariates. Along with that, the other pre-self-efficacy and stress of the students were also taken as covariates.

3.2. Analysis of Post-Test Data

3.2.1. The Effect of Metacognitive Interventions on Students' Self-Efficacy

One of the study's aims was to investigate the influence of metacognitive treatments on self-efficacy by comparing the adjusted mean of self-efficacy ratings of experimental and control group students while controlling for pre-self-efficacy, stress, and general mental capacity. According to this purpose, the strategy of instruction was an independent variable with two levels: metacognitive interventions (experimental group) and traditional methods (control group). Covariates included students' pre-self-efficacy, general mental competence, and stress levels. The dependent variable was pupils' post-self-efficacy levels. Thus, the data were analysed with the help of One-Way Analysis of Covariance ANCOVA using SPSS-23, and the outputs are given below.

Table 3a. Group wise N, SD, mean, and adjusted mean scores of post-self-efficacy of students.

| Group	N	SD	Mean	Adjusted mean
Experimental group	41	11.65	83.63	82.17
Control group	38	15.26	54.24	55.81
Total	79			

Table 3a depicts the mean, adjusted means, N, and standard deviation of post-self-efficacy of students in the experimental group and control group. ANCOVA analysis of the post-self-efficacy data revealed a slight variation in the mean and adjusted means of both groups, allowing for a comparison of their adjusted means. However, the adjusted means of post-self-efficacy of the experimental group was found to be 82.17, and the control group was found to be 55.81. The result of the One-Way ANCOVA is given below.

Table 3b. Sum of square, df, mean square, F and Sig. value of post-self-efficacy score of students.

Sources	Sum of squares	df	Mean square	F	Sig.
General mental ability	240.50	1	240.50	1.30	0.257
Stress	0.226	1	0.226	0.001	0.972
Pre-self-efficacy	272.17	1	272.17	1.48	0.228
Strategy of teaching	8367.51	1	8367.51	45.35	0.000
Error	13655.08	74	184.53		
Total	412610.00	79			
Corrected total	31089.75	78			

Note: R squared = 0.561 (Adjusted R squared = 0.537).

Table 3b shows that the corrected F-value is 45.35, which is statistically significant at the 0.01 level (df=1/74). It demonstrates that the adjusted mean post-self-efficacy ratings of higher secondary school students in the experimental and control groups differ substantially when pre-self-efficacy, general mental capacity, and stress are considered covariate factors. Thus, the research hypothesis that metacognitive treatments had a favorable influence on higher secondary school students' self-efficacy has been accepted.
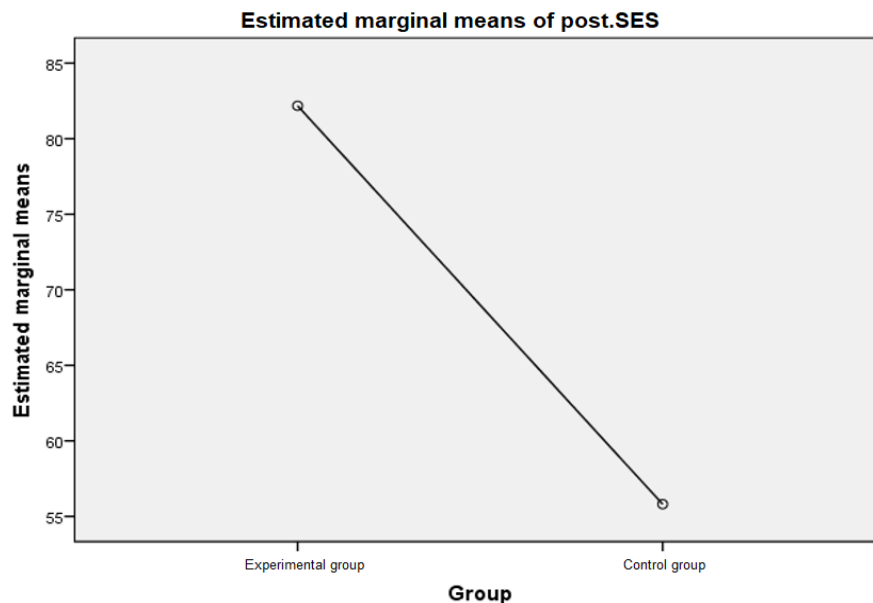
Figure 1. Estimated adjusted means of post-self-efficacy of students.

Figure 1 shows that the adjusted mean of self-efficacy of students in the experimental group is 82.17, which is considerably higher than that of students in the control group, whose adjusted mean score of self-efficacy is 55.81. When groups of higher secondary school students were matched based on pre-self-efficacy, general mental capacity, and stress, metacognitive intervention in teaching was found to be considerably superior to traditional methods of teaching in terms of student self-efficacy. As a result, the study showed that metacognitive treatments had a substantial favorable influence on higher secondary school students' self-efficacy.

3.2.2. Impact of metacognitive Interventions on General Self-Efficacy of Students

In the present study, the general self-efficacy of students was one of the components of self-efficacy, so the impact of metacognitive interventions on the general self-efficacy component of the self-efficacy scale was examined. Students' pre-general self-efficacy, general mental ability, and stress were all covariates. The post-general self-efficacy score of students was the dependent variable. Thus, the data were analysed with the help of One Way ANCOVA using SPSS-23, and the outputs are given below.

Table 4a. Group wise N, SD, mean, and adjusted mean scores of post-general self-efficacy of students.

Groups	N	SD	Mean	Adjusted mean
Experimental group	41	10.88	60.80	60.24
Control group	38	11.61	39.63	40.24
Total	79			

Table 4a depicts the mean, adjusted means, N, and standard deviation of post-general self-efficacy of students in the experimental group and control group. It was found that there is a slight variation in the mean and adjusted means of both groups as ANCOVA was used to analyse the obtained data related to post-general self-efficacy, where the adjusted means of post-general self-efficacy of both these two groups were compared. However, the adjusted means of post-general self-efficacy of the experimental group was found to be 60.24, and the control group was found to be 40.24. The result of One-Way ANCOVA is given below.

Table 4b. Sum of square, df, mean square, F and Sig. value of post-general-self-efficacy score of students.

Sources	Sum of squares	df	Mean square	F	Sig.
General mental ability	42.16	1	42.16	0.326	0.570
Stress	0.039	1	0.039	0.000	0.986
Pre-general self-efficacy	131.26	1	131.26	1.01	0.317
Strategy of teaching	5117.97	1	5117.97	39.54	0.000
Error	9577.53	74	129.43		
Total	220993.00	79			
Corrected total	18562.61	78			

Note: R squared = 0.484 (Adjusted R squared = 0.456).

Table 4b shows that the corrected F-value is 39.54, which is significant at the 0.01 level (df=1/74). It shows that when pre-general self-efficacy, general mental capacity, and stress are taken into account as covariate factors, the experimental and control groups' post-general self-efficacy scores are very different from each other. Thus, the research hypothesis that metacognitive treatments improve the general self-efficacy of higher secondary school pupils is accepted.

Furthermore, the adjusted mean of general self-efficacy for students in the experimental group is 60.24, which is considerably greater than that of students in the control group, who had an adjusted mean of 40.24. When groups of

higher secondary school students were matched based on pre-general self-efficacy, general mental ability, and stress, metacognitive intervention in teaching was found to be significantly superior to traditional methods of teaching in terms of general self-efficacy. As a result, the study showed that metacognitive treatments had a substantial favorable influence on higher secondary school students' general self-efficacy.

3.2.3. Impact of Metacognitive Interventions on Social Self-Efficacy of Students

In the present study, the social self-efficacy of students was one of the components of self-efficacy, so the impact of metacognitive interventions on the social self-efficacy component of the self-efficacy scale was examined. Pre-social self-efficacy, general mental ability, and stress of students were covariates. Post-social self-efficacy of students was the dependent variable. Thus, the data were analysed with the help of One-Way ANCOVA using SPSS-23, and the outputs are given below.

Table 5a. Group wise N, SD, mean and adjusted mean scores of post-social self-efficacy of students.

Group	N	SD	Mean	Adjusted mean
Experimental group	41	11.70	23.49	23.53
Control group	38	4.85	14.61	14.56
Total	79			

Table 5a depicts the mean, adjusted means, N, and standard deviation of post-social self-efficacy of students in the experimental group and control group. It was found that there is a slight variation in the mean and adjusted means of both groups as ANCOVA was used to analyse the obtained data related to post-social self-efficacy, where the adjusted means of post-social self-efficacy of both these two groups were compared. However, the adjusted means of post-social self-efficacy of the experimental group was found to be 23.53, and the control group was found to be 14.56. The result of One-Way ANCOVA is given below.

Table 5b. Sum of square, df, mean square, F and Sig. value of post-social-self-efficacy score of students

Sources	Sum of squares	df	Mean square	F	Sig.
General mental ability	53.55	1	53.55	0.657	0.420
Stress	14.42	1	14.42	0.177	0.675
Pre-Social self-efficacy	178.77	1	178.77	2.20	0.143
Strategy of teaching	895.49	1	895.40	10.99	0.001
Error	6028.01	74	81.46		
Total	37068.00	79			
Corrected total	7899.34	78			

Note: a. R squared = 0.237 (Adjusted R squared = 0.196)

As can be observed from Table 5b, the adjusted F-value of 10.99 is significant at the 0.01 level (df=1/74). The results demonstrate a significant difference in the adjusted mean scores of post-social self-efficacy between higher secondary school students in the experimental and control groups, accounting for pre-social self-efficacy, general mental ability, and stress. Thus, the research hypothesis that metacognitive interventions promote social self-efficacy in upper secondary school students is accepted. Furthermore, the adjusted mean social self-efficacy for students in the experimental group is 23.53, which is considerably greater than that of students in the control group, who had an adjusted mean of 14.56. When groups of higher secondary school students were matched in terms of pre-social self-efficacy, general mental ability, and stress, metacognitive intervention in teaching was found to be significantly

superior to traditional teaching methods in terms of social self-efficacy. The results demonstrated a significant positive impact of metacognitive treatments on the social self-efficacy of higher secondary school pupils.

3.2.4. Interaction Effect of Teaching Strategy, Gender, and Caste on Self-Efficacy of Students

One of the current study's aims was to investigate the interaction effect of teaching technique, gender, and caste on student self-efficacy while taking pre-self-efficacy, general mental capacity, and stress as variables. For this purpose, teaching strategy is defined as having two levels: metacognitive strategy and conventional strategy of instruction. Boys and girls were divided into two categories. There were three degrees of caste: general, scheduled caste, and scheduled tribe. Students' self-efficacy, stress, and overall mental aptitude were also considered covariates. Students' self-efficacy scores were used as the dependent variable. Thus, the data were analyzed using SPSS-23's Three Way ANCOVA or 2*2*3 Factorial Design ANCOVA methods. The outputs are shown below.

The adjusted mean of self-efficacy of higher secondary school students based on their teaching strategy, gender, and caste. The table reveals that the adjusted means of self-efficacy of students the experimental group was found to be 80.77, and the control group was found to be 55.07. The adjusted means for boys were found to be 65.22, and for girls, it was found to be 70.62. The adjusted mean based on caste revealed that it was 69.36 for general, 73.11 for scheduled caste, and 61.29 for scheduled tribe.

Table 6. Summary of three-way ANCOVA of post-self-efficacy scores of students.

Sources of variations	Sum of squares	df	Mean square	F	Remark
Strategy of teaching × Gender (A×B)	35.85	1	35.85	0.196	Ns
Strategy of teaching × Caste (A×C)	512.55	2	256.28	1.40	Ns
Gender × Caste (B×C)	289.51	2	144.75	0.793	Ns
Strategy of teaching × Gender × Caste (A×B×C)	365.29	2	182.65	1.00	Ns
Error	11689.54	64	182.65		
Total	412610.00	79			

Note: NS: Not significant.
The result of the three-way ANCOVA is interpreted below.

Table 6 represents the result of Three-Way ANCOVA, which revealed that the adjusted F-value for interaction among Strategy of teaching * gender, strategy of teaching * caste, gender * caste and strategy of teaching * gender * caste were found to be, .196 1.40 .793 and 1.00, respectively which were not significant at 0.05 level with 1/64, 2/64, 2/64, and 2/64 df, respectively. The results of the three-way ANCOVA made it clear that there is no significant interaction effect among strategies of teaching, gender, and caste on self-efficacy of higher secondary school students. So, the alternative hypothesis was rejected and the null hypothesis was accepted in this situation.

4. DISCUSSION OF RESULTS

So far as results of present study related to the impact of metacognitive interventions on self-efficacy of students are concerned, the findings were matched with some of the research studies, which reflected that the students taught with metacognitive interventions were superior in understanding their capabilities as compared to the students taught with traditional approach, which made it clear that the use of metacognitive interventions in teaching had a positive impact on the self-efficacy of the students (Cera et al., 2013; Colognesi, Hanin, Still, & Van Nieuwenhoven, 2019; Goli et al., 2016; Jozestani, Faramarzi, & Yarmohammadian, 2016; Mohamed, Mohamed, & Abdeen, 2020; Schumann & Sibthorp, 2016; Tavakoli & Koosha, 2016). So far as the results of Hadi and Forawi (2014) were concerned, the

metacognitive interventions were effective for students in Mathematics, but in the case of physics, they failed to develop the self-efficacy of students. So, it can be said that the finding of the present study was contrasted to the finding of Hadi and Forawi (2014) in terms of self-efficacy of students in Physics. Apart from this, the findings of the present study related to the impact of self-efficacy were also contrasted with some of the findings of studies, which revealed no significant difference in the self-efficacy of the students taught with metacognitive interventions, so it was concluded that metacognitive interventions had no impact on student's self-efficacy (Javidan, Hossein Khanzadeh, & Abolghasemi, 2018; Papinczak, Young, Groves, & Haynes, 2008). However, in the present study, self-efficacy was investigated in terms of its two components, i.e., general self-efficacy and social self-efficacy, but fewer studies were found about the two components of the study, so it may be investigated further.

Teachers may boost students' self-efficacy by setting achievable goals, providing critical comments, and celebrating their accomplishments. Promoting a growth attitude in students, which acknowledges the enhancement of talents through hard work and practice, can enhance their self-efficacy. Furthermore, peer modeling, in which pupils witness their peers completing tasks, may be an effective motivator and confidence booster. Metacognition and self-efficacy are critical components of schooling. These constructs have a substantial influence on students' learning experiences, motivation, and academic success. Educators can help students become more successful and self-sufficient learners by developing their metacognitive abilities and self-efficacy. The relationship between metacognition and self-efficacy emphasizes the importance of integrated therapies that target both domains. Despite the difficulties, the potential benefits to children's educational achievements and personal development make this an important project. As educational research and practice progress, a better understanding of these dimensions will help to improve teaching and learning practices.

5. IMPLICATIONS

The present study has implications for students, teachers, principals, curriculum developers, and policymakers. Metacognitive ways of learning should be encouraged among students, instead of memorization, much more emphasis should be given to their understanding of the construction of new knowledge with the help of their metacognition, thinking aloud should be encouraged among them. Teachers should be encouraged to teach the students by using metacognitive interventions in the classroom rather than traditional teaching. They should be encouraged to ask metacognitive and reflective questions to the students. They should use models of metacognition in the classroom, emphasizing higher-order skills among students in terms of knowledge of cognition and regulation of cognition. Principals should create a school environment by giving utmost importance to the metacognition of students rather than marks. They should encourage teachers to teach some chapters of education subject using metacognitive interventions. Parents of students should give much more importance to student's metacognition than memorization. They should encourage their children to use metacognitive ways of learning rather than memorizing. Curriculum developers should include such activities in the curriculum that could develop student's metacognitive knowledge. They should include content that is based on student's metacognition.

6. LIMITATIONS & CONCLUSION

The present study was limited to the higher secondary school students (+2 2nd year Arts) of Govt.-Aided Hirakud Higher Secondary School and Burla N.A.C. Higher Secondary School affiliated to CHSE, Odisha 2020-21 session. It was limited to the use of four metacognitive interventions, i.e., thinking aloud, brainstorming, concept mapping, and self-assessment in 5E lesson plans in only one subject area, i.e., 'Education' in the selected higher secondary schools of Sambalpur. The present study was limited to self-efficacy of the higher secondary students of class XII belonging

173

to Govt.-Aided Hirakud Higher Secondary School and Burla N.A.C. Higher Secondary School affiliated to CHSE, Odisha. It was also delimited to stress and general mental ability of higher secondary students of class XII, which were used as covariates.

From the present study, it could be concluded that metacognitive interventions, i.e., thinking aloud, brainstorming, concept mapping, and self-assessment, have a positive impact on student's self-efficacy, as the students taught with metacognitive interventions scored better than the students taught with the traditional approach in terms of both general and social self-efficacy. The study also proves that metacognitive interventions and constructivist approaches to teaching are closely related to each other, as metacognitive interventions were used in the form of 5E model lesson plans.

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