Promoting Problem Solving Skills of Secondary School Students in 'Physical Science through Metacognitive Strategies

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Abstract: *Problem Solving in one of the vital skill of learning Physical Science in 21st Century. In this study, efforts have been made through Descriptive Survey Method to examine the influence of Metacognitive Strategies on Problem Solving Skills of class IX Students in Physical Science. Sample of 180 students from 4 Government Sponsored Co-education Hindi Medium schools of Kolkata city have been selected through simple random sampling. To assess different Metacognitive Strategies related to Planning, Monitoring and Evaluation, Self–developed close-ended questionnaire with five-point Likert-Type scale and a competency based test consisting of 20 problems width four options in each from Newton's Laws of Motion unit have been taken from class IX text book of Physical Science of West Bengal Board of Secondary Education. The reliability and validity of the tool used was found to be 0.82 and 0.9 respectively. Data were analysed using statistical correlation techniques through SPSS. The study reveals that there is a positive correlation between Metacognitive Strategies and Problem Solving Skills in Physical Science. There is need to acquaint students to monitor and self-evaluate their learning while Solving Problems.*

***Keywords*:** Metacognitive strategies, Problem Solving Skills, Physical Science

Introduction

The New Education Policy 2020 prioritises the development of higher-order cognitive abilities such as critical thinking and problem solving. One of the most significant abilities of learning Physical Science at different levels is problem solving (Shute et. al., 2016). The goal of teaching-learning process is not to provide the only knowledge to the learners but also to orient students about how to acquaint with learning, to regulate their thinking processes to solve different problems and to develop necessary skills to handle and overcome with the forthcoming challenges. Students can develop these competencies with the help of metacognition (Kaur and Kaur, 2017). In 1976, American Psychologist John Flavell coined the word metacognition, which means "cognition of cognition" or "knowing of knowing" (Flavell, 1976). It is the understanding of how to apply specific tactics for learning or problem solving.

Problem solving skills in Physical Science has remarkable importance and is ascertained to be a potential tool for the learners (Adachi and Willoughby, 2013). The role of a Physical Science Teacher is to cultivate problem solving skills within the leaners through metacognitive strategiesi.e. Planning, Monitoring and Regulating (Abromitis, 2009). From the previous studies it is noticed that in most of the countries school students are poor in problem solving in Physics (Ince, 2018) due to lack of appropriate thinking strategies, poor Mathematical skill and misconceptions in understanding of principles of Physics (Butler and Coleoni, 2016).

In this study an attempt was made to investigate the correlation between metacognitive strategies and Problem Solving Skills. in Physical Science of class IX students studying in Hindi Medium Co-Educational Government sponsored Schools recognised by the West Bengal Board of Secondary Education.

Objectives

(i) To study the correlation between Metacognitive Planning and Problem Solving Skills in Physical Science among secondary school students.
(ii) To study the correlation between Metacognitive Monitoring and Problem Solving Skills in Physical Science among secondary school students.
(iii)To study the correlation between Metacognitive Regulating and Problem Solving Skills in Physical Science among secondary school students.

Hypotheses

(i) There is no significant correlation between Metacognitive Planning and Problem Solving Skills in Physical Science among secondary school students.
(ii) There is no significant correlation between Metacognitive Monitoring and Problem Solving Skills in Physical Science among secondary school students.
(iii)There is no significant correlation between Metacognitive Regulating and Problem Solving Skills in Physical Science among secondary school students.

Method

Design of the study: Descriptive survey method was used in this study.

Population: All class IX students from Government sponsored schools of Kolkata City in West Bengal were considered as population.

Sample:180 students of class IX from four different Government sponsored Co-Educational Hindi Medium schools, one from each region (South, North, East and West) of Kolkata City were taken as sample through simple random sampling for the study.

Table 1: Description of sample

Region	School	Male	Female	Total
South	School 1	22	18	40
North	School II	17	23	40
East	School II	20	30	50
West	School IV	28	22	50
		87	93	180

Tools used for data collection: To assess different Metacognitive strategies related to Planning, Monitoring and Evaluation, Self–developed close-ended questionnaire with five-point Likert-Type scale and a competency based test consisting of 20 problems width four options in each from Newton's Laws of Motion unit of class IX text book of Physical Science of West Bengal Board of Secondary Education were administered for collecting the data. The tool's reliability was calculated using the Test-Retest Method. The Pearson's Product moment Method was used to calculate the coefficient of correlation, which was determined to be 0.82, indicating a high level of correlation. So, the tool used as a whole for acquiring problem solving skills is reliable. The validity index was calculated from the square root of the correlation value. It was found to be 0.9. Thus the tool constructed for the study was considered valid. In addition, collecting feedback from the subject Experts ensured face and content validity.

Techniques used for data analysis: To analyse the data correlation technique was used through SPSS and interpretation was done accordingly.

Results

Correlation between metacognitive planning and problem solving skills

The 1stobjective was to study the correlation between Metacognitive Planning in Physical Science and Problem Solving Skills of students at secondary level. The data was analysed using Product Moment Correlation, and the findings are shown in Table 1.

Table 1: Correlation Coefficient between Metacognitive Planning and Problem Solving Skills

Variable	r	Remark
Metacognitive Planning Problem Solving Skills	0.9	$P < 0.05$

Table 1 shows that the correlation coefficient is 0.9, which is significant at the 0.05 level with df =188. It demonstrates that there is a substantial positive link between Metacognitive Planning and Problem Solving Skills. As a result, the null hypothesis that there is no significant correlation between Metacognitive Planning and Problem Solving Skills is rejected. So Metacognitive Planning and Problem Solving Skills were found to be significantly positively related and correlation coefficient is high. Further the % of commonness between and Metacognitive Planning and Problem Solving Skills is 81. It may be said that Metacognitive Planning and Problem Solving Skills were found to have high positive correlation.

Correlation between metacognitive monitoring and problem solving skills

The 2nd objective was to study the correlation between Metacognitive Monitoring in Physical Science and Problem Solving Skills of student's at secondary level. The data was analysed using Product Moment Correlation, and the findings are shown in Table 2.

Table 2: Correlation Coefficient between Metacognitive Monitoring and Problem Solving Skills

Variable	r	Remark
Metacognitive Monitoring Problem Solving Skills	0.82	P < 0.01

According to Table 2, the correlation coefficient is 0.82, which is significant at the 0.01 level with df =188. It shows a substantial positive correlation between Metacognitive Monitoring and Problem Solving Skills. As a result, the null hypothesis of no significant relationship between Metacognitive Monitoring and Problem Solving Skills is rejected. So Metacognitive Monitoring and Problem Solving Skills were found to be significantly positively related and correlation coefficient is high. Further the % of commonness between and Metacognitive Monitoring and Problem Solving Skills is 67.24. It may be said that Metacognitive Monitoring and Problem Solving Skills were found to have high positive correlation.

Correlation between metacognitive regulating and problem solving skills

The 3rd objective was to study the correlation between Metacognitive Regulating in Physical Science and Problem Solving Skills of students at secondary level. The data were analysed using Product Moment Correlation, and the findings are shown in Table 3.

Table 3: Correlation Coefficient between Metacognitive Regulating and Problem Solving Skills

Variable	r	Remark
Metacognitive Regulating Problem Solving Skills	0.78	P < 0.01

Table 3 shows that the correlation coefficient is 0.78, which is significant at the 0.01 level with df =188. It suggests that there is a substantial positive association between Metacognitive Regulating and Problem Solving Skills. As a result, the null hypothesis that there is no significant correlation between Metacognitive Regulating and Problem Solving Skills is rejected. So Metacognitive Regulating and Problem Solving Skills were found to be significantly positively related and correlation coefficient is high. Further the % of commonness between and Metacognitive Regulating and Problem Solving Skills is 60.84. It may be said that Metacognitive Regulating and Problem Solving Skills were found to have high positive correlation.

Discussion

According to the findings, all three metacognitive methods help promote Problem Solving Skills. Monitoring strategies, followed by regulating techniques, are seen to be the most crucial. To nurture these strategies in students, it is vital to promote the use of metacognitive processes in their learning practices. (Anthonysamy et al., 2020).

Conclusion

The current study looked into the relationship between metacognitive methods and Problem Solving Skills in Physical Science in class IX pupils. The findings demonstrated that the three metacognition processes, namely planning, monitoring, and regulating, are the best predictors of students' Problem Solving Skills. Students with metacognitive talents can manage their learning and its implementation by regulating ideas, assessing learning, and evaluating the time required for study.

Educational Implication

According to the findings of this study, metacognitive methods are the most important predictors of improving students' problem solving abilities. Students will not apply metacognitive tactics unless they are motivated to do so. Furthermore, teachers must equip themselves with information, skills, and experience to help students acquire and develop metacognitive skills (Bernard et al., 2014).

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